

Bio 4: Study Guide - Lecture Exam #3

Biotechnology

- * definition
- * applied biology
- * selective breeding vs genetic engineering
- * recombinant DNA
- * transgenic, or genetically modified organisms (GMOs)
- * DNA recombination in nature
 - transformation in bacteria
 - chromosomal fragments
 - plasmids
 - DNA transfer with viruses
- * forensics
 - amplifying DNA (polymerase chain reaction – PCR)
 - synthesized primers, polymerase, heating/cooling cycles
 - determining matches
 - short tandem repeats (STRs), # of repeats determines fragment length
 - gel electrophoresis – basic concepts
 - how to interpret results
 - fragment size, heterozygosity, homozygosity, quantity of DNA
- * agriculture
 - herbicide tolerance
 - insect tolerance (Bt crops)
 - Bacillus thuringiensis, Cry proteins
 - How to make a transgenic plant – Agrobacterium
 - other uses of agricultural biotechnology
- *medicine
 - diagnosis
 - restriction enzymes, RFLPs
 - DNA probes / arrays
 - treatment
 - recombinant DNA; Diabetes - insulin
 - Introduced alleles through viruses; cystic fibrosis

Evolution

How the Theory of Evolution emerged

- diversity, fossils, geology

Mechanism for evolution

- Darwin and Wallace
- natural selection
 - o Four observations/conclusions

Evidence for evolution

- Progressive series of fossils
- Comparative anatomy
 - o Homologous structures
 - o Vestigial structures
- Convergent evolution
 - o Analogous structures
- Embryonic similarity in vertebrates
- Artificial selection
- Sexual selection, Predation, Pesticide resistance

Evidence occurs at population level

- Gene pool, Allele frequency
- Hardy-Weinberg equilibrium
 - o Five conditions

- Three types of selection
 - o Directional, Stabilizing, Disruptive

Speciation

- Species concepts: Biological Species Concept, Phylogenetic Species Concept
- Isolation, Genetic divergence
 - o Allopatric vs. Sympatric speciation

Life on Earth

Early Earth

- Components of early Earth - anaerobic
- Simple molecules, Miller and Urey experiments
- Complex molecules, tidal pools, RNA world
- Membranes – microspheres, protocells
- First living cells - Anaerobic bacteria
- Photosynthetic bacteria

Endosymbiont hypothesis

- Eukaryotes

Multicellularity emerges (why?)

- Algae
- Marine invertebrates, Fishes
- Land plants
 - o adaptations
- Insects, amphibians
 - o adaptations
- Gymnosperms, reptiles
 - o adaptations
- Dinosaurs
 - o Extinction – 65 million years ago
- Mammals, birds
 - o adaptations
- Flowering plants
 - o adaptations

Hominids

Originated in Africa 5-8 mya

Australopithecus spp. 4mya – 1.2 mya

Homo spp – 2.5mya

H. erectus, first to leave Africa

H. neanderthalensis - characteristics

H. sapiens – characteristics

Dispersal: African Replacement Hypothesis vs. Multiregional Hypothesis

Cultural evolution

Systematics

Taxonomy vs. Systematics

Taxonomic Hierarchy

- Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species

Aristotle, Linnaeus, Darwin

Tools of Systematics

- Homologous structures
- Molecular tools

Current classifications of life

Biodiversity

Bacteria

Classification

- Gram stain types related to amount of peptidoglycan in cell wall

- Shape - Cocci, Bacilli, Spirilla
- Colony Morphology - Circular smooth, irregular wrinkled, irregular granulated
- Metabolic activity - Anaerobic, aerobic, photosynthesis

Cyanobacteria

- Photosynthetic (thylakoids) - *Gleocapsa*, *Oscillatoria*
- Provide much of oxygen on Earth

Protists

Photoautotrophic protists

- Algae, Diatoms, Dinoflagellates

Heterotrophic protists

- Phagocytosis, vacuoles

Modes of locomotion

- flagella (e.g., Euglena)
- cilia (e.g., Paramecia)
- pseudopodia (e.g., amoeba)

Slime molds

- plasmoids

Fungi

Structure – hyphae, mycelia, septa

Extracellular digestion

Asexual vs. Sexual reproduction strategies

Plasmogamy vs karyogamy

Four phyla **and their characteristics**

- Chytridiomycota (chytrids) – flagellated spores, aquatic
- Zygomycota (zygote fungi) – fruit rots, bread molds; zygospores; *Rhizopus*
- Ascomycota (sac fungi) – yeasts, colorful molds, truffles; ascus; *Aspergillus*, *Penicillium*
- Basidiomycota (club fungi) – mushrooms, shelf fungi; basidia

Lichens = fungus + cyanobacteri or green algae

- symbiotic relationship: benefits for each?

Mycorrhizae = fungus + plants

- symbiotic relationship: benefits for each?

Plants

Alternation of generations

Bryophytes

- Non-vascular – liverworts, hornworts, mosses
- Gametophyte generation dominant

Seedless Vascular plants

- Ferns, whisk ferns, horsetails, club mosses
- Sporophyte dominate
- Ferns: frond, indusium, sporangium with spores
- Ferns: gametophyte = prothallium
antheridia (male) and archegonia (female); rhizoids