BIO1300 Winter 2017 (Semester 2)
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Evolution
Ecological context: interaction of organisms

Darwin's Voyage
- Published book in 1859
- Russian guy said can't understand anything in biology without understanding and recognizing evolution
- Darwin set sail in 1831
    - Had an epiphany in the galapagos islands about the modes of evolution
    - Noticed birds that were similar in other areas (finches), and that the different forms of finches did different things, particularly in relation to food
    - Different beak shapes
    - Determined that the birds adapted to the new environment in order to avoid competition with food and that multiple species could coexist

Evolution Terms
- Heritable traits
    - Genes that cause certain traits to occur (ex colour and spiral pattern of snail)
- Effect of trait
    - Different traits have different levels of fitness
    - Reproductive success follows survival success
- Nature of adaptations
    - Improves the survival of an individual
    - Improves attraction to opposite sex
- Evolution acts on populations

DNA: The Genetic Code
- Every living organism has DNA
    - Differences DNA can be traced to determine the relatedness of organisms
    - Some genes are common to all organisms or multiple
    - Genes are the building blocks of DNA

Commonality of all Life forms
- Phylogenetic trees
- Common ancestors continued to evolve and become more complex

Tree of Life
- Prokaryote: first "seed" cell
    - Very simple
    - Bacteria and archaea

- Eukaryote: true “seed” cell
    - Lots more structure and complexity
- Unicellular: without tissues
    - Protista is a single cell eukaryote
- Multicellular
    - Autotrophs (make own food, photosynthesis) plantae
    - Absorption fungi (absorb nutrients)
    - Ingestion Animalia (ingests food)

Building the Trees

- Evolution of appendages in vertebrates
- Evolution of digits
- Evolution of hair
- These features distinguish and separate organisms, building the evolutionary trees

Our place Among the Animals

- Review

Evidence for Evolution

- Fossil records
    - One of the first points of evolution that occurred
    - Fossilization is hard body tissues that are petrified and turned into rock
        - Things such as bones, but not skin or organs
    - Not all organisms that die will turn into fossils
    - Fossil layers are different forms of sedimentation that occur as the geological conditions change
    - Fossils indicate that organisms previously existed
        - Often exhibit changes from current organisms
        - Lots of those organisms don’t even exist anymore
    - Should find transition forms (something in between the old version and the current version)
        - Ex the evolution of birds

- Dinosaurs and feathers

Evolution of Whales

- Descendants of terrestrial mammals that once lived on land
- Types of whales

Vestigial Structures

- Features that have lost their function but are still physically present
    - Ex the hind pelvic remains on a whale
- Coccyx in humans, a remnant of tails

Distribution in Space and Time

- Older rocks are lower down, newer ones are higher up
- Relative dating of organisms by comparing earlier to later ones based on positions in strata
- Absolute dating can be done through radiometric dating
- Strata- a layer
- Stratification- layer process that occurs in sedimentation over time

Radiometric Dating

- Rocks, fossils, volcanic ash, sediment, etc naturally contain unstable elements
- Each unstable element has a characteristic half life or rate of decay
- By measuring ration of parent to daughter isotopes, we can estimate age of material
- Carbon dating is a form of radiometric dating

Biogeography

- The life on the planet
- Where the life is found is evidence of evolution
- See slide

Organism Distribution in Time

- Important, see slides
- Origin of life began 4000 million? years ago, animal life began 500 million years ago
    - Cambrian explosion- when animals begin
- 250 million years ago pangea formed (what problems did this cause, lack of water)
- 65 million years ago, asteroid hit the earth and tons of species went extinct
- 2 million years ago, human development begins

Homologies

- Internal skeleton of all vertebrates is structurally identical
- Homologous structures
- Differences are in proportions and arrangements
- Adaptations of common structures to different environments
- Strong indicator of evolution
- Looking at different types of cells also indicate homologies
- Embryological development
- Embryological development indicates evolutionary past

Analogies

- Similarities from convergence
- Shark: class chondrichthyes
- Whales: class mammalia

Observable Evolution

- Resistance to antibiotics
- Most antibacterial are extracts from fungi
- Genetic variability (eye colour, spots)
- Bacteria become resistant to antibiotics over time

Pesticide REsistance

- Due to a high selection pressure (death) and insect reproductive potential (high numbers and fast generation time), pesticides lead to resistance very quickly
- Usually after a couple years the pesticide treatment is no longer effective
- Started using pesticides after advances in science after the wars
- Observable part of evolution
- Very short generation time (reproduce quickly)
- High fecundity (reproductive potential)
- A beneficial gene will quickly spread to future generations (leading to quick resistance)

Evolutionary Change

- There was a drought in 1977 and more of the larger-billed birds survived
- Birds in the galapagos islands
- Plants that produced smaller seeds didn't thrive as well as the plants that produced larger seeds
- Therefore, birds with larger beaks were able to have more food selection
- See graphs of variability of a trait that shows the beak size prior to the drought and after

Industrial Melanism

- 2 forms: light and dark moths
- Industrial revolution in england
- Melanism: colouring of organisms
- Often used to increase survival
- Industrial revolution resulted in the environment shifting to darker coloured backgrounds, resulting in a favouring in the darker moths

Artificial Selection

- By selecting individuals with desired traits and reproducing only them, we can dramatically change organisms over a few generations
- Can work on plants and animals
- Dogs were selected to make breeds from the wolf

The Evolution of the Human Leg

- If all animals descend from common ancestors, then humans should show traces of this common descent

- Signs of evolution should be observable
- Hind limbs first appeared in fish around 440 million years ago (MYA)
- A pelvis that is fused to the vertebral column appeared in tetrapods around 385 MYA
- Rotation of the elbows and knees to support the body occurred in early reptiles for an upright posture around 220 MYA
- Primates are mammals that have a flat nail on the big toe (65 MYA)
- Hominoids, such as gibbons and the great apes are the only primates to walk bipedally on the ground or in trees: 25 MYA
- Human species (Hominins) have the big toe oriented in the same plane as the other toes: 7 MYA
- Homo sapiens differ from other human species by having a slender leg and an ankle adapted for running: 200000 YA
- The leg of a human is the result of 440 million years of evolution

Mechanisms of MIcroevolution

- Effects that interpreted at the genetic level
- Gametic level of selection is the unity of the sperm and egg and production of a fetus
- Changes of genes can occur through selection, mutation, migration of new species, and drift (dependent on the specific sperm that fertilizes the specific egg)

Mutation

- The basis for all future selection
- Where new genes come from
- Most mutations deleterious (not a good mutation or advantage)
- Some bring novel abilities or traits
- Error prone

Genetic Drift

- Largely a random process
- Population bottlenecks
    - Something happens that greatly reduces the diversity of the population
    - Not all versions of the trait are likely to survive
    - Random chance events (usually natural disasters or catastrophic events)

Migration and founder effect

- Process of new genes being brought into the population by new individuals

Natural Selection

- Heritable traits lead to differential survival
- Desirable traits that lead to survival are advantageous and will increase reproducibility
- Undesirable traits will slowly get fazed out as they don’t reproduce as often

Sexual Selection

- Some individuals have greater reproductive success
- The process that gives rise to greater reproduction
- Animals can have favours for sexual selection
    - Ex fighting
    - Beauty (peacocks)

Evolution Terms and Concepts

- Evolution acts on heritable traits that vary among individuals in a population
- Those differences lead to differences in fitness: variable abilities to survive and reproduce
- Adaptations