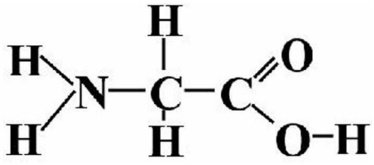
SBI 3UI Exam Review #1: Biochemistry

1. Terms: biology, biochemistry, hydrogen bond, organic molecule, polar molecule, non-polar molecule, macromolecules, subunits, substrate and terms related to the questions below.
2. Water
   a) Explain why water is classified as a polar molecule.
   b) What are three functions of water in living things?
3. Carbohydrates
   a) Describe the composition and polarity of glucose.
   b) What are the three main monosaccharides (simple sugars)? What is the main function of glucose?
   c) What are the three main disaccharides? Which monosaccharides are found in each?
   d) What are the three main polysaccharides? Which monosaccharides are found in each?
   e) What is the function of carbohydrates in plants and animals?
   f) Describe the standard tests for monosaccharides and polysaccharides, the chemical used and the appearance of a positive and negative test.
4. Lipids
   a) Triglycerides: describe their composition (subunits), polarity and three functions in the body.
   b) Phospholipids: describe their composition (subunits), polarity and their most important role in the cell.
   c) Cholesterol: describe its polarity and two of its functions in the cell and/or body.
   d) Describe the standard test for lipids and the appearance of a positive and negative test.
5. Proteins
   a) Describe the composition of protein (its subunits), its polarity and five (5) functions in the body
   b) Explain the importance of their 3-D shape.
   c) Explain what it means to denature a protein and three ways proteins can be denatured.
   d) Compare and contrast polypeptides and proteins.
   e) Describe the standard test for proteins, the chemical used and the appearance of a positive and negative test.
6. Nucleic acids
   a) What are the subunits of nucleic acids?
   b) What are nucleotides made of?
   c) In what two ways do the subunits of DNA and RNA differ?
7. Metabolism
   a) Compare and contrast anabolic and catabolic reactions, including what generally occurs in each and if they require or release energy.
   b) Compare and contrast hydrolysis and condensation reactions, including what occurs in each and if they require or release energy
   c) Write the overall chemical reactions for photosynthesis and cellular respiration. How are these processes related?
   d) ATP and glucose are important energy storage molecules. How does ATP store chemical energy and which organelle produces the majority of ATP in the cell?
8. Enzymes
   a) Define enzyme and describe generally what they do.
   b) What type of macromolecule are enzymes made from?
   c) Describe how an enzyme works, including the role of the active site.
   d) What does it mean to denature an enzyme? What three ways can enzymes can be denatured?

Extra Practice Questions:

For the amino acid shown to the right:



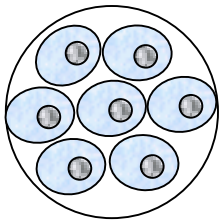
1. Classify the amino acid as either:
   a) organic or inorganic, giving evidence to support your answer.
   b) polar or non-polar, giving evidence to support your answer.
   c) hydrophilic or hydrophobic, giving evidence to support your answer.
2. Is this molecule able to form hydrogen bonds? Explain.
3. If this amino acid is combined with many other amino acids:
   a) What type of macromolecule will be formed?
   b) Is the reaction catabolic or anabolic? Explain.
   c) Is the reaction a hydrolysis or condensation reaction? Explain.

SBI 3UI Exam Review #2: Cell Structure and Function

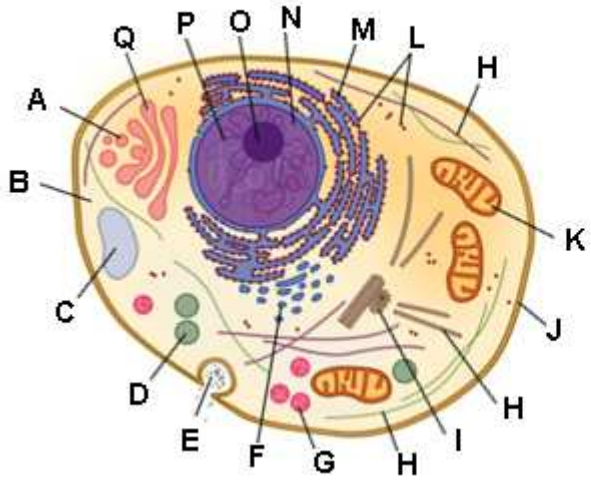
1. Terms: phospholipid bilayer, hydrophilic, hydrophobic, solute, solvent, intracellular fluid (ICF), extracellular fluid (ECF), concentration gradient, diffusion, osmosis and terms related to the questions below.
2. Cells:
   a) What does LUCA stand for and why is LUCA significant?
   b) Write the three statements of the Cell Theory.
   c) Compare and contrast prokaryotic and eukaryotic cells.
   d) Describe the idea behind Endosymbiosis Theory and explain how it is related to eukaryotic cells.
   e) What are the characteristics of living things? (MRS GREN)
   f) Estimate the size of a cell from a description or picture of the field of view (see the example below).
3. Cell membranes:
   a) Describe the composition and structure of cell membranes.
   b) Explain how the composition and structure of cell membranes are critical to their function.
   c) Describe how substances move across and through the cell membrane, including examples of substances that move by each method.
   d) Define osmosis and describe what happens when a cell is placed in a hypertonic (eg. high solute), hypotonic (eg. low solute) or isotonic solution.
   e) Compare and contrast active transport and passive transport, include the role of membrane proteins.
   f) Describe two types of bulk transport (endocytosis and exocytosis)
4. Parts of a cell:
   a) Be able to label diagrams of generalized plant and animal cells.
   b) Know the functions of all organelles, including leucoplasts and chloroplasts (from the microscope lab).
   c) Compare and contrast plant and animal cells, including the types of organelles present in each.
5. Nucleic acids (in more detail now):
   a) What are the components of nucleotides?
   b) List three significant differences in the composition and structure of DNA and RNA.
   c) Describe the relationship between DNA, chromatin and chromosomes.
   d) Describe the steps in DNA replication, including two enzymes and the role of each.
   e) Describe two types of mutations caused by errors in DNA replication.
   f) Explain how the structure of DNA is ideally suited to its function.
6. Protein synthesis:
   a) What is a gene?
   b) Outline the steps in protein synthesis, including transcription and translation.
   c) What are the roles of DNA, mRNA and tRNA in protein synthesis?
   d) If a strand of DNA has the nucleotide sequence: TTA GTC CAG ACT, what is the nucleotide sequence of the corresponding mRNA?
   e) What is a codon?
   f) Know the roles of the organelles and endomembrane systems (ER, Golgi and vesicles) that are involved in protein synthesis

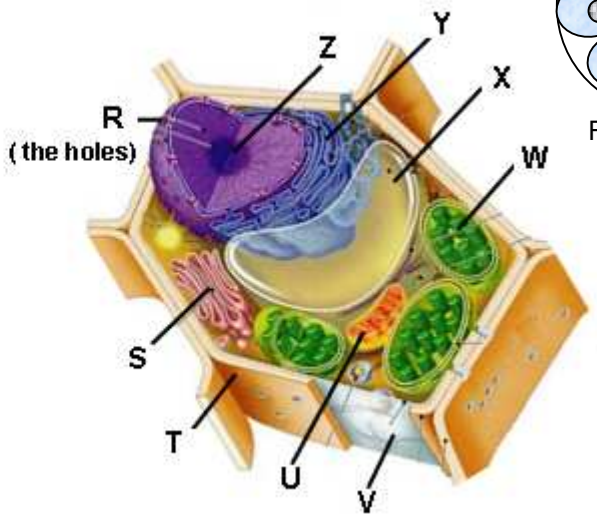
Extra practice questions:

1. Estimate the width of the cells in the picture shown to the right.
2. Label the plant and animal cells below:



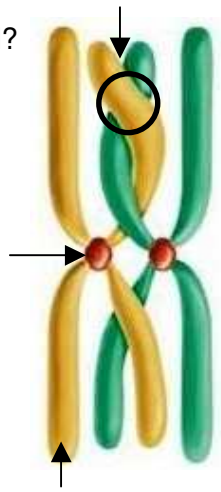
Field of View: 300 µm





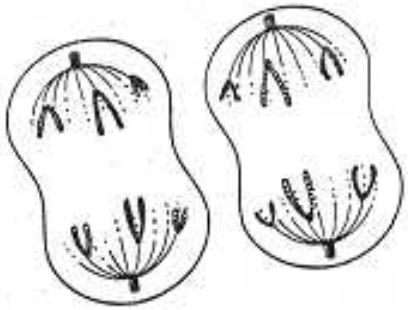
SBI 3UI Exam Review #3: Mitosis and Meiosis

1. Terms: haploid, diploid, gametes, gametogenesis, chromatin, chromosome, centromere, chromatid, synapsis, tetrad, chiasmata, crossing over, fertilization, zygote and all terms related to the questions below
2. The Cell Cycle
   a) Explain why cells divide (why cells must be small).
   b) What are the two main stages of the cell cycle?
   c) Compare and contrast chromatin and chromosomes. During what parts of the cell cycle is DNA found in each form?
   d) What is the most important event of interphase?
   e) Define mitosis – what is dividing?
   f) Define cytokinesis – what is dividing?
   g) Be able to ***recognize*** the stages of the cell cycle from diagrams (interphase, prophase, metaphase, anaphase and telophase/cytokinesis).
   h) Be able to ***describe*** the events of each stage of the cell cycle.
   i) Know the differences in mitosis between plant and animal cells.
3. Meiosis
   a) Know the purpose of meiosis and in which parts of the body it takes place.
   b) Be able to ***recognize*** the stages of meiosis I and meiosis II from diagrams.
   c) Be able to ***describe*** the events and significance of each stage of meiosis, especially the events of prophase I, metaphase I and anaphase I .
   d) Meiosis is known as a 'reduction division'. What does this mean and during what stage of meiosis is the chromosome number reduced?
   e) Meiosis introduces genetic diversity. What does this mean and what are the two main events during meiosis that introduce genetic diversity?
4. Errors in Meiosis
   a) Know what is meant by a non-disjunction disorder.
   b) Be able to recognize a monosomy and a trisomy from a karyotype.
5. Karyotypes
   a) What are homologous chromosomes?
   b) Know the difference between an autosome and a sex chromosome.
6. Sexual reproduction
   a) What are gametes and where are they produced?
   b) Are gametes haploid or diploid? Explain what this means.
   c) What are the gametes in animals called? What are the gametes in plant cells called?
   d) Describe what happens during fertilization.
   e) Are zygotes haploid or diploid? Explain what this means.



Extra Practice Questions

1. For the structure shown to the right:
   a) What is the overall, total structure called?
   b) What is the name of the process that is occurring?
   c) In what stage of meiosis does this process take place? Be specific.
   d) Label the parts that are indicated by arrows.
   e) How many chromosomes are present?
   f) What is the relationship between the chromosomes?
   g) How many chromatids are present?
   h) What is the importance or significance of this process?
2. Identify the stage of meiosis I or II for the cells below. What is significant about each stage?

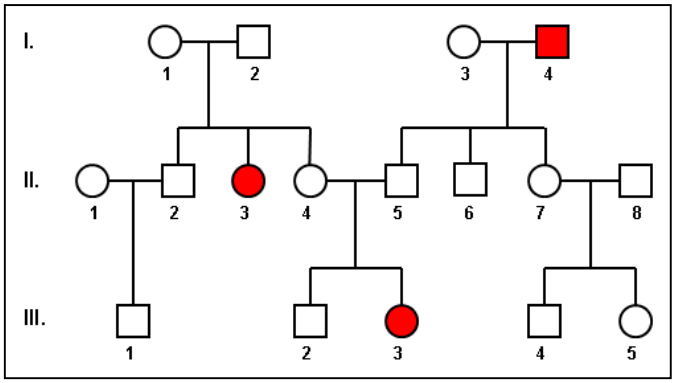


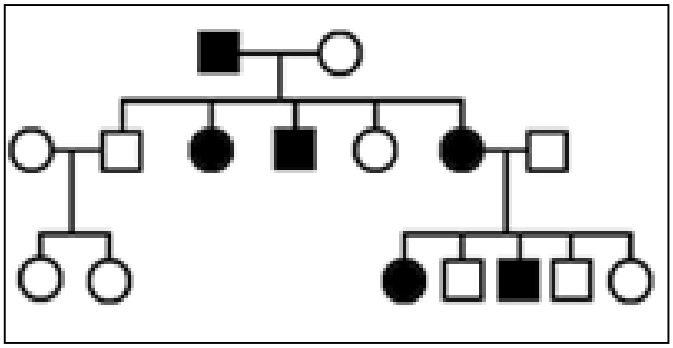
SBI 3UI Exam Review #4: Genetic Continuity

1. Terms: genetics, dominant trait, recessive trait, homozygous, heterozygous, hybrid, carrier, genetic engineering and all terms related to the questions below.
2. Genes
   a) What is an allele?
   b) Explain the difference between a dominant and recessive allele.
3. Genetics Problems: use Punnett squares to find the genotypes and phenotypes of the offspring for a:
   a) monohybrid cross (one allele/trait) for the F_1 and F_2 generations
   b) dihybrid cross (two alleles/traits) for the F_1 and F_2 generations
   c) X-linked (sex-linked) monohybrid cross
   d) co-dominant monohybrid cross
   e) incompletely dominant monohybrid cross
   f) Compare and contrast co-dominance and incomplete dominance, include the offsprings' appearance.
4. Pedigrees
   a) Know how a pedigree is organized and the meaning of the symbols.
   b) Be able to read a pedigree and determine whether a genetic disorder is autosomal dominant, autosomal recessive or X-linked (sex linked).
5. Blood types
   a) What are the three alleles for blood type?
   b) Write the genotypes for a person who is: homozygous Type O _____, heterozygous Type A_____, Type AB _____ and hybrid Type B _____.
   c) Which types of blood are compatible (can be mixed)? Why?
   d) Which types of blood are incompatible (can not be mixed)? Why?
   e) Explain what is meant by antibody, antigen and agglutination.
6. Cystic fibrosis and hemophilia are genetic diseases.
   a) How is each inherited? (autosomal dominant, autosomal recessive, X-linked etc.)
   b) What is the role of the protein that is mutated?
   c) What are the major symptoms of this disorder and how are they related to the mutated protein?

Extra Practice Questions:

1. For the pedigrees shown to the right, determine the pattern of inheritance. Give evidence to support your answer.
2. In the first pedigree, individual II – 5 is:
   a) individual II – 7's _____
   b) individual II – 4's _____
   c) individual I – 3's _____
   d) individual III – 2's _____
3. Black fur (B) is dominant to yellow fur in Labrador retriever dogs. If a hybrid male is bred with a yellow female, predict the genotypes and phenotypes of the puppies.
4. In pea plants, a tall stem is dominant to a short stem. If a homozygous tall pea plant is crossed with a homozygous short pea plant, predict the genotypes and phenotypes of the F_1 and F_2 generation plants.
5. A man with Type O blood marries a woman who is Type A hybrid.
   a) Predict the possible blood types of their children.
   b) Can the woman give blood to her husband? Explain why or why not.
6. Red-green colour blindness is X-linked recessive. If a man with normal colour vision marries a woman with normal colour vision whose father was red-green colour blind, predict the probability that their:
   a) sons will be red-green colour blind
   b) daughters will be red-green colour blind.



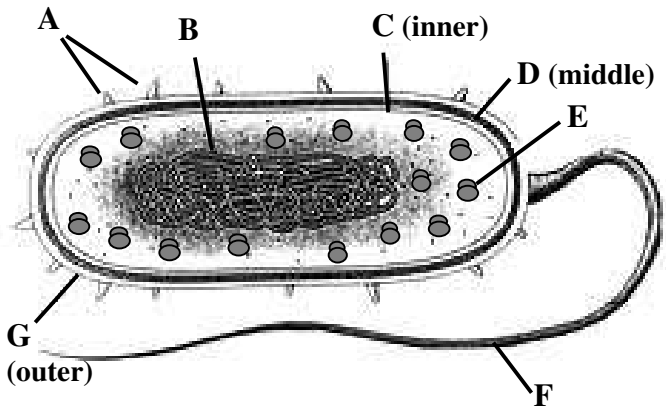


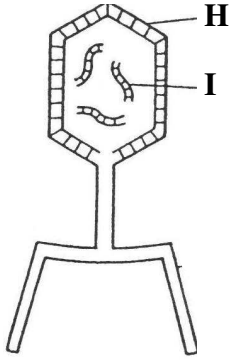
SBI 3UI Exam Review #5: Viruses and Bacteria and the Immune System

1. Terms: microbiology, streptococcus, staphylococcus, staphylobacillus, staphylobacillus, spirillum, immunity, antibodies, antigens, inflammation, antibiotics and all terms related to the questions below.
2. Viruses
   a) Be able to label a diagram of a typical virus.
   b) Are viruses living? Why or why not?
   c) What is the most important criteria used to classify viruses?
   d) Describe how viruses replicate by the lytic cycle. You may use diagrams to enhance your answer.
   e) Describe how viruses replicate by the lysogenic cycle. You may use diagrams.
   f) Compare and contrast the lytic and lysogenic cycles.
3. Bacteria
   a) Be able to label a diagram of a typical bacterial cell.
   b) Are bacteria prokaryotic or eukaryotic? Explain why.
   c) Are bacteria living? Why or why not?
   d) What are four of the most important criteria used to classify bacteria?
   e) Give three examples of "helpful" (beneficial) functions or roles of bacteria.
   f) Describe how bacteria reproduce asexually. What is the name of the process?
   g) Describe how bacteria reproduce sexually. What is the name of this process?
   h) Compare and contrast binary fission and mitosis.
4. Pathogens
   a) What are pathogens?
   b) Give two examples of pathogenic viruses and two examples of pathogenic bacteria.
5. Bacterial Resistance
   a) What is bacterial resistance and why is it such a serious problem?
   b) Explain how bacterial resistance develops.
   c) Explain why the misuse and overuse of antibiotics is increasing the development of bacterial resistance.
6. The Immune System
   a) Describe the general function of the immune system.
   b) What are the three lines of defense?
   c) Compare and contrast specific and non-specific immunity, and give an example of each.
   d) What is the role of inflammation in the immune response?
   e) Which parts of the circulatory system are responsible for providing immune protection?
   f) Describe how antibodies and phagocytic cells (eg. macrophages) provide immune protection.
   g) What is vaccination and why is it beneficial?

Extra Practice Questions:

1. Label the diagrams of the viruses and bacteria below.
2. What is the capsid of the virus and the cell wall of the bacteria made from?
3. Archaea cells look similar to bacterial cells, but are very different biochemically. What is the cell wall of an Archaea cell made of?





SBI 3UI Exam Review #6: Diversity of Living Things

1. Terms: taxonomy, taxa, tissues, vascular system and all terms related to the questions below.
2. Domains
   a) Name the three domains.
   b) Which domains are also kingdoms (for now)?
3. Kingdoms
   a) Which kingdom has the greatest diversity and will likely be sub-divided in the future?
   b) Bacteria can be aerobic or anaerobic. What does this mean?
   c) Some Archaea can live in extreme conditions. Give examples of three different types of extremophiles.
   d) Which two kingdoms include organisms that can reproduce sexually using spores?
   e) For each of the six kingdoms, know whether the organisms in this kingdom are:
      - prokaryotic or eukaryotic
      - single-celled, multi-cellular or some of each
      - aerobic, anaerobic or some of each
      - autotrophic or heterotrophic
      - capable of asexual, sexual reproduction or some of each
      - have any other distinctive characteristics that can be used to identify them (eg. the presence of a cell wall, the composition of the cell wall)
4. Taxonomy
   a) What is the purpose of taxonomy?
   b) What are the 8 main taxa (in order)?
   c) Which of the taxa is the most general (broad)? Which is the most specific (narrow)?
   d) Be able to correctly write the scientific name for an organism from its taxonomic information.
   e) What criteria can be used to determine if two organisms belong to the same species?
5. Dichotomous Keys
   a) Give an example of the type of question that should be used to make a dichotomous key.
   b) Be able to use a simple dichotomous key (either in chart form or written form) to identify an organism.
   c) Draw a dichotomous key that could be used to distinguish between Archaea, bacteria, animal-like protists, plant-like protists and yeasts
   d) Draw a dichotomous key that could be used to distinguish between a cell from a bacteria, an algae, an animal cell and a mould cell.

Extra Practice Questions:

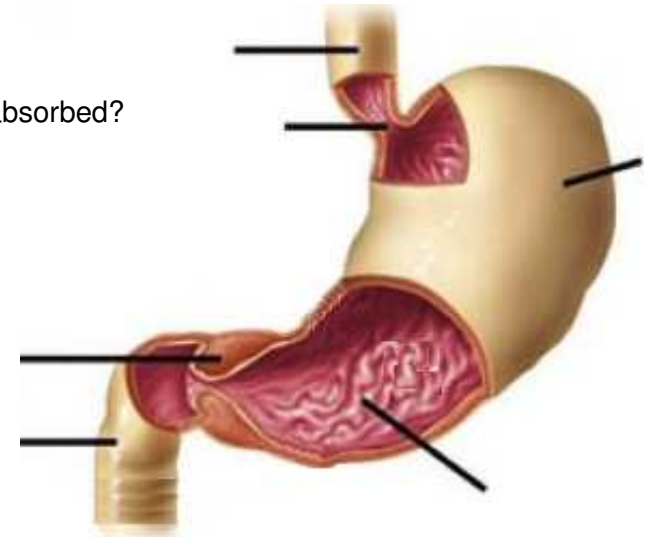
1. Using the taxonomic information in the chart, answer the questions below:

Plantae	Plantae	Plantae	Plantae
Angiosperms	Angiosperms	Pinophyta	Pinophyta
Eudicots	Eudicots	Pinopsida	Pinopsida
Caryophyllales	Caryophyllales	Pinales	Pinales
Cactaceae	Cactaceae	Cupressaceae	Pinaceae
Schlumbergera	Carnegiea	Sequoia	Pseudotsuga
S. kautskyi	C. gigantea	S. sempervirens	P. menziesii

a) To which kingdom do these organisms belong?
b) Give three ways in which these organisms are all very similar.
c) How many Classes are represented by the organisms? _____ How many Families? _____
d) Which two organisms are the most closely related?
e) Write the complete, proper name for the organism in the right hand column

SBI 3UI Exam Review #7: The Digestive System

1. Terms: chyme, sphincter, peristalsis, rugae, villi and microvilli, hydrolysis reactions and all terms related to the questions below.
2. Digestion
   a) What is digestion?
   b) Fungi, such as moulds, carry out external digestion. What does this mean?
   c) Which is the only kingdom to have organisms with a digestive system?
   d) Be able to label a diagram of the human digestive system.
   e) Know the functions of each part of the digestive system.
   f) Know three functions for both the pancreas and liver (accessory organs).
   g) Explain the difference between mechanical and chemical digestion. Give two examples of each.
3. Nutrients
   a) List the 6 types of nutrients.
   b) What are the three macronutrients?
   c) What are the two micronutrients? Give two examples of each.
   d) Fiber is considered to be an 'essential non-nutrient'? What are three benefits of fiber?
4. Carbohydrates
   a) What are the products of carbohydrate digestion?
   b) What are the main functions of carbohydrates?
   c) Where does carbohydrate digestion begin?
   d) What is the name of the enzymes that digest starch?
5. Fats (triglycerides)
   a) What are the products of triglyceride digestion?
   b) What are the main functions of fats in the body?
   c) Where does the majority of triglyceride digestion take place?
   d) What is the name of the enzymes that digest fats?
6. Proteins
   a) What are the products of protein digestion?
   b) What are the main functions of proteins in the body?
   c) Where does protein digestion begin?
   d) What is the general name of enzymes that digest proteins? What are the names of two specific enzymes that digest proteins?
7. Secretions
   a) What are two roles of bile in the digestion of fats? Where is it produced, where is it stored and where does it act?
   b) What are two roles of saliva in digestion? Where is it produced and where does it act?
   c) What are two roles of mucous in digestion? Where does it act?
8. Absorption and Elimination
   a) Compare and contrast digestion and absorption
   b) What is the major site of absorption of nutrients?
   c) Where is the majority of water reabsorbed?
   d) What happens to materials that can't be digested and absorbed?
9. Diseases and Disorders of the Human Digestive System
   a) What is heartburn and what causes it?
   b) What are ulcers and what causes them?
   c) Which organ and hormone are involved in diabetes?



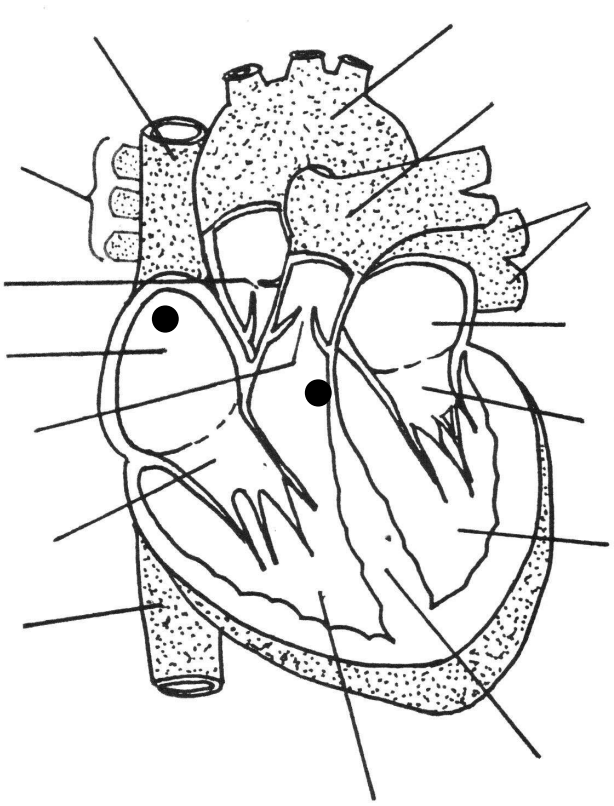
Extra Practice Questions:

1. Label the diagram of the upper part of the digestive system.

a) What is the name of a protease found in the stomach?
b) What is the name of the sphincter which controls the movement of chyme into the duodenum?
c) Which two accessory organs secrete substances into the duodenum?
d) How is the surface of the duodenum ideally suited to its function?

SBI 3UI Exam Review #8: The Cardiovascular System

1. Terms: systole, diastole, vascular tissue, platelets and all terms related to the questions below
2. Circulatory System
   a) Which two kingdoms include organisms that have vascular systems?
   b) What are three functions of the human circulatory system?
   c) What are the names of the two circulatory systems that run simultaneously in humans?
   d) What are the three parts of the human circulatory system?
   e) Be able to label a diagram of the human circulatory system.
3. Blood
   a) What is the liquid part of the blood called?
   b) Name three proteins found in the plasma and describe the function of each.
   c) Name three components of the formed (solid) portion of the blood. What is the main function of each?
4. Blood Vessels
   a) Name the five types of blood vessels found in the human body.
   b) Name the four "great vessels" that bring blood to, and from, the heart. For each vessel, identify whether it carries oxygenated or deoxygenated blood.
   c) Compare and contrast arteries and veins.
   d) Describe the structure of capillaries and explain how this structure is ideally suited to their function.
5. The Heart
   a) Be able to label a diagram of the human heart, including all chambers and four valves.
   b) Follow the general path of blood to, through and from, the heart for one full cardiac cycle.
   c) What is the main pacemaker of the heart?
6. Blood Pressure
   a) What is 'normal' blood pressure?
   b) What does systolic pressure measure?
   c) What does diastolic blood pressure measure?
7. Diseases and Disorders
   a) What is anemia and why is it harmful?
   b) What is hypertension and why is it harmful?
   c) What is atherosclerosis and why is it harmful?
   d) Describe what happens when someone has a heart attack.
   e) Describe what happens when someone has a stroke.



Extra Practice Questions:

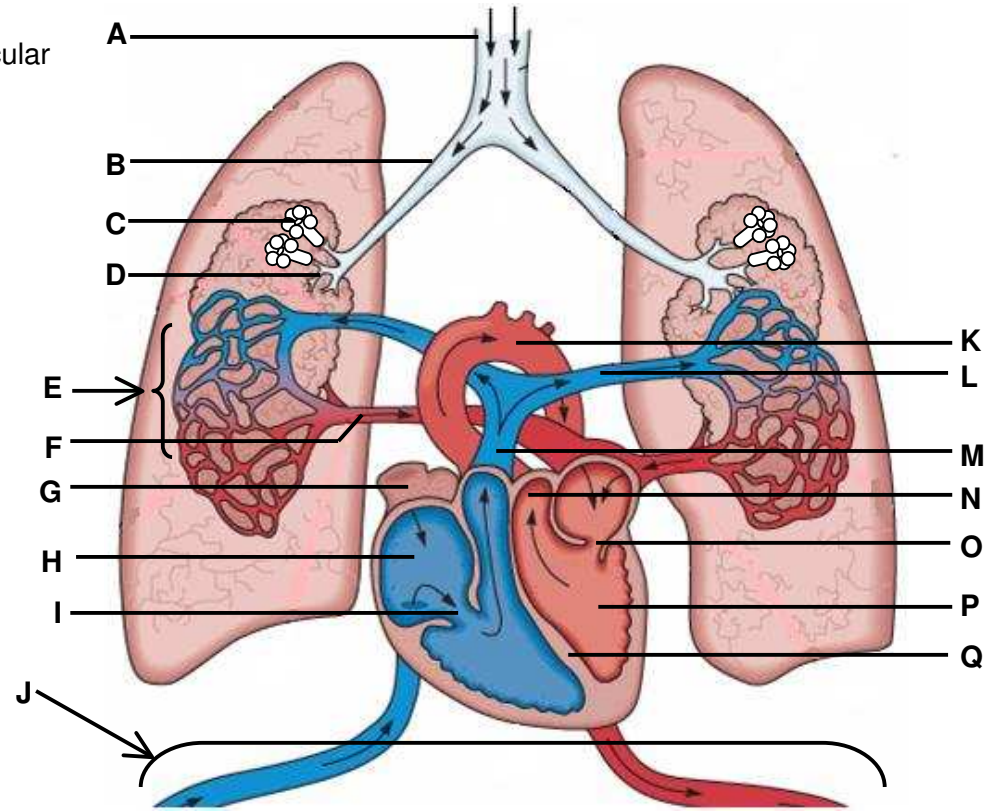
1. Label as many structures as possible in the diagram of the heart.
2. The two black circles represent the nodes which initiate and control heart beats. Which one is the primary pacemaker?
3. Identify and label the four principal valves that control blood flow through and out of the heart.
4. Describe the flow of blood through the heart for one heart beat.
5. Which artery contains deoxygenated blood? Which vein contains oxygenated blood?

SBI 3UI Exam Review #9: The Respiratory System

1. Terms: all terms related to the questions below.
2. Respiratory System
   a) Which kingdom includes organisms that have a respiratory system?
   b) What is the main function of the human respiratory system?
   c) Be able to label a diagram of the human respiratory system.
   d) Describe the path of air during one complete breath.
   e) What happens to the air as it passes through the nasal cavity?
   f) What is the function of the epiglottis?
3. Breathing
   a) Which two sets of muscles are involved in breathing?
   b) Describe what happens during inhalation, paying particular attention to the movement of the diaphragm and inter-costal muscles. Is this passive or active?
   c) Describe what happens during exhalation, paying particular attention to the movement of the diaphragm and inter-costal muscles. Is this passive or active?
4. Gas Exchange
   a) Clearly distinguish between breathing and gas exchange.
   b) Where does gas exchange take place in the lungs? Describe the steps in this process.
   c) Where does gas exchange take place in the tissues? Describe the steps in this process.
   d) How is the majority of oxygen carried in the blood?
   e) How is the majority of carbon dioxide carried in the blood? What is the name of the enzyme which is involved in this process?
5. Cellular Respiration
   a) What is the purpose of cellular respiration?
   b) Write the overall chemical reaction for cellular respiration.
   c) Based on the overall reaction, is cellular respiration anabolic or catabolic?
   d) Where in the cell do the main steps of cellular respiration take place?
6. Diseases and Disorders
   a) What is asthma and why is it harmful?
   b) What is chronic bronchitis and why is it harmful?
   c) Describe what happens when a person has carbon monoxide poisoning.

Extra Practice Questions:
Label the diagram of the cardiovascular and respiratory systems:

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____



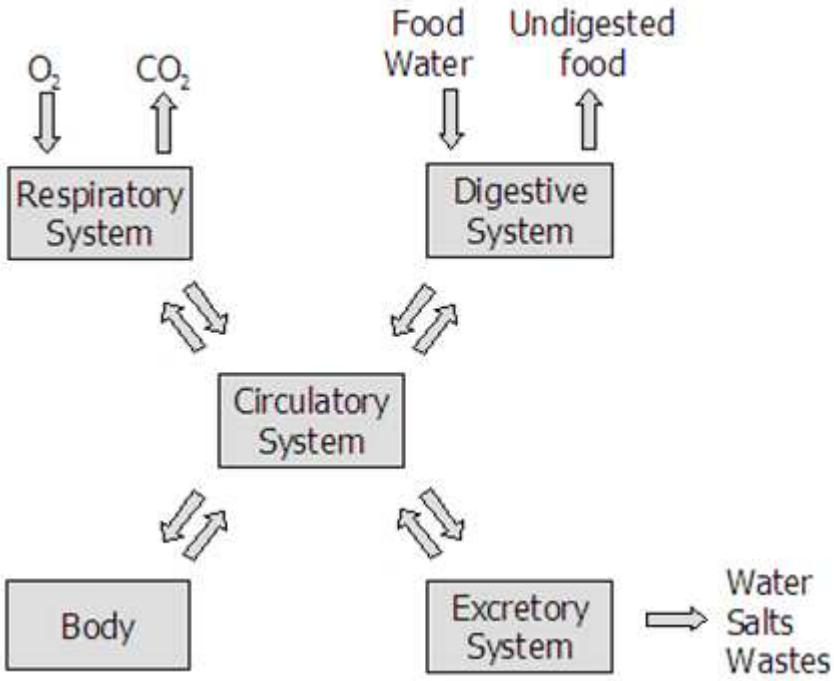
SBI 3UI Exam Review #10: Overall Course Summary and Questions

All cells (living things) require:

1. **nutrients** which are atoms and molecules consumed or absorbed from the environment
2. **energy** which is obtained by a series of chemical reactions, including cellular respiration converts the energy in glucose to the usable energy as ATP:

$$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O + \text{energy (ATP)}$$

Cells can be prokaryotic or eukaryotic. Organisms can be single-celled or multi-cellular. In single-celled organisms (Archaea, bacteria, protists and yeast), each cell operates independently and exchanges nutrients and wastes directly with its environment. In multi-cellular organisms, their large size and complexity requires that various systems work together to provide each and every cell with nutrients and energy and remove wastes.



Ultimately, the control of all body processes is determined by the amount and activity of enzymes and other proteins. The genetic instructions to make these proteins are passed from generation to generation when cells reproduce. To ensure that enzymes and other proteins maintain their correct 3-D shape to function properly, the temperature, pH and concentration of ions in the body are tightly regulated and controlled.

Questions:

1. Name and describe the role of ONE enzyme from EACH of the digestive system, the cardiovascular system, protein synthesis and DNA replication.
2. Cells must exchange substances with their environment. Explain how a large surface area is important in the exchange of material in cells, the respiratory system, the digestive system and the cardiovascular system.
3. While organisms from a species are very similar, individuals within a population may have slightly different genes. Explain the advantage of genetic diversity and several ways that diversity is introduced.
4. A central theme in biology is that the structure of an organism or its parts is directly related to how it functions. Explain how the structure of each of the following is ideally suited to its function:
   a) DNA
   b) capillaries
   c) the small intestine
   d) phospholipid bilayer of cell membranes
   e) alveoli
5. Cystic fibrosis and hemophilia are genetic disorders.
   a) How is each inherited? (autosomal dominant, autosomal recessive, X-linked etc)
   b) What is the function of the protein that is mutated?
   c) Which system(s) of the body are affected by the mutated protein and what symptoms does it cause?