Top Five Lists – Spring 2008

Surface/Volume Ratios (Shashika, Andy)

1. Be able to define surface area (outside, skin), volume (interior, guts), and surface-to-volume ratio (proportion of outside to the inside (=SA/V)
2. Surface area increases by the square of the linear dimension while volume increases by the cube. Therefore, as something gets bigger its S/V decreases.
3. Exchange with the environment occurs through SA, and therefore it must be appropriate for an organism's volume and needs.
4. S/V ratios are an important factor in the evolution of organismal/cell shape and S/V also sets a limit on scaling/size
5. S/V ratios also determine metabolic rates.
6. benefits of having a high surface to volume ratio in animals and plants
7. evolution in animals and plants to maximize surface to volume ratio
8. The basal metabolic rate of the body and body temperature regulation in animals according ot their surface to volume ratio
9. Animals are sphere shaped to allow for motility and to minimize heat loss (small S/V).
10. Plants are "stem like" in order to maximize absorption of food materials (high S/V).
11. When large animals get bigger they grow allometically (dispropotionately).
12. Reynold's number (inertia/viscosity) increases as animals get bigger because gravity has a larger affect on more massive objects.

Plant Form & Function (Jenny, Mike N)

1. Three main types of cells and their characteristics (parenchyma, collenchyma, sclerenchyma)
2. Four major tissue types – meristematic, vascular, dermal, ground.
3. Meristems can be primary or secondary, and include apical meristems, pericycle, cork cambium, and vascular cambium. Meristems are the only region of the plant where cell division/growth can occur. There is a typical pattern of growth: meristem, then new cells, then cells enlarge, and finally cells differentiate and become specialized
4. A bud is an embryonic shoot with leaves that are waiting to develop. They give rise to branches and may also house flowers
5. The vascular cambium is a secondary meristem that produces secondary xylem to its interior and secondary phloem to its exterior. Thus, the woody stem increases in girth, and every new growing season the vascular cambium adds another layer of phloem and xylem.
6. The cork cambium is another secondary meristem that produces cork to protect the phloem and the wood of a tree.
7. The characteristics of a plant are: photosynthetic autotrophs, walls of cellulose, immobile, multi-cellular, eukaryotic.
8. Plants have three main vegetative organs – leaves, stems, roots
9. Openings in the epidermis of the leaves allow for gas exchange and are controlled by guard cells

Animal Form & Function *(Dan, Nick, Mike R, Jenn)*

1. animal form & function is a product of evolution)
2. form & function involves evolutionary "trade-offs" – constraints on adaptations
3. An organ is composed of two or more kinds of tissues. In an organ system, different organs work together to perform an overall function.
4. homeostasis is the dynamic process of adapting to the external environment and maintaining a relatively stable internal environment.; maintenance of relatively constant steady state
5. correlation of form and function, survival value of structures
6. Glucose Homeostasis
7. Mechanisms of Thermoregulation, brown fat and temp. regulation
8. Negative feedback is far more common in animals than positive feedback.
9. Pavlov's experiments with dogs demonstrated that certain feedforward responses such as salivation could be conditioned to irrelevant stimuli, like the ticking of a metronome.

Circulation (Jevinne, Shawn)

1. heart chambers and circuits have increased evolutionarily
2. difference between closed and open circulatory systems
3. SA & AV nodes provide electrical activation for heart function; cardiac cycle
4. route of blood flow in mammals
5. pressure and blood flow
6. form & function of the circulatory system (e.g., parts of heart & function)
7. major components of the heart beat.

Hormones

1. hormones active in low concentration
2. hormones have a target remote from site of synthesis/release
3. some hormones enter the target cell and bind to receptors directly to change gene expression, others bind to receptors and use secondary messengers to convey the message to the gene being transcribed/translated
4. general response scheme: hormones → receptor → amplification → transcription/translation/etc → response
5. requirements (four) to identify a hormone
6. GA and flowering in corn cockle

Plant Transport (Michael P)

1. water potential refers to the energy state of water and determines the rate and direction of water movement
2. route of movement of water from the soil to the stele
3. mechanism of phloem transport
4. bulk flow (cohesion-tension) hypothesis explains water transport to the leaves
5. stomata control water loss from the leaf
6. root pressure - created by endodermis not allowing apoplastic entry to stele
7. Symplastic transport vs. apoplastic transport

8. Root pressure and guttation
9. Guard cells and their roles in plants.

Neurons (Stacy, Kate H)

1. neuron structure and types (sensory, motor, interneurons)
2. resting potential and the role of sodium of potassium
3. action potential
4. pumps and gated channels
5. neurotransmitter and synapses
6. nervous system cells – structure and function (dendrite, axon, cell body, Schwann cells, myelin sheath, node of Ranvier post/pre synaptic terminals)
7. Electrical (animals; action potentials) and Chemical (plants and animals; hormones)
8. Membrane Potentials- charge difference across a membrane; depolarization - inside becomes less negative; hyperpolarization: inside becomes more negative than resting potential; Nernst Equation: relates ion distribution to resting membrane potential
9. Sodium Potassium Pump, Sodium and Potassium channels: move ions into and out of cell to produce membrane potentials
10. Action Potentials: carry electrical signal along axon and across synapse result from depolarization of membrane cause neurotransmitters (like acetylcholine) to be released and generate another action potential

Nervous System (Katelynn, Luke)

1. the central nervous system is composed of the brain and the spinal cord.
2. the peripheral nervous system divides into the somatic nervous system, which is meant to sense the external environmental conditions and to control the skeletal muscles. The PNS is also made up of the autonomic nervous system, which regulates homeostasis and organ function
3. Brain structures: Know the major divisions of the brain which are the hindbrain, midbrain, and the forebrain.
4. Brain layers: Layers of the brain are the dura mater (outer), arachnoid (middle), and pia mater (inner).
5. Spaces in the brain are called ventricles, and the fluid is called cerebrospinal fluid. sympathetic/Parasympathetic divisions: These divisions come are out of the autonomic nervous system. The sympathetic system prepares the body for danger or stress. It readies the body for reaction. The parasympathetic system prepares the body for rest. It restores and maintains body functions.

Immunology (Carmen)

1. Nonspecific (innate) immunity - the body's defenses that are present at birth and act against forgien materials in much the same way regardless of the specific identity of the invading material. Examples: skin, mucus
2. Antimicrobial Proteins- generally inhibit viral replication inside host cells.
3. Specific (acquired) immunity- Develops only after the body is exposed to feign substances.
4. There are three types of leukocytes involved in wound response/healing (mast cells → release histamine, macrophages → phagocytes, signal other immune cells; neutrophils → phagocytic, release oxidizers

5. When tissue damage occurs, platelets, mast cells, and phagocytes respond and work together to heal the tissue
6. The major histocompatibility complex (MHC) consists of a group of genes that code for marker proteins on all nucleated cells (MHCI) and immune system cells (MHCII).
7. Antibodies are a result of acquired immunity that recognize one specific antigen and eliminate invaders by binding to it and: neutralizing it directly or targeting it for elimination by the complement system (proteins) or phagocytes
8. Lymphocytes are an organism's final line of defense and include antibody producing cells (B cells) and T cells.
9. Immunity acquired by previous exposure (by accident or vaccination) to a particular antigen or mother to child transfer through milk or placenta (receiving antibodies from others
10. two main parts to the immune system: humoral response - circulation of free antibodies; destroys free (not inside a cell) pathogens; extracellular. Named because it is associated with the "humors" (blood); and cell-mediated immunity - destroys cells containing intracellular pathogens (and transplanted tissues, cancer cells).
11. Lymphatic System- network of lymphatic vessels.
12. Lymphocytes- type of leukocytes that are responsible for specific immunity. 2 types: B cells and T cells

Nutrition & Digestion (Andy H, Rose)

1. form and function in nutrient acquisition (*e.g.,* tooth types, mouth parts, gut length)
2. Sequence of nutrient acquisition and utilization (four steps: ingestion, digestion, absorption, elimination)
3. Structure and function of the digestive tract (=Square dude)
4. Digestive enzymes – know location and functions of main ones (proteases, lipases, nucleases, amylases)
5. Compare and contrast nutrient types on plants and animals (complexity, type, concentration in environment, localization) Or, why did animals develop a digestive tract?
6. Note functioning of stomach, small intestine, large intestine
7. Organisms cannot synthesize all the nutrients needed to carry out daily functions and must obtain these nutrients from the environment.
8. Organisms have adapted to actively or passively absorb food and nutrients through the alimentary canal.
9. The route taken by food through the alimentary canal humans is: salivary glands, pharynx, esophagus, stomach, small intestine, large intestine, the rectum, and finally the anus.
10. The nervous and endocrine systems regulate this system.
11. Starling and Bayliss showed that hormones play an important role in gastrointestinal function

Sensory Systems (Matt)

1. Basic scheme of sensory system response (receptor, transduction, amplification, transmission, integration, response)

2. Structure and function of the ear
3. Structure and function of the eye

Muscles (Tyler)

1. Muscle types (smooth, skeletal, cardiac)
2. Muscle structure (fibers, myofibrils, sarcomeres, sarcoplasmic reticulum, t tubules)
3. Muscle function (actin, myosin, troponin, tropomyosin, Ach, t-tubules, sarcoplasmic reticulum, calcium
4. What are slow-oxidative fibers, fast-oxidative fibers and fast-flycolytic fibers?

Gas Exchange (Paige, Chris, Emily)

1. Know the equation that relates photosynthesis and respiration
2. Know the difference between bulk flow and diffusion
3. What is Fick's law?
4. Compare and contrast positive and negative pressure breathing
5. What are the components of the hemoglobin and relate to the Bohr effect.
6. hemoglobin and oxygen saturation
7. Carbon Dioxide Transport
8. How to calculate partial pressure and its significance
9. function of human and bird respiratory system
10. diffusion vs. bulk flow methods (gills, positive pressure, negative pressure) and tidal vs. flow through system
11. Anatomy (location, function) of the mammalian respiratory system (pharynx, larynx, trachea, lungs, bronchus, bronchioles)
12. Lungs receive deoxygenated blod from the heart and return xxygenated blood to the heart.
13. partial pressure of oxygen entering the lung is about 40 mm Hg and the partial pressure of oxygen in the alevolar air is about 100 mm Hg (oxygen will diffuse into the lung).
14. know how to calculate partial pressures
15. Hemoglobin is an iron-containing pigment that carries oxygen through the blood. Hemoglobin is a globular protein that has four protein subunits, with one heme and iron.

Kidney & Osmoregulation (Josh)

1. Sodium/potassium pump
2. Form & function of the kidney (filtration dude, Bowman's capsule)
3. Osmoregulation and why it's important
4. Function of a nephron
5. Osmolarity vs. molarity
6. Salt water vs. fresh water fish water and electrolyte movement

Sensory Systems In Plants (Nick P, Janae)

1. GA stimulates aleurone layer to undergo transcription & translation to produce amylase that breaks down starch into simpler sugars
2. Little seeds commony have light-triggered germination

3. Malting process in beer making is done to induce productin of starch digesting enzymes, mashing employs the enzymes to convert the starch into sugar; brewing – yeast use sugars to make alcohol; lagering – aging and carbonation step
4. Gravitropism – plant response to gravity
5. Mechanism for gravitropism (signal → receptor → transducing mechanism → response)
6. Phototropism – plant response to unidirectional light
7. Know the 'general' scheme of how hormone mechanisms of action work (eg. hormone → receptor → amplification via protein kinases, G proteins, other → transcription, translation, enzyme activation, other → response)
8. definition of a hormone (i.e., site of production = different from site of action, organic, active in low concentration)
9. phytochrome and germination

Plant Reproduction *(Russ)*

1. Floral structure and function (parts of flower and their function)
2. double fertilization
3. sexual vs. asexual reproduction
4. seed structure & function
5. pollination
6. Pollen grains are immature male gametophytes, and female gametophytes develop within the ovule.
7. During pollen germination, the pollen tube grows, and double fertilization occurs.
8. The two multicellular stages in plants are a gamete-producing gametophyte and a spore-producing sporophyte. They alternate with one another in a process called alternation of generations.

Animal Reproduction (Jake, Neva)

1. sexual life cycle including meiosis & fertilization
2. Sexual reproduction is the production of a new individual by the joining of two haploid gametes: sperm and eggs. The union of a sperm and egg produces a zygote which develops into an embryo.
3. Gametogenesis is the formation of gametes, which begins with diploid primordial cells (germ cells).
4. Spermatogenesis- one spermatogonium becomes a primary spermatocyte which gives rise to two secondary spermatocytes, yielding four spermatids maturing into four sperm cells.
5. Oogenesis- one oogonium becomes primary oocyte, which produces a secondary oocyte that yields a mature egg (ovum).
6. Asexual reproduction is the production of offspring from a single parent, without the fusion of gametes from two parents. Three methods: Budding, regeneration, and parthenogenesis.
7. form & function of the female reproductive system
8. female reproductive (menstrual) cycle and hormones
9. form & function of the male reproductive system
10. mechanism of fertilization
11. contraceptive methods (e.g., NFP, barrier methods, hormonal methods, vaccine)