**Origins of Species Notes 2019**

**Concept: The biological species concept emphasizes reproductive isolation**

The Origin of Life is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Special Creation

Was life created by a supernatural or divine force?

-not testable

Extra-terrestrial Origin

Was the original source of organic (carbon) materials comets & meteorites striking early Earth?

-testable

Spontaneous Abiotic Origin

Did life evolve spontaneously from inorganic molecules?

-testable

Conditions on early Earth:

Reducing atmosphere

water vapor (H2O), CO2, N2, NOx, H2, NH3, CH4, H2S

lots of available H & its electron

no free \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Energy source

lightning, UV radiation, volcanic

Origin of Organic Molecules

Abiotic synthesis

-1920: Oparin & Haldane propose reducing atmosphere hypothesis

-1953: Miller & Urey tested hypothesis

-formed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds including amino acids, adenine, nitrogen bases, other organics, and hydrocarbons

Key Events in Origin of Life

-Origin of Cells (Protobionts)

-lipid bubbles 🡪 separate inside from outside

 🡪 metabolism & reproduction

-Origin of Genetics

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is likely first genetic material

-multiple functions: encodes information (self-replicating), enzyme, regulatory molecule, transport molecule (tRNA, mRNA)

-makes inheritance possible

-makes natural selection & evolution possible

-Origin of Eukaryotes

-endosymbiosis

Timeline

-Key events in evolutionary history of life on Earth

-3.5–4.0 bya: life originated

-2.7 bya: free O2 = photosynthetic bacteria

-2 bya: first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

First Eukaryotes

-Development of internal membranes

-create internal micro-environments

-advantage: specialization = increase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-natural selection!

1st Endosymbiosis

-Evolution of eukaryotes

-origin of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-engulfed aerobic bacteria, but did not digest them

-mutually beneficial relationship

-natural selection!

2nd Endosymbiosis

-Evolution of eukaryotes

-origin of chloroplasts

-engulfed photosynthetic bacteria, but did not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ them

-mutually beneficial relationship

-natural selection!

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Endosymbiosis

-Evidence

-structural

-mitochondria & chloroplasts resemble bacterial structure

-genetic

-mitochondria & chloroplasts have their own circular DNA, like bacteria

-functional

-mitochondria & chloroplasts move freely within the cell

-mitochondria & chloroplasts reproduce independently from the cell

Cambrian explosion

-Diversification of Animals happened within 10–20 million years most of the major phyla of animals appear in fossil record

So….What is a species?

-Biological species concept: defined by Ernst Mayr

-population whose members can interbreed & produce viable, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ offspring

-reproductively compatible

PRE-reproduction barriers

-Obstacle to mating or to fertilization if mating occurs

-geographic isolation, ecological isolation, temporal isolation, behavioral isolation, mechanical isolation, gametic isolation.

Geographic isolation

Species occur in different area due to a physical barrier such as an ocean, canyon etc. Allopatric Speciation is geographic isolation. All other barriers are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speciation.

Ecological isolation

Species occur in same region, but occupy different habitats so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ encounter each other

Temporal isolation

Species that breed during different times of day, different seasons, or different years cannot mix gametes

Behavioral isolation

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ behavioral patterns & rituals isolate species

-identifies members of species

-attract mates of same species 

-courtship rituals, mating calls

Mechanical isolation

Morphological differences can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ successful mating

For many insects, male & female sex organs of closely related species do not fit together, preventing
sperm transfer

-lack of “fit” between sexual organs:
-hard to imagine for us… but a big issue for insects with different shaped genitals!

Gametic isolation

Sperm of one species may not be able to fertilize eggs of another species

-mechanisms

-biochemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ so sperm cannot penetrate egg

-receptor recognition: lock & key between egg & sperm

-chemical incompatibility

-sperm cannot survive in female reproductive tract

POST-reproduction barriers

 -Prevent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ offspring from developing into a viable, fertile adult

Reduced hybrid viability

 -Genes of different parent species may interact & impair the hybrid’s development

-Even if hybrids are vigorous they may be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Chromosomes of parents may differ in number or structure & meiosis in hybrids may fail to produce normal gametes

Hybrid breakdown

-Hybrids may be fertile & viable in first generation, but when they mate offspring are feeble or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rate of Speciation

 -Does speciation happen gradually or rapidly

Gradualism vs Punctuated Equilibrium

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-gradual divergence over long spans of time

-assume that big changes occur as the accumulation of many small ones

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-rapid bursts of change

-long periods of little or no change

species undergo rapid change when they 1st bud from parent population