Chapter 22 : Descent With Modification

Wednesday, January 14, 2015
11:32 AM

Linnaeus: binomial system for classification of species
Hutton: gradualism, father of geology (valleys formed by rivers running through)
Lamarck: use and disuse (ex. Giraffe stretching neck and passing on long neck to offspring)
Darwin: Galapagos Islands, finches, descent with modification

- Natural selection: differential reproductive success of individuals
  - If your traits = higher rate of survival, you will reproduce more
  - If you die, your traits will not be passed on
- Artificial selection: humans modify species over generations by selecting desirable traits
- Individuals do not evolve. Populations evolve over generations.
- Four pieces of evidence for evolution
  - Direct observations
  - Homology
  - Fossil Record
  - Biogeography

developmental genes

- "evo-devo" - explains how slight genetic divergences can produce major morphological differences between species
- **Heterochrony**: an evolutionary change in the rate or timing of developmental events
    - Can alter timing of reproductive development relative to development of nonreproductive organs
    - Head, limbs, and rest of body grow at different rates
- **Paedomorphosis**: adults of some species retain features that were juvenile in ancestors
    - Salamanders retain gills and other larval features even after sexual maturity
- Homeotic genes: mastery regulatory genes that determine basic features
    - Ex. Determine where a pair of wings or legs will develop or how a plant's flower parts are arranged

25.6 Evolution is not goal oriented

- Limpets have a simple eye: can only distinguish light from dark, but it's enough to protect them from predators
- Exaptations: structures that evolve in one context but become co-opted for another function
    - Jaw hinge incorporated into ear region --> function to transmit sound
- Natural selection cannot predict the future; it can only improve a structure in the context of its *current* utility

- **Keystone species**: not abundant, exert control on community structure by pivotal ecological roles
- **Ecosystem engineers**: species that dramatically alter their environment
    - Beaver: felling trees, building dams, creating ponds
- Bottom-up model vs top-down model (predation controls community organization bc predators limit herbivores, herbivores limit plants, plants limit nutrient levels through nutrient uptake)
- **Biomanipulation**: tries to prevent algal blooms and eutrophication by altering density of consumers instead of using chemical treatments

54.3 Disturbance influences species diversity and composition

- **Stability**: community's tendency to reach and maintain a relatively constant composition of species
- **Disturbance**: event (storm, fire, flood) that changes a community by removing organisms or altering availability of resources
- **Nonequilibrium model**: communities are constantly changing after disturbance
- Intermediate disturbance hypothesis: moderate levels of disturbance foster greater species diversity than do high or low levels
- **Ecological succession**: disturbed area colonized by species, replaced by some other species, which are replaced by still a different species
- **Primary succession**: when process begins in a lifeless area where soil hasn't formed
    - Only life-forms present = prokaryotes and protists
- **Secondary succession**: existing community cleared by a disturbance that leaves soil in tact

Slide 28 - question like that on the test

Chapter 42: Circulation and Gas Exchange

Tuesday, March 10, 2015
10:05 AM

42.1 Circulatory systems link exchange surfaces with cells throughout the body

- Small molecules like CO2 and O2 can move through diffusion
- Time taken for substance to diffuse is proportional to the square of the distance
- Natural selection permits effective exchange for all cells
    - Many or all cells in direct contact with the environment (cnidarians/flatworms)
    - Circulatory system (all other animals)
- Gastrovascular cavity: distribution of substances throughout the body, digestion, opening connects it to the surrounding water
    - Only cells lining cavity have access to nutrients released by digestion
    - Body wall is only 2 cells thick
    - Flat body in planarians survive without circulatory system because flat body increases surface area and optimizes exchange
- Circulatory system: circulatory fluid, interconnecting vessels, and muscular pump
    - Uses metabolic energy to elevate hydrostatic pressure making fluid flow through vessels and back to the heart
    - Open - the circulatory fluid also is interstitial fluid that bathes body cells
        - Hemolymph: circulatory fluid
        - Arthropods, grasshoppers, clams
        - Body movements squeeze sinuses to circulate hemolymph
        - Benefits: less costly in terms of energy expenditure
    - Closed - circulatory fluid, blood, is confined to vessels and is distinct from interstitial fluid
        - Annelids, cephalopods, all vertebrates
        - Benefits: high blood pressure, effective delivery of O2 and nutrients to cells
- Arteries: carry blood from heart to organs throughout the body
    - Branch into arterioles (convey blood to capillaries)
- Capillary beds: networks of capillaries
- Capillaries converge into venules and venules converge into veins
    - Veins: vessels that carry blood back to the heart
- Hepatic portal system: carries from capillaries in the digestive system to those in the liver
- Atria: receive blood coming into the heart
- Ventricles: carry blood away from the heart
- High metabolic rates = more complex circulatory systems
- Single circulation: blood passes through the heart once (bony fishes, etc.)
    - One atria and one ventricle
    - Gills: where there is a net influx of O2 and CO2 is removed from blood
    - Passes through 2 capillary beds
    - When blood flows through capillary bed, blood pressure decreases substantially
- Double circulation: two distinct circuits (amphibians, reptiles, mammals)
    - Pulmonary circuit: if the capillaries in the lungs are involved
    - Pulmocutaneous circuit: if capillaries in both the lungs and the skin are involved (amphibians)

42.2 Coordinated cycles of heart contraction drive double circulation in mammals

- Know the pathway of the blood
- Cardiac cycle: one complete sequence of pumping and filling
- Systole: contraction phase
- Diastole: relaxation phase
- Cardiac output: volume of blood each ventricle pumps per minute
- Heart rate: rate of contraction (bpm)
- Stroke volume: amount of blood pumped by ventricle in a single contraction

Chapter 43: The Immune System

Tuesday, March 24, 2015
6:03 PM

- Innate immunity: all animals have it, same whether or not the pathogen has been encountered before (rapid)
  - Barrier: skin, mucous membranes, secretions
  - Internal: phagocytic cells, antimicrobial proteins, inflammatory response, natural killer cells
- Acquired immunity: only in vertebrates; response enhanced by previous exposure to infecting pathogen (slower)
  - Humoral: antibodies defend against infection in body fluids
  - Cell mediated: cytotoxic lymphocytes defend against infection in body cells

43.1 In innate immunity, recognition and response rely on shared traits of pathogens

- Exoskeleton of chitin provides effective barrier against most pathogens
- Lysozyme: digest microbial cell walls
- Hemocytes: phagocytic, trigger production of chemicals that kill microbes and trap parasites, secrete antimicrobial peptides
- Barrier Defense
  - Body secretions create environment that is hostile to many microbes
    - Sweat/oil glands give skin pH of 3-5, acidic to stop growth of microorganisms
- Innate Defense
  - Neutrophils: most abundant phagocytic cell in mammalian body
  - Eosinophils: against parasitic worms, position themselves against parasite's body and discharge enzymes that destroy invader
  - Dendritic cells: populate tissues in contact with the environment, development of acquired immunity
  - Interferons: provide innate defense against viral infection
- Inflammatory Response
  - Mast cells: store chemicals in granules for secretion; store histamine
  - Fever is a systemic inflammatory response
    - Elevated body temperature might enhance phagocytosis and speed up reactions
- Natural Killer cells: find cells that don't express that class I MHC protein and release chemicals to kill them
- Some bacteria have outer capsule that hides the polysaccharides of their cell walls, preventing recognition (among other adaptations)

43.2 In acquired immunity, lymphocyte receptors provide pathogen-specific recognition

- Lymphocytes made from stem cells in bone marrow
  - T cells: migrate from bone marrow to the thymus
  - B cells: mature in the bone marrow
- Immunological memory: enhanced response to a foreign molecule encountered previously
- Cytokines: proteins that help recruit and activate lymphocytes

Antigen Recognition

- Antigen: any foreign molecule that a lymphocyte recognizes and respond to
- B cells can give rise to plasma cells that secrete soluble form of the antigen receptor
- Antibody: immunoglobulin; secreted protein
- Epitope: antigenic determinant
- All of the antigen receptors on a lymphocyte recognize the same epitope
- Each B cell receptor has two identical heavy and light chains connected by disulfide bridges
- T cell receptor: contains alpha and beta chains linked by a disulfide bridge
  - Bind only to antigen fragments presented on surface of host cells
- Class I MHC: almost all cells of the body, recognized by cytotoxic T cells
- Class II MHC: made by dendritic, macrophages, and B cells; recognized by cytotoxic t cells and helper t cells