Unit 6- Anatomy Unit

1. Define homeostasis and give an example.
   Homeostasis is the ability of the body to maintain relatively constant internal physical and chemical conditions despite changes in the external environment. An example of homeostasis is the maintenance of our body temperature and pH levels.

2. How does the body use a negative feedback loop to maintain homeostasis? Draw an example of a negative feedback loop and explain it.
   The body uses a negative feedback loop to maintain a balance. For example, when it gets cold, our skin has receptors that send the signal to our brain to warm up. The brain sends a signal to our muscles to start shivering to produce heat. When we get to warm, our body sweats to release the excess temperature. Bringing us back to the stable 98.5 F mark.

Macromolecules

3. Fill in the following table about the 3 types of macromolecules.

<table>
<thead>
<tr>
<th>Macromolecule</th>
<th>Function</th>
<th>Where in Body?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipids</td>
<td>Long term energy storage, protection</td>
<td>Cholesterol, hormones, wax, cell membranes, storage under the skin and around organs.</td>
</tr>
</tbody>
</table>
| Proteins      | Structural: Provide support (hair and nails, ligaments, tendons and skin) and movement (muscles)  
                Metabolic: Enzymes, communication, protection | Hair and nails, ligaments, tendons and skin, muscles, enzymes, antibodies, hormones, cell membranes. |
| Carbohydrates | Short term energy and structure. | Glucose for cellular respiration and stored in the liver |
4. What is the function of an enzyme?
   An enzyme acts as a catalyst to increase the speed of chemical reactions.

5. What does a catalyst (enzymes) do to activation energy? Draw a graph.
   An enzyme reduces the activation energy needed to start a chemical reaction so you get more net usable energy.

6. How can enzymes be denatured?
   An enzyme can be denatured by heat, a change in pH, or other inhibitors.

7. What is the definition of a substrate? How do enzymes interact with substrate?
   A substrate is the substance that an enzyme works on. The substrate binds to the active site on the enzyme causing the substrate to break apart or to create bonds to form a new substance.

8. Do enzymes have different substrates? Explain.
   No, enzymes only work on one substrate. They are reusable and do not get changed during the chemical reaction. This allows them to break apart many of the same substrates over time.

Digestive System

9. What is the function of the digestive system?
   The function of the digestive system is to break down food into the three usable macromolecules: carbohydrates, lipids, and proteins. The digestive system then absorbs the macromolecules to be used in the body.

10. Label the organs (mouth, esophagus, stomach, small and large intestines, pancreas, liver, gallbladder, rectum) on the following diagram and give a brief explanation of what each organ does.

   Functions:
   - **Mouth:** mechanical breakdown of food with the teeth and tongue. Chemical breakdown of carbohydrates with saliva.
   - **Esophagus:** tube that carries food from the mouth to the stomach.
   - **Stomach:** mechanical breakdown of food with churning, chemical breakdown of food with stomach acid and enzymes to start protein digestion.
   - **Small Intestine:** chemical breakdown of lipids using bile and absorption of the nutrients.
   - **Liver:** bile production and glucose storage
   - **Gallbladder:** storage for bile
   - **Pancreas:** produces enzymes to break down the macromolecules in the small intestine and sodium bicarbonate to neutralize stomach acid.
   - **Large Intestine:** absorption of water and concentration of waste materials.
   - **Anus:** opening in the digestive tract to release waste material.

11. Compare and contrast mechanical and chemical digestion. Where does each take place?
   Mechanical digestion is the physical breakdown of food using the motion of the organs. It occurs primarily in the mouth and stomach.
Chemical digestion is the breakdown of food into their similar macromolecules through enzymes. It occurs primarily in the mouth, stomach and small intestines.

**Circulatory System**

12. What is the function of the circulatory system?  
   To transport essential nutrients and gases throughout the body.

13. Label the parts of the heart (right and left atria, right and left ventricles, superior and inferior vena cava, aorta, pulmonary arteries, pulmonary veins, semi lunar valves, tricuspid valve, mitral valve) on the diagram on the left.

   Pulmonary valve and aortic valve are also called semi lunar valves.

14. Trace the path of blood through the heart starting in the right atria.
   
   Right Atria $\rightarrow$ **Tricuspid** valve $\rightarrow$ **Right Ventricle** $\rightarrow$ Pulmonary Valve $\rightarrow$ **Pulmonary Artery** $\rightarrow$ Lungs $\rightarrow$ **Pulmonary Vein** $\rightarrow$ Left Atria $\rightarrow$ **Mitral** valve $\rightarrow$ **Left Ventricle** $\rightarrow$ **Aortic** valve $\rightarrow$ **Aorta** $\rightarrow$ Body $\rightarrow$ **Vena Cava** $\rightarrow$ Right Atria

**Respiratory System**

15. What is the function of the respiratory system?  
   The function of the respiratory system is to provide the body with oxygen and to get rid of waste carbon dioxide.

16. Label the parts of the respiratory system (Nose, Pharynx, Epiglottis, Larynx, Trachea, Bronchioles, Alveoli, Diaphragm) on the diagram below and give a brief explanation of what each part does.
Unit 7-Molecular Genetics

1. DNA Structure and Replication
   a. What is DNA?
      Deoxyribose nucleic acid- it carries genetic material from one generation to the next in all living things
   b. Label the DNA molecule with the following: sugar, phosphate, nucleotide, hydrogen bond, covalent bond. (Use the diagram in your notes to help you!)
   c. Write the bases for the complementary DNA strand: ATTATACGA
      TAATATGCT

2. Compare RNA and DNA.
<table>
<thead>
<tr>
<th></th>
<th>DNA</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar type</td>
<td>Deoxyribose</td>
<td>Ribose</td>
</tr>
<tr>
<td>Number of strands</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Purpose</td>
<td>Carries genetic code</td>
<td>Provides the direction for making proteins</td>
</tr>
</tbody>
</table>

3. Protein Synthesis:
   a. Describe transcription and translation (where they are located, which types of RNA are involved, and what happens).
      i. Transcription- Transcription takes place in the nucleus where mRNA copies DNA by using complementary base pairing
      ii. Translation- Translation takes place in the ribosomes, which attaches to mRNA and travels its length. tRNA brings the amino acids that are specified by the codon on the mRNA strand.
b. Distinguish between codons and anti-codons.

A codon is found on mRNA and is a group of 3 bases. These code for the specific amino acids that will be delivered. Anti-codons are found on tRNA and are complementary to the codons on the mRNA strand.

c. List the amino acids for the following DNA strand: ATCGGCATG

Hint: you will need to determine the mRNA bases and use a codon chart

mRNA- AUGCGGUAC amino acids: Methionine-Proline-Tyrosine

d. What are the anti-codons for this DNA strand: ATCGGCATG

Hint: on which RNA are anti-codons found?

mRNA- AUGCGGUAC tRNA- UACGGCAUG

e. Put the following steps of protein synthesis in order:

1. DNA uncoils and unzips
2. RNA bases pair up with DNA bases forming mRNA
3. tRNA adds amino acids using the mRNA as a template
4. A protein is made

Unit 8-Mendelian Genetics

Genetics and Heredity

1. How are phenotype and genotype different?

_**Phenotype are the physical traits you see, while genotype is what is in the genes.**_

2. Compare heterozygous and homozygous.

_**Heterozygous in when two alleles for a trait are different and homozygous is when two alleles for a trait are homozygous.**_

3. Explain the different patterns of heredity and give an example:

   a. Completely dominant: _One allele is completely expressed over another allele._ (brown eyes are dominant over blue eyes)
   b. Incomplete dominance: _Phenotype is a blend (red + white flower = pink flower)_
   c. Codominance: _Both alleles are clearly expressed (i.e.: red and white cattle)_
   d. Sex-linked: _The gene is carried on a sex chromosome (color-blindness)_

4. If a trait is sex-linked, is it more common in males or females? Why?

_Sex-linked traits are more common in males because they only have one X and 1 Y. Consequently, there is not another allele to be dominant._

Punnett Squares

1. For the following monohybrid cross, Green is dominant. A heterozygous green pea is crossed to yellow pea. What are the possible phenotypes and genotypes of the offspring?

   a. Parent 1 genotype: _Gg_
   b. Parent 2 genotype: _gg_
   c. Offspring genotypes: _Gg- ½, gg- ½_
   d. Offspring phenotypes: _Green- ½, Yellow- ½_
   e. What is the likelihood of having a fully homozygous offspring? _½_
5. Colorblindness is inherited as a sex-linked recessive disease. An affected male marries a heterozygous female. Draw a Punnett square of the possible offspring.
   a. Mother genotype: Xx
   b. Father genotype: xY
   c. Offspring genotypes: Xx, xx, XY, xY
   d. Offspring phenotypes: Carrier female, affected female, normal male, affected male
   e. What is the chance that they will have an affected child? 
   f. Could any of their daughters be affected? Yes, if it is a girl, there is a $\frac{1}{2}$ probability that girl will be affected

\[
\begin{array}{ccc}
X & x \\
\text{x} & \text{Xx} & \text{xx} \\
\text{Y} & \text{XY} & \text{xY}
\end{array}
\]

6. Dihybrid- A black, smooth guinea pig was mated with an albino, rough guinea pig. Their offspring were black, rough and black, smooth. These were the only offspring types produced over a period of several years after multiple matings. Black color and rough fur are the dominant traits for guinea pigs. What was the probable genotype of each parent? (hint: do the Punnett square to check)
   a. Parent 1 genotype: BBrr
   b. Parent 2 genotype: bbRr
   c. Offspring genotypes: BbRr-$\frac{1}{2}$, Bbrr-$\frac{1}{2}$

\[
\begin{array}{cccc}
\text{Br} & \text{Br} & \text{Br} & \text{Br} \\
\text{bR} & \text{BbRr} & \text{BbRr} & \text{BbRr} & \text{BbRr} \\
\text{br} & \text{Bbrr} & \text{Bbrr} & \text{Bbrr} & \text{Bbrr} \\
\text{bR} & \text{BbRr} & \text{BbRr} & \text{BbRr} & \text{BbRr} \\
\text{br} & \text{Bbrr} & \text{Bbrr} & \text{Bbrr} & \text{Bbrr}
\end{array}
\]

Genetic Diseases
Match the genetic disease on the top with the effect on the body below. Each genetic disease/disorder may be used twice.

A. Sickle-Cell Disease          D. Cystic Fibrosis
B. Tay-Sachs Disease          E. Phenylketonuria (PKU)
C. Huntington’s Disease        F. Down Syndrome
G. Turner Syndrome
H. Klinefelter Syndrome

1. D This is a defective gene on chromosome 7 that causes a salt channel to be incorrectly formed leading to thick, sticky mucus increasing the chances of infection by bacteria.
2. B This is a mutation on chromosome 15 that causes nerve cells to deteriorate and eventually die due to a lack in the enzyme Hex-A.
3. A This is a mutation on chromosome 11 that causes the red blood cells to become crescent shaped.
4. **E** Individuals with this disease start to show symptoms early in life and have a difficult time absorbing the amino acid phenylalanine. However, the disease can be treated through dietary changes.

**Unit 9-Evolution Review**

1. **Age of the Earth**
   a. Describe the theory of plate tectonics
      
      *The surface of Earth is made of several large continental plates that move over the Earth’s molten mantle. This movement causes continental drift, earthquakes, volcanoes, the creation of new ocean floor, and the recycling of older crust.*
   b. How many mass extinctions have there been in Earth’s history?
      
      *There have been 5 mass extinctions in Earth’s history.*
   c. What causes the biodiversity of life to increase over time after a mass extinction?
      
      *The species that survive a mass extinction have traits that allow them to adapt to the new environment and they will eventually change over time to create new species.*

2. **Theory of Evolution**
   a. Define evolution.
      
      *A change in a species over time.*
   b. Define natural selection.
      
      *The process by which organisms with variations most suited to their environment survive and leave more offspring.*
   c. Explain the 4 requirements for natural selection.
      
      i. *The struggle for existence* - more individuals are produced than can survive and must compete
      ii. *Variation* - individuals vary, and some are better suited to life in an environment than others.
      iii. *Adaptation* - Any heritable characteristic that increases an organism’s ability to survive and reproduce in its environment. May be physical, physiological, or behavioral.
      iv. *Survival of the fittest* - the individuals in a population that have the traits best suited to their environment will survive to reproduce and pass along the traits.
   d. Explain and give an example of how natural selection occurs in nature.
      
      *Examples will vary* - A forest has a species of butterfly that comes in two variations - red and brown. A new predator begins to live in the forest and eat the butterflies. The red ones are easier to stop, so they are eaten more often. Over time, the population changes and there are only brown individuals in future populations.
   e. Why is variation important to natural selection?
      
      *Natural selection acts on the different traits of a population. Without variation there would be nothing to select for.*

3. **How Evolution Happens**
   a. Explain the different types of isolation and how they affect evolution:
      
      - **Geographic Isolation**
        
        *A species is separated by a geologic feature. The species evolves separate, since it is no longer able to breed.*
      - **Temporal Isolation**
        
        *Two species breed during different times of the year. Consequently, they will not share genetics and will become more and more different.*
      - **Behavioral Isolation**
        
        *Different behaviors are used to attract mates. As a result, the two populations will not share genetics, allowing them to evolve along different paths.*
- **Reproductive Isolation**
  *There are biological factors that prevent members of two species from producing viable offspring.*

- **Mechanical Isolation**
  *The individuals from different species are not physically able to mate. There is no sharing of traits.*

b. Explain the different type of natural selection

<table>
<thead>
<tr>
<th></th>
<th>What does it favor?</th>
<th>Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilizing</td>
<td>Individuals near the center of the cure</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>Disruptive</td>
<td>Individuals on either end of the curve</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>Directional</td>
<td>Individuals on one end of the curve or the other</td>
<td><img src="image" alt="Graph" /></td>
</tr>
</tbody>
</table>

4. **Evidence for Evolution**

   a. Explain and give an example of homologous structures.
   *Similar structures that share a similar origin, but may not share a similar function*  
   *Example: arm and hand bones in humans, cats, whales, and bats*  

   b. Explain and give an example of vestigial structures.
   *Structure present by in reduced size. They have no use or a less important function. Example: Femurs in pythons.*  

   c. What is suggested by the fact that bats and humans have similar bone structure?  
   *They share a common ancestor.*  

   d. If you looked at the DNA of organisms with similar bone structures, would you expect it to be exactly the same, similar, or different?  
   *You would expect their DNA to be similar.*