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Biomes and patterns of Vegetation

What are three characteristics which make each **biome** unique from others?

1. 

2. 

3. 

The Merging line between one type of biome and another is referred to as an_________

**Desert Biome**

Deserts are usually defined by an area in which __________________________ exceeds ____________

Where do we find the highest concentration of deserts in the world?

_________________________ are thick outer coverings on leaves that help reduce the amount of transpiration from the leaf.

Temperature ranges from very _______________ days to very _______________ nights.

Animals have adapted to be able to exist without drinking.

Deserts are one of the most _________________ ecosystems.
**Chaparral**
1. Shrubs ranging from 1m to 5m
2. Developing under ________________ climates characterized by winter rainfall and hot summer drought.
3. Many plant species contain flammable chemicals that ignite like gasoline
4. Found in __________ regions between 30-40 degrees N and S (Coastal CA, Mediterranean region, Chile, Australia.)
5. Naturally occurring wildlife include: ________________, ________________, and Red tail hawk.

**Thorn Forest**
1. The vegetation is dominated by spiny, bushy drought tolerant species of ________________ and other members of the ________________ family.
2. Located in arid ________________ environments with little or no __________
3. Common Mammals which inhabit thorn forest include
   A
   B
   C
   D

**Savannah**
1. What types of plants make up a savannah?
   A
   B
   C (Only a few along streams)
2 In Mexico, grasses are mingled with what type of trees?
3 Describe the climate and soil types that give rise to grass lands.
4 On what part of a continent do savannas usually occur on?
5 Common animals found on savannas include; Bison, antelope, horses, camels, elephants, prairie dogs, coyotes, badger, prairie chickens, meadowlark

Deciduous Forest
1 Composed of___________________ leafed trees that drop their leaves seasonally
   The two type of deciduous forest include
   A
   B
2 Why do deciduous trees in temperate areas drop their leaves?
3 Why do deciduous trees in tropical areas drop their leaves?
3 Common mammals found in deciduous forest include:

Coniferous Forest
1 Characterized by dense, tall ___________bearing trees with needle shaped leaves(spruce, fir, larch, pine), few deciduous trees.
2 Little ground cover or under-story present under canopy
3 Diversity is______________ than other biomes. Thick stands of a single species often
dominating an area

4 Common mammals which inhabit coniferous forest include moose, wolves, lynx, porcupine, grouse, warblers

**Tundra**

1 What type of plants grow in the tundra?

2 The ground surface of the tundra is covered with permafrost. Explain what is permafrost is?

3 Winter temps drops below -40 F and winds are between 30-60 mph.

4 Precipitation averages 10 inches per year making this a freezing ________________.

5 Wildlife in the tundra include: caribou, musk ox, polar bears

6 The last biome encountered before reaching the polar ice caps. Borders the Arctic Ocean

**Tropical Rain Forest**

1 What are the four different types of Tropical Rain forest:
   
a.

b.

c.

d.

2 ________________________ Forest are flooded at least part of the year

3 ________________________ Rainforest are the most diverse, has the largest trees and a canopy dominated by lianas.
4 Rainforest has dry and wet seasons. Some trees lose their leaves in the dry season.

5 Rainforest is at high elevation cloaked in clouds.

6 Tropical Rainforest are usually dominated by which types of plants.
   a
   b
   c
   d
   e
   f

7 What are epiphytes?

8 Why are tropical Rainforest considered to be the most divers biomes in the world?

9 What conditions contribute to the high diversity seen in a Rainforest?

10 When does winter occur in an equatorial Rainforest?

11 What does the term tropical mean?
Climate is the principal factor in determining the geographical variation of vegetation that make up different biomes.

1. The five major determinants of climate include:
   
a.
   
b.
   
c.
   
d.
   
e.

2. Define latitude

3. Explain why the sun’s rays becomes stronger the closer it is to the equator.

Latitude and Seasonality:

1. Why does the earth experience different seasons with different weather patterns?

2. Do all parts of the earth experience the same seasonal change simultaneously? Explain.

3. How does the seasonal changes affect life on earth?
Temperature is affected by large bodies of water

1. How does water acts as a heat reservoir

2. Regions near an ocean are said to have a ______________________
   
   Inland regions have a ______________________

Mid-latitude Desertification

1. Many of the world’s deserts are located near _______ north and south of the equator.

2. Sun light is more intense at the equator causing the air to warm.

3. As warm air, rises it ____________ cools causing great amounts of rainfall at equatorial regions.

4. The cool dry air spreads away from the equator and sinks back to the earth surface at about latitudes 30° North and South causing great deserts.

Rain Shadow

A mountain range running perpendicular to the prevailing wind create regions of high precipitation on the windward slope and dry conditions on the leeward side, a condition called “Rain Shadow”

1. Explain how the Rain Shadow effect works.

Slope Effects

1. In the Northern Hemisphere, north and east facing slopes tend to be ____________ and _______ than south and west facing slopes

2. North facing slopes receive less ____________ sunlight while east facing slopes receive less ____________ sunlight.

3. ____________ facing slopes that receive direct sunlight only in the morning tend to
have cooler temperatures than west facing slopes. Evaporation is reduced and humidity and soil moisture are greater.

**El Nino - Southern Oscillation**

1. The warming of the equatorial surface waters along the west coast of _______ causes drastic changes in weather patterns around the globe.

2. Warm water which has built up in the western Pacific push back across the ocean to the west coast of South America.

3. Under normal conditions
   A. The trade winds blow towards the west across the tropical Pacific, piling up warm surface water in the west Pacific.
   B. The sea surface is about _______ meter higher at Indonesia than at Ecuador.

4. El Nino conditions.
   A. The westerly trade winds relax in the central and western Pacific, leading to a depression of the thermocline in the___________ Pacific, and an elevation of the thermocline in the ____________.
   B. The upwelling of cold water along the west coast of South America is halted causing ocean surface temperatures to rise there.
   C. The supply of nutrient rich water to the ____________ zone is cut off to the west coast of South America.
   D. Causes a drastic decline in primary producers, which adversely affects commercial fisheries in this region.
   E. Rainfall follows the warm water eastward, with associated flooding in Peru and drought in Indonesia and Australia.
Adaptations to Environment Leads to Diversity

Early naturalist believed that the earth was formed by a “Special Creation”
   The concept of the Special creation consists of three important ideas
   1 The Creation took place in one particular location (The garden of Eden).
   2 The creation was accomplished in one particular time period (6 days about 7000 years ago).
   3 The creation was directed and constructed by God and therefore divine in nature and perfect.

The Great Chain of Being as understood by early naturalist.
   Since the creation was carried out by God, it was done with perfection and order. His order was manifested in the “Great Chain of Being” the hierarchal order of God’s creations from the highest to lowest of life forms.
   – Example:

   A
   B
   C
   D
   E

The Renaissance brought new scientific enquiry
1 Biogeography:
2 Geology:
3 Comparative Anatomy:

Biogeography poses two hard questions for the Special Creation hypothesis
1
2

Geology leads to new insights concerning the age of the earth
1 New insights and tools lead to the understanding that the earth is very old.
   A
   B
   The fossil record details a history different than that described in the Special creation
   1.
   2.
   3.
Comparative Anatomy
A human arm, a whale flipper, and a bat wing all differ in size, shape and function, yet they consist of the same tissues and bones arranged in the same overall patterns on the body. Why are animals that seem so different and live in such different habitats structured so much alike?

Vestigial organs
1 Define:
2 Examples:

Ontogeny begets Phylogeny
1 Define ontogeny:
2 Define phylogeny:
3 Explain the idea of “Ontogeny begets Phylogeny”.

Natural selection
Charles Darwin and Alfred Russel Wallace developed the Theory of Natural Selection based upon 4 basic premises.

1 All organisms have the ability to out____________________ their natural resources. Thus, there is competition for limited resources
2 There is____________________ among individuals in every population. Thus, some individuals within the population will compete better for natural resources than others
3 Those who compete best will live longer and have more____________________ than those who can’t compete as well.
4 Traits and genes which allow an organism to compete better will be passed on and become more____________________ in the population. Thus the population evolves.
Define the following terms:

**Genes**: segments of ______________ that provide the ________________ for traits and characteristics

**Locus**: The ______________ of a specific gene on a specific Chromosome

**Alleles**: Are ________________ forms of a specific gene.

*Give some examples of alleles for hair color.*

*Is the locus for the above examples all the same are different?*

**Homologous chromosomes**: 2 Chromosomes in a cell that contain the same genes. One chromosome is inherited from the father and the other from the mother.

**Population**: An ________________ group of individuals all located in a particular geographical area.

**Gene pool**: The ________________ amount of genes in a population.

**Allele Frequency**: Is the ________________ that a particular allele is found in the population, or put another way - the number of times the allele is present in the population divided by the total number of chromosomes on which the gene appears.

Example: Suppose eye color for tree frogs is dictated by a single gene and there are two different alleles found in the population, red eyes and black eyes. Suppose next we gathered a sample of 1000 gametes (sperm and eggs) from a pond. Of those gametes, 750 contained red eye alleles and 250 had black eye alleles. What is the allele frequency for each of the alleles?
Microevolution is the Change in allele frequency due to one of the following processes or mechanisms:

1. Natural Selection (the first mechanism of microevolution)

Types of Natural selection

Direction Selection

1. Selection favors one of the extreme types in the population.
2. Changes in the environment often lead to directional selection
3. Examples: Pesticide and antibiotic resistance

Stabilizing Selection

1. Selection favors the intermediate forms while selecting against the extremes.
2. Occurs in stable environments in which organisms are well adapted

Disruptive Selection

1. Selection favors both extremes while the intermediate forms are selected against.
2. Over long periods of time disruptive selection may lead to speciation.
Sexual Selection

1. Individuals will select potential mates according to specific characteristics.

2. These traits may or may not be healthy for the species.

3. Example:

Mutations: (The Second mechanism of microevolution)

1. Mutations are the raw material for all new alleles.

2. New mutations will change gene frequency.

3. Natural selection will either__________________ or__________________ mutations in a population.

Genetic Drift (the third mechanism of microevolution)

1. Genetic drift is a______________ change in allele frequencies over the generations, brought about by______________ events.

2. Genetic drift is most powerfully felt in______________ populations.

3. The founder effect and the bottleneck effect are two examples where genetic drift changes allele frequency in a small population.

Founder Effect

1. A founder effect occurs when a small group of individuals breaks off and becomes _______________ ________________ from a larger population.

2. The new group will likely have a different______________ frequency compared to
the parent group they originated from.

3. Example: Mutiny on the Bounty

**Bottleneck Effect**

1. A bottleneck is a severe ________ in a population brought about by intense selection pressure or some natural calamity.

2. The population is regenerated by means of the few individuals left.

3. The genetic ________ is greatly diminished compared to the original population.

**Gene Flow** (the fourth mechanism of microevolution)

1. Is the flow of genes or alleles between different populations. The new flow of genes into or out of a population can change the allele frequencies of a population.

2. Alleles are lost from a population when individuals leave (emigrate).

3. Alleles enter a population when new individuals move in (immigrate)

**Hardy-Weinberg equilibrium**

1. A population not ________ is said to be in Hardy-Weinberg equilibrium.

2. A population in Hardy-Weinberg equilibrium must have the following characteristics
   - Random mating that inhibits the effect of ________ ________
   - No mutations and thus no new ________ arising
   - Infinitely large population size to insure no ________ ________
   - Isolated from other populations to stop ________ ________
Speciation explains the diversity of life

What is a Species?

One or more populations of individuals that can ____________ under natural conditions and produce ____________ offspring.

What is speciation?

The formation of a new species from previously existing species.

How do new species arise?

Different species may arise from ____________ ____________ between populations

What is Genetic Divergence and how does it lead to speciation?

1. Genetic divergence is the process whereby local units of a population become reproductively isolated from other units and thus experience changes in gene frequencies between the groups.

2. If the environments are different between reproductively isolated units then natural selection, mutations, and genetic drift will work independently on each group. As long as two groups do not interbreed their gene pools will continue to drift further and further apart.

3. If two groups are reproductively isolated long enough, genetic divergence will eventually grow to the extent that isolating mechanisms will begin to form which act to separate the groups reproductively ie... no mating will occur between species.

What are Isolating mechanisms

Isolating mechanisms are situations that prevent interbreeding between two groups. Isolating
mechanisms can be divide into two different types, **Prezygotic** and **Poszygotic**.

1. Isolating mechanisms that occur before fertilization are called ______________ mechanisms

2. Isolating mechanisms that occur after fertilization are called ______________ mechanisms

**Types of Prezygotic Isolating mechanisms:**

1. ______________ isolation: Potential mates meet but cannot figure out what to do about it because patterns of courtship may be altered to the extent that sexual union is not achieved

2. ______________ isolation: (Time) Different groups overlap in range but may not be reproductively mature in the same season.

3. ______________ : Potential mates attempt engagement but sperm cannot be successfully transferred. This may be due to differences in reproductive organs.

4. ______________ isolation: Sperm is transferred but sperm and egg are incompatible.

5. ______________ isolation: potential mates never meet because they live in different habitats

**Types of Postzygotic isolating mechanisms**

1. __________ ___________ : Egg is fertilized but zygote does not develop properly dies before birth because parents are genetically incompatible.

2. __________ ___________ : Hybrid very weak and can’t live outside the uterus.

3  __________ ___________ : Hybrid is sterile.
Speciation

Speciation occurs as one species gives rise to other species.

There are three main speciation patterns

– Allopatric speciation
– Sympatric speciation
– Parapatric speciation

Allopatric Speciation:

Allopatric (Allo= different, Patric =homeland)

Population are separated due to geographical barriers

1. Rivers, earthquakes, continental drift, glaciation, and archipelagos cause geographical barriers between populations of a specific species.
2. Geographical barriers isolate species reproductively from each other.
3. Populations which are separated geographically experience different environments and thus different natural selective forces.
4. The different natural selective forces that each population experiences enhances the genetic divergence that is developing from mutations and genetic drift.
5. Examples:
   – Cave fish,
   – Darwin’s finches
   – Antelope squirrels of the Grand Canyon
   – Isthmus of Panama
Sympatric Speciation

Sympatric (Sym = same, Patric=homeland)

Speciation occurs in the same geographical region without physical isolation.

1. A new species can arise in a single generation if a genetic change produces a reproductive barrier between mutants and the parent population.

2. Example: Accidents during cell division resulting in extra sets of chromosomes (Polyploidy).

3. Self-fertilization can give rise to new individuals that are unable to mate and form fertile off-spring with the parent species.

Parapatric Speciation

Parapatric (Para = near, Patric=homeland)

1. Neighboring populations become distinct species while maintaining contact through Hybrid zones

2. If a hybrid zone is removed through increased natural selection, natural disasters or some other means the extremes of a population fail to mate.

3. Examples
   - Toad population along the north rim of the Grand Canyon.
   - Dog

Branching and unbranched evolution

1. Cladogenesis: Branched evolution. Occurs as populations split and become reproductively isolated from each other.
2. **Anagenesis**: Unbranched evolution. Occurs as changes in allele frequency and morphology accumulate over long periods of time in a single species. New species do not live within the same time period.

A. Example: Due to slow changes in the environment, a species A undergoes slow speciation to species B and then to C.

**Question?** If humans came from ape-like creatures, then how is it that there are still apes on the earth? Why haven’t all the apes turned into humans?

**Intermediate forms**

If species are constantly changing from one species to another, one should expect to find organisms that are in the midst of changing from one form into another, i.e., intermediate forms.

Archaeopteryx
- Intermediate in body structure
- Intermediate in time

**History of life on earth**

The Origin of Life and the Stanley Miller experiment

1. An experiment to test the hypothesis of the biogenesis of life on earth.

A) The environment of early earth was hot with
geothermic activity that produced methane, ammonia, hydrogen, and steam.

B) It was a reduced atmosphere without Oxygen

C) The environment of early earth allowed the spontaneous creation of amino acids, carbohydrates, lipids and RNA

The Geologic Time scale:
1. A time scale describing the sequence of geological time periods or eras in the development of the earth.
2. The boundaries of the respective eras are marked by explosive diversification of new life forms as well as mass extinctions.

<table>
<thead>
<tr>
<th>Era</th>
<th>Periods</th>
<th>(millions of years ago)</th>
<th>Important events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenozoic</td>
<td>Quaternary</td>
<td>.035</td>
<td>Earliest modern human fossilized bones.</td>
</tr>
<tr>
<td></td>
<td>Tertiary</td>
<td>2</td>
<td>Ape like ancestors of humans appear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>Origins of many primate groups, including apes</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>Cretaceous</td>
<td>65</td>
<td>Cretaceous extinctions occur many groups of organisms including most dinosaurs become extinct</td>
</tr>
<tr>
<td></td>
<td>Jurassic</td>
<td>145</td>
<td>Dinosaurs dominate</td>
</tr>
<tr>
<td></td>
<td>Triassic</td>
<td>245</td>
<td>cone bearing plants (gymnosperms) emerge. Radiation of dinosaurs, early mammals, and birds.</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>Permian</td>
<td>290</td>
<td>Extinction of many marine and terrestrial organisms</td>
</tr>
<tr>
<td></td>
<td>Carboniferous</td>
<td>363</td>
<td>Origin of reptiles, and first seed plants, forest of vascular plants</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td>409</td>
<td>First amphibians and insects. First evergreen-upland plant communities</td>
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<tr>
<td></td>
<td>Silurian</td>
<td>439</td>
<td>Colonization of land by vascular plants</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td>510</td>
<td>Origin of plants; marine algae</td>
</tr>
<tr>
<td></td>
<td>Cambrian</td>
<td>570</td>
<td>The Cambrian explosion occurs. The greatest diversification of animals that has ever occurred.</td>
</tr>
<tr>
<td>Precambrian</td>
<td></td>
<td>1000</td>
<td>First multicellular organisms originate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1700</td>
<td>First Eukaryotic cells develop</td>
</tr>
</tbody>
</table>
The earliest fossils of life forms found (all are prokaryotes)

Approximate time of origin of Earth: 4600 million years ago.

Evolution of plants

Evolutionary trends

1. **At the beginning** of the Silurian (435 MBP), plants began to invade the land.
   A. Photosynthetic cells in the earth’s seas had produced enough oxygen to create the ozone layer. The ozone layer protected new life forms on land from lethal doses of ultraviolet radiation.
   B. Charophyte Algae evolving at the water’s edge gave rise to the first plants
   C. It took almost 220 million years for plants to radiate form the swampy lowlands to high mountains. They did so through the following modifications in their structure, function, and reproductive modes.
   1. **Structure**: Roots, Stems and leaves.
      a. Roots formed as underground absorptive and anchoring structures with large surface area.
      b. Roots associated with fungal Mycorrhizal symbionts which helped root tissue absorb water and dissolved mineral ions.
      c. Stems became taller and able to branch more as they gained the capacity to make lignin, a glue like polymer in their cell walls.
      d. Leaves grew as specialized structures out of stems to capture light and carbon monoxide.
      e. Stems and leaves developed vascular tissue called xylem and phloem. Xylem distributes water and minerals through the plant, while phloem distributes photosynthetic products.
      f. Stems and leaves developed a cuticle, a waxy coat to help conserve water on dry land.
   2. Reproduction: The development of pollen allowed gametes to travel by air or animal pollinator instead of by water currents. This was essential in order for plants to live on land.
   3. **Seeds**: Embryo’s became packaged in nutritive tissues and a tough, water proof coat called a seed. This allowed dispersal of plants in unfavorable environments. As the environment changed for the better, the seeds would
germinate.

The Bryophytes -

1. Plants with no vascular tissue like mosses and liverworts.
   A. Bryophytes haven’t evolved vascular tissue or pollen because they grow in moist habitats. Sperm swim to eggs through water droplets.
   B. These plants can dry out, then revive after absorbing water. They can survive desert environments.
   C. All groups share three traits that evolved early in land plants
      1. Waxy cuticle
      2. A cellular jacket around the gamete producing parts conserves moisture.
      3. Gametophytes are large and don’t draw nutrients form sporophytes as they do in other plants. In fact it is the other way around.

2. Mosses can form peat bogs in cold temperature regions. These mosses excrete highly acidic metabolites that hamper the growth of bacterial and fungal decomposers. Well preserved bodies about 3,000 years old have turned up.

Seedless Vascular Plants-

1. Ferns, horsetails and ancient extinct Lycophytes are examples of seedless vascular plants. These plants became dominant during the Devonian period.
   A. They differ from the Bryophytes in that they contain the vascular structures called xylem (water and ion transport) and phloem (conducts sugars and salutes throughout the plant)

2. Seedless vascular plants are sometimes called the amphibians of the plant kingdom. Like amphibians they require a moist habitat for the sexual phase of the life cycle. Thus ferns and horsetails thrive in wet moist areas.
   A. Fern structure: The most conspicuous feature of ferns are the fronds. These long feathery branches usually grow out of a root like structure in the ground called the rhizome. New fronds appear as a coiled form called fiddleheads. As the new fiddleheads unfold and spread out they reveal small leaflets known as pinnae (singular pinna). On the underside of most pinnae are found rust colored patches called sori (singular sorus). These sorus are composed of clusters of spore producing structures called sporangia. In many species of ferns, the sori are protected by individual flaps of tissue called indusia (singular: indusium) while they are developing.
   B. Reproduction of ferns: As spores mature, the sporangia will pop open and catapult the spores through the air. A single fern can produce 50 million spores that are carried by the wind. If spores land on wet shady ledges or soil the spores germinate giving rise to a heart-shaped gametophyte, a quarter of an inch across. Two different types of rhizoids begin to grow out of the gametophyte, the antheridia and archegonia. Antheridia produce sperm and archegonia produced ova. The sperm must be able to swim to the archegonia therefore it is imperative that they are in a liquid medium. The Zygote grows on the gametophyte into the sporophyte (the mature plant above the ground)

Massive Carboniferous forest- Ancient Carbon Treasures

1. During the Carboniferous period, massive forest of huge ferns, towering lycophytic trees and sixty foot horsetails grew thick over the continents. Importantly, during this period, sea levels rose and fell over 50 times. Each time the seas receded, the forest
flourished in the swampy lands until the next flood when again it was covered in tons of sediments. These sediments protected much of the organic material from decomposers which allowed many beautiful fossils to form. Also the organic material was compressed into great seams of coal and oil which are essential today to meet our energy needs.

The Rise of Seed Bearing Plants

1. When did seeds evolve: Fern like Seed-bearing plants first developed in the late Devonian and began to flourish in the Carboniferous. Because of their appearance, these fossils were originally classified as ferns until specimens with obvious seeds as big as walnuts were identified on their fronds. These pteridosperms (“seed ferns”) first appear in wet swampy forest but act as opportunist and colonize dryer more inhospitable environments.

2. How seeds evolved: Colonization of land was hampered in two different ways. First, because their gametophytes need free standing water, the sporophyte of seedless plants can only grow and succeed where there is water. Also fertilization is between gametes from the same gametophytes. Thus there is little opportunity for genetic variability. Plants that could overcome these obstacles would have a selective advantage and thrive in away never before

Gymnosperms

Angiosperms

A glimpse into flowering plant diversity

Deforestation
Hominid evolution

What led to the evolution of the hominid from Ape-like ancestors?

1. 25 million years ago, the environment cooled, glaciers advanced and rainforest changed to the African savanna.
2. As trees and fruits became scarce many apes came down to the Savanna floor to take advantage of the abundance of food there.
3. On the ground there were different natural selective forces at work. The hominids of the savanna began to evolve differently than the apes of the trees and forest.

What changes took place as a result of Hominids adapting to their new environment?

1. Relative brain size
   A. Corresponds with higher intelligence and speech centers
2. Pelvis shape
   A. Humans have wider bowl shaped pelvis
   B. In Humans the Joints attaching the legs to the pelvis are at the base of the pelvis. This is contrasted to apes which have hind legs attached to the front of the pelvis
3. Skull feature
   A. unlike apes, humans have high forehead and no brow ridge
   B. In humans, vertebrae and spinal cord attach and enter at the base of the skull. The spinal cord of apes enter at the back of the skull
   C. The human jaw is thinner and curved compared to the longer rectangular shape of apes.
   D. The teeth of humans are smaller especially the canines

How much similarity is there between apes and humans?

1. Monkeys share 93 percent of their DNA structure with both humans and apes and differ in 7 percent
2. Gorillas differ by about 2.3 percent, from us or from the chimps.
3. Humans differ from chimps in about 1.6 percent of their DNA, and share 98.4 percent
4. According to DNA studies, to whom are gorillas most closely related to, humans are chimps?

Australopithecus afarensis (Lucy)

1. 3.7 million years ago
2. 3' to 3.5' feet tall 50 lbs
3. Bipedal skeleton and footprints
4. 400 cc brain capacity

Australopithecus africanus
1. 2.8 million years ago
2. 4.5' feet tall 80 lbs, more robust body
3. Bipedal skeleton
4. 450 cc brain capacity

**Homo habilis (Handy man)**
1. 1 million years ago
2. Made stone tools
3. 660 cc brain
4. Sexual dimorphism (males larger)
5. Scavengers and omnivorous

**Homo erectus**
1. 200,000 years ago
2. 1200 cc brain capacity
3. Used fire and clothes
4. Smaller jaw and teeth
5. Migrated out of Africa to Europe and Asia
6. Mostly hunter gathers
7. Sexual dimorphism (males larger)
8. Lived in small family groups

**Homo sapien-neanderthal**
1. 125,000 - 35000 years ago
2. Very modern looking facial features
3. Built stronger and stockier than modern man
4. Made advanced tools
5. 1500 cc brain
6. Able to think in the abstract, comprehending religion and spiritual matters
7. Buried and mourned their dead
8. Hunters
9. Strong family groups

**Homo Sapiens-sapiens**
1. 40,000 years ago
2. Cultural revolution
3. Domestication of animals and agriculture
4. Technology
5. Larger social orders that go beyond the family (politics)
Practice Study Question

Biomes and climate

1. Define a desert
2. What latitudes are deserts concentrated around? Why?
3. Describe the type of climate that chaparral grows in.
4. Describe a grassland: soil, vegetation, climate etc...
5. What is the difference between a tropical and temperate deciduous forest
6. What special adaptations do plants and animals have in the desert.
7. Compare the temperature of the desert with the rainforest.
8. What are the four different types of rainforest and how do they differ from each other.
9. What does the term tropical mean.
10. What are the major factors that determine the climate in any given region.

Evolution; life adapts to climate and environment

1. What does the term Special Creation mean?
2. Explain the concept of "The Great Chain of Being."
3. What is biogeography?
4. Explain what problems biogeography poised for the special creation theory.
5. Explain what new insights geology brought to the following concepts: age of the earth, extinctions, organization of the creation of life.
6. Are fossils of modern species that are alive today ever found lying side by side fossils of earlier periods such as the Jurassic Period? What does this tell us?
7. Explain the phrase: "ontogeny begets phylogeny".
8. What are vestigial organs?
9. Know who the following individuals are and their ideas, or contribution to evolutionary biology.
   - De Buffon
   - Cuvier
   - Lamark
   - Thomas Malthus
   - Darwin
   - Wallus
10. Explain the five premises of Natural Selection.
11. What is Archaeopteryx?
12. Define microevolution.
13. Describe 5 factors which contribute to an individuals particular mix of alleles and give him uniqueness in the population.
14. What are the 4 mechanisms that drive micro-evolution?
What is the original source of alleles, and hence of all variation in heritable traits?

What is the difference between genetic drift and natural selection?

Give an example of gene flow.

Why do cheetahs, as well as many other endangered species, have so little genetic variation among them?

Describe the founder effect.

Describe and give an example of stabilizing directional and disruptive modes of natural selection.

Speciation

1. Define species.
2. How does genetic divergence induce speciation?

3. Describe how the various types of isolation mechanisms: Temporal, Behavior, Mechanical, Gametic, Ecological, Zygotic Mortality, Hybrid Inviability and Hybrid Offspring.

4. Which of the above isolation mechanisms are considered pre-zygotic and post-zygotic?

5. Give examples of Allopatric speciation, sympatric speciation, and parapactric speciation.

6. Contrast the differences between cladogenesis and anagenesis.

History of Life on Earth

1. Describe the conditions and environment of early earth.

2. What was unique about the atmosphere of earth when life was first being created?

3. Describe Stanley Miller’s experiment. What is important about the results of this experiment?

4. Be able to name the different eras and periods in order from oldest to most recent.

Hominid Evolution

1. What are hominids?

2. Describe the main physiological differences between apes and humans.

3. What is the difference in genetic make up between chimpanzees and humans?

4. Know the basic characteristics, as described in class, concerning the following hominids:
   - *Australopithecus afarensis*
   - *A. Africanus*
   - *Homo habilis*
   - *Homo erectus*
   - *Neanderthal*
   - *H. sapiens*

5. What are pseudogenes and how do they support Darwin’s theory of evolution of species?
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<td>Theory of Inheritance of acquired characteristics</td>
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Population Ecology

Population is a group of ____________________________ individuals belonging to one species and living in the same geographic area.

Estimating population growth

1. Growth of a population is determined by:
   (rate of births) - (rate of deaths)

2. How to calculate birth rate and death rate
   Example of 20 mice living in a barn

   In a months time, 10 new mice are born. The birth rate would be calculated as
   \[ \frac{10}{20} = 0.5 \text{ per mouse per month} \]
   In the same months time, 2 mice die. The death rate would be calculated as
   \[ \frac{2}{20} = 0.1 \text{ per mouse per month} \]

   We can combine these rates, death and birth into a single variable \( r \)
   \[ r = \text{Birth rate} - \text{Death rate} \]
   So
   \[ r = \text{net reproduction per individual per unit time} \]

   If we multiply “\( r \)” by the number of individuals in the population \( N \) we can calculate the “population’s growth per unit time” or \( G \)

   \[ G = rN \]

   For every 20 mice,
   – 10 new mice will be reproduced per month
   – 2 mice will die per month
   \[ G = rN \text{ for January} \]
   \[ G = (0.5 - 0.1) 20 \]
   \[ G = 8 \]
   – or by the end of January, our population will have increased by 8
G = rN is Exponential Growth

1. If the net growth continued to be calculated every month and as long as the birth-rate remains ________________ than death-rate, G will continue to get larger every month.

2. When plotted on a graph a characteristic “________” shape curve immerses signifying Exponential growth.

Limiting Factors are forces in nature which inhibit or stop population growth. There are two types of limiting factors:

1. ________________ limiting factors become more intense as the population increases in size.
   A. Examples: Disease, predation, food, shelter and pollution.

2. ________________ factors hit with the same force no matter how many individuals are in the population.
   A. Examples, natural disasters, pesticides and herbicides

**Carrying Capacity (K):** Maximum number of individuals that can be sustained in a particular habitat

1. K of a particular habitat can be estimated by taking into account the amount of nutrients, living space and other limiting factors.
2. Logistic growth occurs when population size is limited by carrying capacity.
3. Logistic Growth Equation is \( G = \) ________________

\[ G = \text{population growth per unit time} \]
\[ r = (\text{birth rate – death rate}) \]
\[ N = \text{number of individuals} \]
\[ K = \text{carrying capacity} \]

4. As size of the population increases, rate of reproduction decreases.
5. When the population reaches carrying capacity, population growth ceases.
6. When plotted on a graph a characteristic “________” shape curve immerses signifying Logistic growth.
Overshooting Capacity
1. Population may ______________ increase above carrying capacity
2. Overshooting is usually followed by a crash; dramatic increase in deaths

Human Population Growth
1. Population now exceeds ______________________
2. Rates of increase vary among countries
3. Average annual increase is 1.26 percent
4. Population continues to increase ______________________

Age structure diagrams

[Diagrams of Rapid Growth, Slow Growth, Zero Growth, Negative Growth]
Demographic transition model: Changes in population size with changes in economic development.

1. At what stage of economic development is the population growing the fastest?
2. Why do you think rapid population growth is associated with poor developing countries, and slow population growth is associated with more wealthy countries?

India

1. Geographically, India is just larger than the state of Texas.
2. India’s population surpasses both North and South America combined.
3. Each week 100,000 enter the job market with little hope of finding employment.
4. Each day 100 acres of cropland that provide food are removed permanently from agriculture.
5. 350 million are in complete poverty living in rat infested shanty towns.
Lecture 14. Tropical forests and North-South relations Study Guide

1. What is silviculture? What are the pros and cons of clear cutting, selective cutting of the most valuable trees (hi-grading), sustainable harvesting, tree plantations, even-aged vs. uneven-aged stand management?

2. How are the histories of tropical forests different from and similar to the history of US forests? Are the conflicts, issues, considerations, and options for management the same or different?

3. What role has/can/should the North play in determining the future of Southern forest management?

4. Contrast proposed management goals and incentives for tropical forests (ecotourism, sustainable harvesting, parks, watershed protection, debt-for-nature swaps, slash-and-burn agriculture, biological prospecting) from economic, ecological, ethical, and political standpoints.
5. Candace Slater states that "today's common images of Amazonia build on very fundamental conceptions of nature." What does she mean by an Edenic narrative? What sets of values are associated with the terms Jungle, Wilderness, and Rainforest? What kind of management systems do/would each of these terms demand?

6. Compare the popular media representations of the Yanomami and the Kayapo. Why are these "superficially contradictory, yet fundamentally similar approaches to native peoples?" What is the overall problem with "common" valuations of lowland tropical forests and their inhabitants?

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**Study Guide Lecture 11. Biodiversity patterns, importance, and loss**

1. How does natural selection work?

2. Be able to use the following terms: Evolution, Natural Selection; Mutation; Fitness; Selection pressures; Adaptations; Population; Gene flow; Genotype; Succession; Clements and Gleason; Diversity; Richness; Evenness; endemic & endemism; native; non-native

3. What are the different levels of ecological diversity and how do they relate to one another?

4. What kinds of places are associated with high biological diversity? Be able to list specific examples.

5. What ecosystem processes or functions are vulnerable to loss in biodiversity?

6. Why are diversity and stability often thought to be linked?

7. What are the leading causes of loss of biological diversity? Be able to give a specific example for each one.

8. Why are introduced species threats to biological diversity? Be able to discuss specific examples. What are the major routes of introduction?
Part Three: The Rain Forest

I think about how we humans search for God. The tropical rain forest is the most complex thing an ordinary human can experience on this planet. A walk in the rain forest is a walk into the mind of God

Birute M.F. Galdikas