**Biology 1 MCAS Model Midterm Study Guide (2017 revision)**

♣ The biology midterm exam counts as 20% of your 2nd quarter grade.

♣ The exam will consist of **60 multiple choice questions** and:

 ***4*** ***open response questions for Honors students,***

***3 for CP1 students,***

***and 2 for CP2 students.***

♣ You will have 90 minutes to complete the exam.

♣ Bring several pencils to the exam.

To prepare for the midterm exam, review the material in small amounts over several days.

Spend more time working on topics that you know the least, and less time on the topics

that you are more comfortable with. This exam covers 6 main topics: The Science of

Biology, The Chemistry of Life, Cell Structure and Function, Photosynthesis and Cellular

Respiration, The Cell Cycle and Cell Division, and Genetics.

Do NOT cram for the midterm. This is an ineffective way to study. Before the test be sure

to get a good night sleep and eat a good breakfast. Your brain works best when rested and

fully fueled. Finally, on the midterm exam, if you do not know the answer to a question, it is

to your advantage to take your best guess. Do not leave questions blank.

**The Science of Biology**

**The Scientific Method: How scientist study biology**

1. Observations and testable hypotheses.

2. Controlled experiments to collect data.

3. Analysis of the data collected to formulate a conclusion.

4. If a hypothesis is consistently supported, it may become a theory.

**Characteristics of Living Things**

1. Cellular Organization, Growth, Reproduction, Evolve Over Time (Adaptability),

Metabolism, Response to Stimuli (Irritability)

2. The ability to do all of these things in an effort to maintain homeostasis

***Study Practice:***

*1. List and define the steps of the scientific method.*

*2. Explain the difference between a control and a variable.*

*3. What are the characteristics of living things?*

**The Chemistry of Life**

**Molecular Structure**

1. Atoms are the basic unit of matter. They are made up of protons (+), neutrons (0), and

electrons (-).

2. Protons and neutrons are located in the nucleus of the atom, and electrons are located

in orbitals outside of the nucleus.

3. Elements are substances made up entirely of one type of atom.

4. Compounds are substances made up of more than one type of atom in a definite

proportion.

5. The most common elements found in living things are Carbon, Hydrogen, Nitrogen,

Oxygen, Phosphorus, and Sulfur. They are known as CHNOPS.

**pH**

1. The pH scale is numbered from 1 to 14. It measures the concentration of hydrogen ions (H+) in a solution.

2. Acids are substances with a pH of 6 or less. Bases are substances with a pH of 8 or more.

3. Substances with a pH of 7 are considered neutral.

4. Both strong acids and strong bases can be harmful.

**Organic Molecules**

1. Molecules that are based on carbon skeletons are called organic molecules. These

molecules consist of monomers which are used to build larger polymers.

2. There are 4 main types of organic molecules that make up living things:

a. Carbohydrates (sugars and starches) are the primary source of energy for living

things.

b. Proteins (muscles, fibers, antibodies, hemoglobin, and enzymes) have 7 different classes of function, such as building muscles, bones, hair, and nails, and regulating cellular metabolism.

c. Lipids (fats, oils, and waxes) are used for long-term energy storage and to

provide waterproof coverings. Phospholipids are special lipids that build cell membranes.

d. Nucleic Acids (DNA and RNA) contain and transmit genetic information.

3. An enzyme is a type of protein that acts as a catalyst in biological reactions. They speed

up reactions by lowering the activation energy of the reaction, helping to convert the

reactants into the necessary products.

***Study Practice:***

*1. What is the difference between organic and inorganic molecules?*

*2. What is CHNOPS and what does each letter stand for?*

*3. Fill out the following chart:*

|  |  |  |  |
| --- | --- | --- | --- |
| *Polymer* | *Monomer* | *Function (give one example)* | *Give one example of this type of organic compound* |
| *Carbohydrates* |  |  |  |
| *Lipids* |  |  |  |
| *Proteins* |  |  |  |
| *Nucleic acids* |  |  |  |

*4. What are enzymes and how do they work as catalysts in living things?*

*5. What is an enzyme-substrate complex?*

*6. What might be the pH of a very strong acid? What about the pH of a very strong base?*

**Cell Structure and Function**

**Cell Theory**

1. All living things are made of cells.

2. Cells are the basic units of structure and function.

3. All cells come from existing cells.

**Types of Cells**

1. Prokaryotic cells do not have a nucleus and are generally simple (ex: bacteria).

2. Eukaryotic cells do have a nucleus and are larger and more complex (ex: animals,

plants, fungi, and protists)

3. All types of cells contain cell membranes, cytoplasm, DNA, and ribosomes.

4. Cell walls are found in all prokaryotic cells and many eukaryotic cells. [Animal cells do not have cell walls.]

**Cell Organelles**

1. There are many structures within cells that work together to maintain homeostasis.

2. They include (but are not limited to): mitochondria, chloroplasts, lysosomes, rough and

smooth endoplasmic reticulum, ribosomes, Golgi apparatus, cytoskeleton, and vacuoles.

3. Plant and Animal cells are both eukaryotic and contain many of the same organelle;

however they have some distinct differences. Plant cells have chloroplasts, a cell wall,

and one large vacuole, while animal cells have centrioles, cilia, flagella, and multiple

smaller vacuoles.

**The Cell Membrane and Cellular Transport**

1. Cell membranes are composed of a phospholipid bilayer, which allows some particles to

move through it in several different ways. It is semi-permeable.

2. Diffusion is the movement of particles from an area of high concentration to an area of

low concentration.

3. Osmosis is the movement of water from an area of high concentration to an area of low

concentration.

4. Facilitated Diffusion is the movement of larger particles from an area of high

concentration to an area of low concentration, through a protein channel.

5. Active Transport is the movement of particles from an area of low concentration

to an area of high concentration, against the concentration gradient. *This process requires energy.*

6. A solution that has a higher solute concentration is called hypertonic.

7. A solution that has a lower solute concentration is called hypotonic.

8. If the concentration of solutes is equal, the solutions are said to be isotonic. They have

achieved dynamic equilibrium.

***Study Practice:***

*1. Compare and contrast a prokaryotic cell with a eukaryotic cell. Give an example of each.*

*2. Compare and contrast a plant cell with an animal cell.*

*3. Give the function and location of the following organelles:*

*a. Cell Membrane*

*b. Cell Wall*

*c. Nucleus*

*d. Ribosome*

*e. Mitochondria*

*f. Chloroplast*

*g. Vacuole*

*h. Cytoplasm*

*i. Lysosome*

*j. Centrioles*

*k. Cilia*

*l. Flagella*

*m. Cytoskeleton (microtubules and microfilaments)*

*n. Golgi Apparatus*

*o. Smooth endoplasmic reticulum*

*p. Rough endoplasmic reticulum*

*q. Nucleolus*

*r. Chromatin/ Chromosomes*

*5. What is the structure of a cell membrane? (Draw a picture and label the parts.)*

*6. What does it mean to say that a cell membrane is ‘selectively or semi- permeable’?*

*7. What is diffusion?*

*8. What is osmosis?*

*9. Explain the relationship between the following terms: hypertonic, hypotonic, isotonic,*

*and equilibrium.*

*10. What is Facilitated Diffusion?*

*11. What is Active Transport?*

**Photosynthesis and Cellular Respiration**

**Photosynthesis**

1. Almost all the energy contained in living things comes from the sun.

2. ATP (adenosine triphosphate) is the primary energy molecule in cellular reactions.

3. Photosynthesis has 2 steps:

a. Light dependent reactions: used chlorophyll to capture light energy, converts

H2O to O2, makes ATP, and charges the high energy electron carrier NADPH.

These reactions take place in the thylakoids of the chloroplast.

b. The Calvin Cycle (light independent reactions): the energy stored in ATP and

NADPH, as well as molecules of CO2, are used to form glucose molecules. These

reactions take place in the stroma of the chloroplast.

4. The equation for photosynthesis is: 6CO2 + 6H2O ---------sunlight---→ C6H12O6 + 6 O2.

**Cellular Respiration**

1. Glucose is broken down, in the presence of oxygen, to release energy (ATP).

2. Cellular Respiration has 3 steps:

a. Glycolysis: glucose is broken down into 2 three-carbon molecules (pyruvates)

and 2 ATP are released. These reactions take place in the cytoplasm.

b. The Krebs Cycle: the pyruvates from glycolysis are broken down to produce CO2

and the high energy electron carriers NADH and FADH2, and 2 ATP are

produced. These reactions take place in the inner membrane of the

mitochondria.

c. The Electron Transport Chain: NADH and FADH2 are used to facilitate the

production of ATP. 32 ATP are produced at this stage, which also occurs in the

mitochondria.

3. ***A total of 36 ATP are produced from every 1 molecule of glucose broken down***.

4. The reaction for Cellular Respiration is: C6H12O6 + 6 O2 → 6CO2 + 6H2O + ATP.

5. Fermentation is the creation of 2 ATP from glucose in the absence of oxygen. There are two kinds: alcoholic fermentation and lactic acid fermentation.

***Study Practice:***

*1. How is sunlight energy converted into useable energy by plants?*

*2. What types of cells/organisms perform photosynthesis?*

*3. What types of cells/organisms perform cellular respiration?*

*4. How are the equations for photosynthesis and cellular respiration related to each*

*other?*

**The Cell Cycle and Cell Division**

**The Cell Cycle**

1. There Cell Cycle is split up into phases: Interphase that includes G1 (growth), S (synthesis of DNA/ copying of chromosomes into sister chromatids), G2 (growth and preparation for division), and the M phase (cell division) that includes mitosis and cytokinesis.

2. Interphase is the longest part of the Cell Cycle.

3. Cancer is a malfunction of the Cell Cycle’s regulatory processes.

**Mitosis**

1. Mitosis also has four stages: prophase, metaphase, anaphase, and telophase.

2. In prophase, chromosomes condense and organize, the nuclear membrane dissolves, centrioles (in animal cells) move to the poles, and spindle fibers begin to appear.

3. In metaphase, the chromosomes (now sister chromatids) line up along the center of the cell and attach to the spindle fibers.

4. In anaphase, the centromere of each chromosome splits apart, moving toward the poles

of the cell, and pulling the sister chromatids away from each other.

5. In telophase, the chromosomes uncoil, two new nuclear membranes appear, new nucleoli are formed, the spindle dissolves, and two identical nuclei are formed.

**Cytokinesis**

1. Cytokinesis is the dividing of the cell membrane, cell wall, cytoplasm, and other

organelles.

a. In plant cells, a cell plate is formed and this eventually develops into a cell wall that separates the 2 daughter cells.

b. In animal cells, the cell membrane pinches in, forming a cleavage furrow, which

eventually connects and separates the 2 daughter cells.

**Meiosis**

1. Meiosis is the formation of gametes (sex cells- egg cells and sperm cells).

2. Gametes are haploid (1N) cells, meaning they only contain one set of chromosomes. Somatic cells (body cells) are diploid (2N), meaning that they contain two sets of chromosomes.

3. There are 2 divisions in meiosis: meiosis I and meiosis II.

 a. Meiosis I divides the homologous chromosomes (tetrads).

 b. Meiosis II divides sister chromatids. [similar to mitosis]

4. In prophase I of meiosis I, homologous chromosomes form a tetrad, during which

crossing-over can occur.

***Study Practice:***

*1. Draw and label a diagram of the Cell Cycle.*

*2. Draw and define the phases of mitosis.*

*prophase metaphase anaphase telophase*

*3. Explain the difference between haploid and diploid.*

*4. How do homologous chromosomes and tetrads relate to crossing-over?*

*5. How is cytokinesis different in plant cells compared to in animal cells?*

*6. Compare and contrast Mitosis with Meiosis. Give at least 3 differences.*

**Genetics**

**Mendel’s Principles/ Laws**

1. Mendel introduced the Principle of Dominance based on his study of inheritance in pea

plants.

2. Genes are the DNA sequences that determine traits and alleles are the different forms of

a gene.

3. Genotype is the genetic make-up of an individual and phenotype is the physical

appearance of an individual.

4. Homozygous (true-breeding or pure) means that both alleles are the same, and heterozygous (hybrid) means that the alleles are different.

5. Mendel proposed 2 other laws:

a. The Law of Segregation of Alleles: describes the interaction between alleles of a

single gene. This includes several types of interactions, including; complete

dominance, incomplete dominance, codominance, sex-linkage, multiple alleles, and polygenic traits. These are demonstrated using single-trait crosses (Punnett Squares).

b. The Law of Independent Assortment: states that the alleles for one trait or gene

do not affect the inheritance of alleles for another trait. This is demonstrated using

multiple-trait crosses (such as dihybrid crosses).

**Punnett Squares**

1. Punnett squares are used to predict the possible genotypes and phenotypes of offspring of a genetic cross.

2. They show the probability of an outcome, not the actual result.

3. Probability is the chance of achieving a particular outcome. It may be shown as a fraction or a percentage. Ratios are also used to tell the probability of one event happening as compared to another event happening.

***Study Practice:***

*1. What is inheritance?*

*2. How are dominant and recessive alleles related?*

*3. What is the difference between a homozygous dominant genotype and a heterozygous*

*genotype?*

*4. How is a genotype related to a phenotype?*

*5. Complete the following Punnett Squares:*

*BB x Bb Ff x ff Rr x Rr*

*6. Complete the following Dihybrid Cross:*

 *HhKk x HhKk*

*7. Give the phenotype ratio and genotype ratio of Mendel’s F2 generation of pea plants’ height trait.*