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**LIFE SCIENCE**  
**BIOLOGY**

**Next Generation Learning Standards**

The workbook correlates with the NYS Life Science: Biology NGLS curriculum.

- 5 major sections each containing: An *Overview*, in-depth explanation of the *Topic*, *Vocabulary Worksheet*, detailed *Diagram* section, two sets of *Practice Questions*.
- 14 Additional Groups of Cluster Questions

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# LIFE SCIENCE

# BIOLOGY

## Workbook

### **The Overview and Essential Information:**

The Overview will introduce you to the unit of study and provide you with a synopsis of the topic. In the Essential Information section, comprehensive coverage of the required concepts is provided. We recommend that you read this section carefully, noting the italicized vocabulary words. If you diligently apply yourself and work through this section, your grade will improve, and we hope you will have a better foundation and appreciation of the natural science of Biology.

### **Diagrams:**

These visual aids, along with the captions, will enhance your understanding of specific concepts. They will reinforce your understanding of the material covered in the Essential Information section. First, study the diagrams, noting all the details, then read over the caption.

### **Vocabulary:**

We suggest reading the definitions, then matching them with the correct word or phrase. Once you have completed this section, take time to memorize it. Look for help with the vocabulary by revisiting the Essential Information area.

### **Set 1: Questions and Answers**

These questions will test your understanding of the topic. Do all questions in Set 1. Correct your work by going to the Answers for Set 1, which are located at the end of the topic section. The explanations will help you to understand any mistakes you have made.

### **Set 2: Questions**

Correctly answering these questions will verify that you have mastered the subject topic. The answers to these questions are in a separate answer key.

### **Clusters Questions:**

These questions are designed to assess your understanding of a key topic or theme. Each cluster section includes a series of multiple-choice and open-ended questions that might involve interpreting a reading passage, a diagram, or a graph. To be successful with these questions, you must apply the biology concepts you have learned while engaging your critical thinking skills. The answers to these question are in a separate answer key.

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# LIFE SCIENCE

# BIOLOGY

## Workbook

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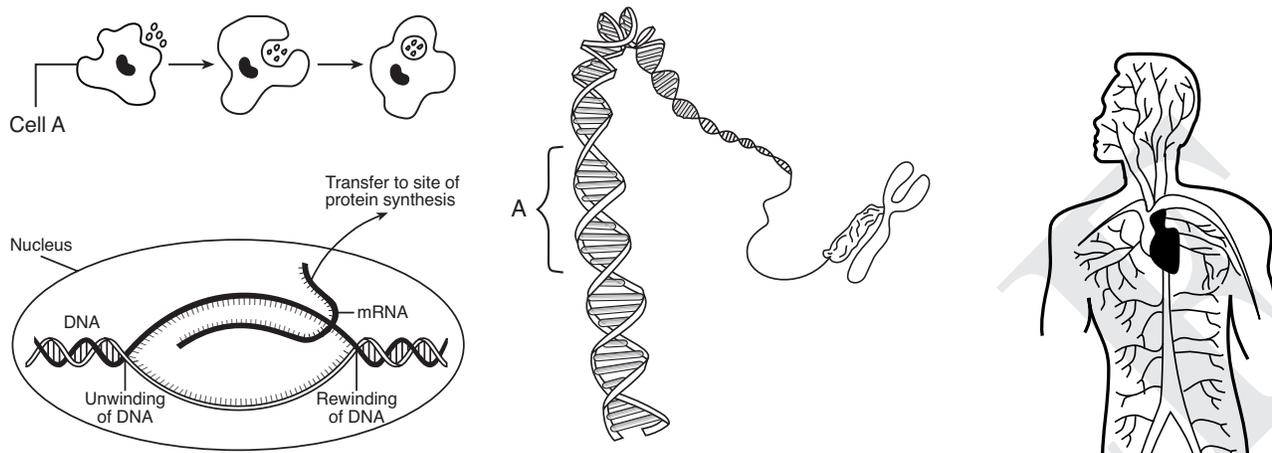
### **About This Workbook:**

The primary goal of this workbook is to provide students with the necessary information, strategies, vocabulary, and practice test questions to meet the specific performance expectations of Life Science-Biology. This workbook is not a stand-alone textbook; rather it is a means to supplement classroom learning experiences that challenge and prepare students to be critical thinkers. This workbook covers five main topics that are relevant in today's world, and the acquired knowledge that the students gain should be transferable to many situations or life events. As authors, we hope the students will embrace the rigor of this subject and see the value of what they learn. It is our hope that this workbook can be a valuable part of this preparation.

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# STRUCTURE AND FUNCTION



## Overview:

In living organisms, structure (the shape of molecules) determines function. Instructions that are embedded in the genetic molecules, DNA and RNA, determine the structure of proteins, which are used in cells, tissues and systems. Some protein molecules will function as physical structures within the organism, some will be used to facilitate chemical reactions and some will be used to regulate body system function. In multicellular organisms, such as humans, the organization of cells into complex structures allows for the maintenance of *homeostasis*—a self-regulating process to maintain the organism’s internal conditions. This concept results in a dynamic equilibrium of body functions that is maintained by constant feedback and adjustments within the organism. Organisms require systems (e.g., digestion, nervous etc.) that coordinate actions and interact with one another. Each system has structures that have a specific function or functions. When homeostasis is disrupted by failure or malfunction within the structure, the organism may experience illness or disease which could lead to death. Research and new medical technologies and treatments are continually being developed to help people cope with disease or illness, while maintaining homeostasis.

## Essential Information:

**DNA's Role** – Living organisms have a set of genetic instructions that determine the characteristics of their structures and functions. In all living organisms, cells store coded genetic information in the form of *DNA*. DNA is composed of *nucleotides*, which consist of sugar, phosphate, and *molecular bases* that form genetic sequences. These *molecular bases* are represented by letters that are the beginning of their molecular names: A = Adenine, T = Thymine, C = Cytosine, G = Guanine. Molecular bases form complimentary pairs: A with T and C with G. These bases form sequences within DNA called genes, which code for specific proteins that have a specific structure and function that determine an organism’s traits or characteristics. Genetic material is organized in the cell for efficient replication practices as well as protein synthesis. DNA is coiled and packed into structures known as chromosomes. *Chromosomes* are located within a nucleus or genetic area within a cell. DNA serves to store the codes for the production of proteins, which are vital to the proper functioning of cells and all living things. Within the cell, *protein synthesis* occurs when coded genetic information is copied and transferred from DNA in the nucleus to *ribosomes* – cellular structures that facilitate protein synthesis.

### ***Genetic Organization Relationship:***

Cell → Nucleus → Chromosome → DNA → Gene → Molecular Bases (A,T,C,G)

**RNA's Role** – The copy and transfer of genetic information involves a second nucleic acid, RNA. *RNA* is single stranded and uses a molecular base represented by U (uracil) instead of T, making the complimentary pairs: A with U and C with G. In the ribosome, *amino acids* are assembled into chains forming a protein molecule. The sequence of the amino acids is determined by the sequence of molecular bases on the copied RNA strand. A sequence of three bases on RNA, known as a *codon*, codes for a particular amino acid. A universal chart allows geneticists and researchers to convert RNA code into an amino acid. Remember, the original code for every protein begins with DNA and each protein has a specific shape that determines its function, all based on the sequence of those amino acids.

**Cellular Transport Processes/Membrane Transport** – In order for basic life functions to occur, important processes and facilitator molecules are required. Movement across a membrane (membrane transport), can be classified into two categories: *Passive transport*, which requires no energy, and *active transport* that requires energy for the movement of molecules or materials. Passive transport can be further divided into the processes of diffusion and osmosis. *Diffusion* is the movement of small molecules like glucose, oxygen, carbon dioxide and electrolytes such as sodium from regions of high concentration to regions of lower concentration. *Osmosis* is the diffusion of water from an area of higher water content to a region of lower water content based on the concentration of the solution on both sides of the cell membrane. Both processes, requiring no energy, are important for the maintenance of homeostasis within a cell, as well as proper system function. Some molecules diffuse easily through a membrane; others do not. The size of a molecule will determine the rate of diffusion. Smaller molecules, like water, readily diffuse through a membrane, whereas larger molecules, like starch, will not diffuse and must be broken down to move across a membrane.

Active transport requires energy, namely *ATP*, for movement. It involves the movement of larger molecules or the movement of molecules from regions of low concentration to regions of higher concentration. Active transport can also involve a process where the cell membrane engulfs or surrounds molecules or materials to bring them into the cell. For example, white blood cells use active transport to engulf foreign proteins and pathogens to protect the body from disease and infection.

**Enzymes** – For organisms to synthesize or break down organic compounds, *enzymes* or biological catalysts are needed. Enzymes have a defined structure based on the sequence of amino acids used to construct them. This structure is important to their function of speeding up chemical reactions. Folds in the protein structure create specific locations known as the *active site* where *substrates*, substances that enzymes act on, can bind and enter into a reaction. Therefore, enzymes are said to be *substrate specific* because they bind to a particular substrate that fits into the active site like a puzzle piece. This enzyme substrate binding is described as a *lock and key model*.

It is important to understand that an enzyme's shape determines its function. Each enzyme will work to either synthesize substrates into a more complex compound or to break down a substrate into a simpler and usable form. Several factors can influence enzyme action. Each enzyme has an *optimum temperature* at which it functions. Enzyme action or rate of reaction will increase as temperature increases. When an enzyme reaches a temperature where its reaction rate has peaked, that is said to be its optimum.

(Enzyme continue)

At a certain point, temperatures become too high, and this causes the enzyme's shape or structure to distort. A change in the enzyme's structure usually will decrease the function of that enzyme or stop it altogether. Another factor that influences enzyme action is pH—the measure of acidity or alkalinity of an environment. Each enzyme has an *optimum pH* where it maximizes its function. As the pH value moves away from that optimum value, the function diminishes due to changes in the enzymes structure.

### ***Human Body Systems:***

**Organization** – The basic organization of function begins with the *cell*. Specific types of cells have special functions based on their genetic expression. When these cells are grouped together for a common purpose, they are called *tissues*. Organs contain tissues of varying functions that work towards a common goal. For example, the stomach has several types of tissues, all functioning to aid in digestion. When organs are arranged to interact together, they make up a *system*, such as the digestive or reproductive system. Each system within the human body plays a role that accomplishes a particular life function by coordinating specific actions within living organisms. Through cell communication and system interaction, homeostasis is maintained throughout the whole organism.

**Digestive System** – The *digestive system* breaks down nutrients into usable form for cells. Large organic compounds, such as carbohydrates and proteins, must be broken down into smaller building-block components like simple sugars and amino acids, respectively. Specific organs within this system, like the stomach, pancreas, and small intestine supply *enzymes* that aid in this digestion. The large intestine functions to absorb water and pass solid waste from the body. Proper diet helps to maintain digestive health and may help to avoid issues such as ulcers or colon cancers.

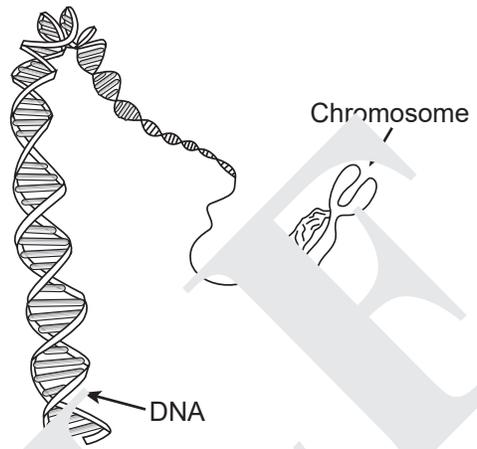
**Respiratory System** – The *respiratory system* functions to supply the cells with necessary O<sub>2</sub>, as well as to remove the waste product CO<sub>2</sub>. Specific organs and structures within this system provide necessary conditions for gas exchange. Air is moved in and out of the body through tubes, known as the trachea and bronchi, that lead to the lungs. Within the lungs, tiny air sacs, known as *alveoli*, allow for the diffusion of gases (O<sub>2</sub> and CO<sub>2</sub>) across their thin membranes. Alveoli are surrounded by tiny capillaries, which efficiently absorb O<sub>2</sub> for use and release CO<sub>2</sub> for removal. Respiratory pigments, such as *hemoglobin* found on red blood cells, allow gases to be carried to and from the cells. Some organisms, such as amphibians, are able to exchange respiratory gases across their thin skin membranes. Environmental air pollution as well as personal actions, can lead to diseases within the lungs. *Emphysema* can develop where lung function is diminished by the loss of ability to exchange gases. This disease is generally caused by cigarette smoking and long-term exposure to industrial pollutants. *Asthma* can develop through exposure to allergens or environmental factors, which cause bronchi to constrict, limiting airflow.

*Note:* The Reproductive System is covered in the Inheritance and Variation of Traits unit.

***This section continues covering Structure and Function of the Circulatory System, the Excretory Systems, the Regulatory System, the Endocrine System, the Immune System, and Plant systems.***

**Diagrams:**

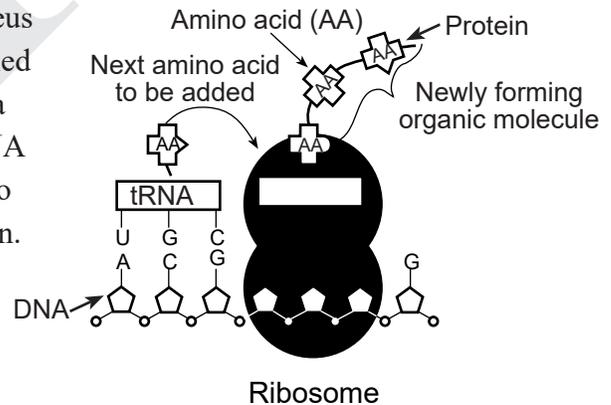
1. **Organization of Genetic Material** – This diagram shows the organization of genetic material found within a chromosome. This double helix of DNA is wound and tightly coiled within the structure of a chromosome. Chromosomes are found within a nucleus of a cell.



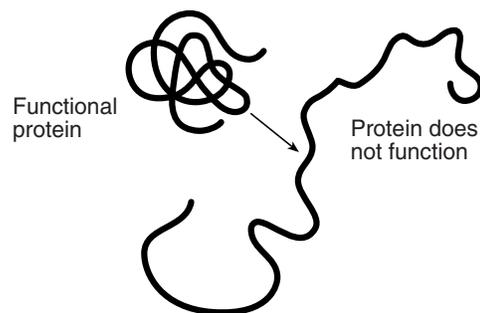
2. **DNA Double Helix Structure** – The DNA double helix structure acts to store genetic information and serves as a template for DNA replication. Shown are molecular base sequences, which are paired with complementary bases (A – T and C – G). Sequences of these molecular bases represent genes that can code for a particular protein and genetic trait.



3. **Protein Synthesis** – DNA which is found in the nucleus of the cell, stores genetic information that can be copied and transferred from the nucleus to the ribosomes of a cell. At the ribosome, the coded information from DNA will be used to align amino acids carried by tRNA into specific sequences that will be converted into a protein. This process is known as protein synthesis and takes place in most cells.



4. **Protein Shape Determines Function** – Proteins are synthesized based on the sequence of amino acids and bend and fold into specific shapes that carry out a particular function within organisms. If a protein becomes misshapen, it no longer is able to carry out its specific function.



*This Diagram section contains a total of 24 diagrams with captions covering Structure and Function content.*

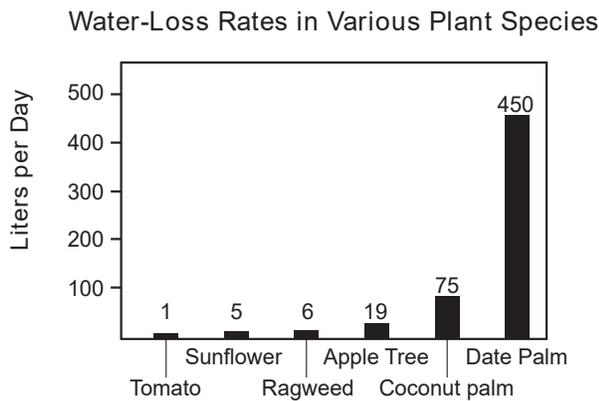
## Vocabulary Refresher

Directions - Match the correct definition for the following terms:

- |                              |   |
|------------------------------|---|
| 1. _____ Homeostasis         | A. An agent that causes a disease, including microorganisms such as bacteria or viruses.  |
| 2. _____ Dynamic equilibrium | B. Secreted in response to an antigen and attach to antigen or infected cell, marking them for destruction.                                 |
| 3. _____ Molecular bases     | C. Nitrogen-based molecules found in DNA and RNA that determine the genetic code.   |
| 4. _____ Protein synthesis   | D. An opening on underside of leaves, regulated by guard cells that allow for gas and water exchange.                                       |
| 5. _____ Diffusion           | E. Used to build immunity to a pathogen, contain weakened pathogens or mRNA.  |
| 6. _____ Enzyme              | F. A mechanism that allows for the regulation of hormone levels or body temperature by increasing or decreasing activity within the system. |
| 7. _____ Receptor protein    | G. Any one of several building blocks of proteins.  |
| 8. _____ Pathogen            | H. Organic molecules composed of amino acids that have specific functions based on an amino acid sequence.                                  |
| 9. _____ Antigen             | I. Maintaining a stable, internal environment.  |
| 10. _____ Antibodies         | J. A set of conditions that constantly change within an organism to maintain stable environments for that organism.                         |
| 11. _____ Stomate            | K. The process of linking amino acids together in the ribosome in a sequence, based on coded genetic information from DNA.                  |
| 12. _____ Vaccine            | L. The movement of small molecules from a region of high concentration to lower concentration with no additional energy.                    |
| 13. _____ Feedback           | M. Special proteins known as biological catalysts that speed up chemical reactions within living organisms.                                 |
| 14. _____ Amino acids        | N. A membrane protein that binds to specific molecules activating a reaction or process within the cell.                                    |
| 15. _____ Proteins           | O. Foreign protein, such as bacteria, virus or transplanted cells, that initiate the production of antibodies.                              |



7. The graph below shows the daily rates of water loss in various plant species.



Source: Adapted from AP Biology Grid

Even though these plants grow in different environments, they most likely control water loss through

- (1) the synthesis of proteins in their roots
  - (2) the functioning of the cell membranes in their flowers
  - (3) the actions of the guard cells in their leaves
  - (4) the storage of glucose in the vacuoles in their stems
- 7 \_\_\_\_\_

8. After ingesting Vitamin D, the body converts it into a hormone that is transported throughout the body. This hormone affects cells in the intestines and bones. The reason that this hormone affects only certain cells in the body is because these cells have

- (1) specific receptors
  - (2) antibodies
  - (3) specific organelles
  - (4) genes
- 8 \_\_\_\_\_

9. Difficulties often occur when tissues or organs are transplanted from one person to another because the

- (1) transplanted structures cannot produce new cells
  - (2) rate of mitosis differs between the two people involved
  - (3) introduction of a foreign substance causes the formation of antibodies
  - (4) two people often have the same blood type
- 9 \_\_\_\_\_

10. In humans, digestion depends on a variety of organs, such as the stomach, small intestine, and liver. The interactions of these organs provide evidence that

- (1) each organ in the human body plays a role in only one life function
  - (2) organs in humans work together, resulting in the survival of the individual
  - (3) the most important life function in humans is the breaking down of food
  - (4) each life function is carried out by at least four different systems in humans
- 10 \_\_\_\_\_

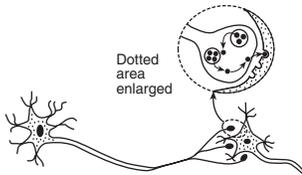
11. Snake venom is modified saliva containing enzymes and other proteins that break down tissue surrounding the bite and destroy blood cells. If bitten, the damage caused by this type of venom would most likely be slowed by

- (1) applying ice to the area where the patient was bitten
  - (2) having the patient drink a large amount of water
  - (3) forcing the patient to vomit, in order to remove the venom
  - (4) increasing the rate of blood flow by having the patient exercise
- 11 \_\_\_\_\_

***Set 1 contains a total of 41 questions.***

1. In humans, lactose is broken down into glucose and galactose in the presence of a particular enzyme. It is most likely that the enzyme that breaks down lactose
- (1) breaks down several other types of food in the stomach
  - (2) is involved in other reactions when the temperature and pH are ideal
  - (3) helps in the synthesis of complex sugars during autotrophic nutrition
  - (4) is not involved in other types of reactions because enzymes are specific
- 1 \_\_\_\_\_

2. A process that occurs in the human body is represented in the diagram below.



Which statement is most closely associated with the diagram?

- (1) Small molecules are obtained from large molecules during digestion.
  - (2) Certain molecules are replicated by means of a template.
  - (3) Receptor molecules play an important role in communication between cells.
  - (4) Energy from nutrients is utilized for waste disposal.
- 2 \_\_\_\_\_
3. Different techniques are used to study cells. Fluorescent (glowing) tags allow scientists to visualize specific proteins as they are synthesized inside cells. Which part of a cell would be studied when using this technology to visualize protein synthesis?
- (1) nucleus
  - (2) ribosome
  - (3) cell wall
  - (4) cell membrane
- 3 \_\_\_\_\_

4. Contractile vacuoles maintain water balance by pumping excess water out of some single-celled pond organisms. In humans, the kidney is chiefly involved in maintaining water balance. These facts best illustrate that
- (1) tissues, organs, and organ systems work together to maintain homeostasis in all living things
  - (2) interference with nerve signals disrupts cellular communication and homeostasis within organisms
  - (3) a disruption in a body system may disrupt the homeostasis of a single-celled organism
  - (4) structures found in single-celled organisms can act in a manner similar to tissues and organs in multicellular organisms
- 4 \_\_\_\_\_

5. The protein in a hamburger is broken down into amino acids. Which two processes are involved in the breakdown of the protein and the absorption of the amino acids into the bloodstream?
- (1) synthesis and mitosis
  - (2) digestion and diffusion
  - (3) mitosis and digestion
  - (4) active transport and replication
- 5 \_\_\_\_\_
6. Two primary chemical messengers used in communication within the human body include
- (1) antibodies and pathogens
  - (2) organic catalysts and toxins
  - (3) enzymes and antigens produced by body cells
  - (4) hormones and chemicals produced by nerve cells
- 6 \_\_\_\_\_

7. Which row in the chart below best describes the active transport of molecule *X* through a cell membrane?

Row	Movement of Molecule X	ATP
(1)	high concentration → low concentration	used
(2)	high concentration → low concentration	not used
(3)	low concentration → high concentration	used
(4)	low concentration → high concentration	not used

7 \_\_\_\_\_

8. If body temperature is too high, some blood vessels increase in size and sweat glands will excrete sweat, resulting in a lower body temperature. These changes are an example of

- (1) a learned behavior
- (2) feedback mechanisms
- (3) an inherited disorder
- (4) genetic mutations

8 \_\_\_\_\_

9. One primary function of the cell membrane is

- (1) regulating the flow of simple sugars into or out of the cell
- (2) synthesizing substances by breaking down cell organelles
- (3) storing carbohydrates, water, and starches for future use
- (4) digesting carbohydrates, fats, and protein

9 \_\_\_\_\_

10. Which process must first take place in order for the proteins in foods to be used by body cells?

- (1) digestion
- (2) storage
- (3) synthesis
- (4) excretion

10 \_\_\_\_\_

11. The major role of carbohydrates in the human diet is to

- (1) form the membranes that surround mitochondria
- (2) act as a catalyst for cellular reactions
- (3) supply energy for the body
- (4) provide building blocks for amino acids

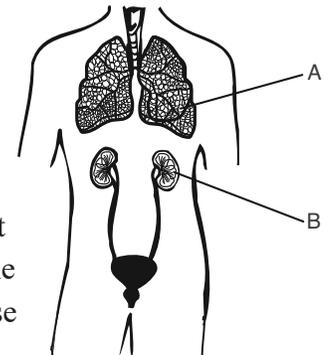
11 \_\_\_\_\_

12. The respiratory system includes a layer of cells in the air passages that clean the air before it gets to the lungs. This layer of cells is best classified as

- (1) a tissue
- (2) an organ
- (3) an organelle
- (4) an organ system

12 \_\_\_\_\_

13. Some organs of the human body are represented in the diagram below.



Which statement best describes the functions of these organs?

- (1) *B* pumps blood to *A* for gas exchange.
- (2) *A* and *B* both produce carbon dioxide, which provides nutrients for other body parts.
- (3) *A* releases antibodies in response to an infection in *B*.
- (4) The removal of wastes from both *A* and *B* involves the use of energy.

13 \_\_\_\_\_

***Set 2 contains a total of 44 questions.***

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# Structure and Function

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## Set 1 – Answers

- 4 The circulatory system consists of the heart and vessels that deliver blood carrying nutrients and gases directly to the cells. Materials diffuse from the vessels into the cells indirectly through intracellular fluid.
- 3 The bioengineered vessels covered with the recipient's cells will not be recognized as containing foreign proteins; therefore, no immune response will occur. Remember that an immune response is triggered by foreign proteins associated with pathogens or allergens.
- 1 Blood enzymes would be affected by a change in pH. Enzymes have specific ranges of pH in which they function. Outside of that range, their shape may become altered and they lose function within the circulatory system.
- 1 Chemical messengers known as neurotransmitters travel through synapses between nerve cells. These messengers have specific shapes that bind to receptors on the targeted cell to elicit a response. Generally, this response generates an impulse that travels from nerve cell to nerve cell.
- 4 A human feedback mechanism occurs when a stimulus (change) from outside or inside the body causes a response. When the stimulus stops, the response by the body will also stop. In this case the stress of testing, stimulates the internal reaction of increased rates of breathing, heart rate and sweat production. When the test is complete, these increased reactions will diminish and the body will return to normal rates.
- 4 Protein synthesis begins with DNA code, located in the nucleus, that is transcribed into mRNA containing genetic codons. mRNA moves to the ribosome where its codon sequences direct the assembly of amino acids into proteins.
- 3 Plant leaves have small openings known as stomates, usually on their undersides that control the loss of water from a plant. Surrounding these stomate openings are guard cells that function to open and close the stomates, thus regulating water loss. The action of guard cells may vary depending on the climate of each environment.
- 1 Hormones are chemical messengers that have specific shapes. As hormones move through the circulatory system, they encounter target cells with receptors on their cell membrane. The hormone will fit and bind to the cell receptor to initiate a response. In this case, the hormone's shape fits into bone and intestine cell receptors.
- 3 Transplanted tissues and organs contain foreign proteins that can initiate an immune response. During an immune response, antibodies are produced which mark foreign proteins for destruction. To promote successful transplants, patients usually take medications that reduce the immune response so that organs or tissues are not attacked.

10. 2 Organisms have systems, such as the digestive system, that rely in the action of organs. Each organ performs a specific function that plays a role in that system. In digestion, organs help to break down food into useable nutrient forms. Organisms then use these nutrients to carry out life functions for survival.
11. 1 Enzymes usually function within warm temperature ranges, having an optimum temperature within that range. When temperatures are reduced, the enzyme may not function efficiently. By applying ice to a snake bite, the cold temperature may prevent the enzymes in the venom from breaking down tissues.
12. 2 One of the ways cells maintain homeostasis is to eliminate harmful waste products. In the diagram, the waste product *B*, produced through processes in the mitochondria, is moved through the cell membrane to the external environment.
13. 2 The digestive process relies on enzymes to break down organic molecules into smaller nutrient forms. Specific enzymes break down specific molecules. The inability to breakdown cellulose occurs because humans do not have a cellulose digesting enzyme.
14. 2 DNA's double strand is composed of matching pairs of molecular bases. These bases are paired, C with G, and T with A. The amounts of each base pair will be equal. So, if C is 18%, then G will be 18%. Together they make up 36% of the DNA in this case. That leaves 64% left to be divided between T and A, meaning each will make up 32% of the DNA.
15. 3 Dynamic equilibrium is a state of balance within an organism. Organism responds to changes both internally and externally so that life functions can operate normally and maintain homeostasis.
16. 1 A successful vaccine will contain pieces of genetic material or proteins from a pathogen like a virus which when introduced into the human body will initiate an immune response. This immune response will involve the production of antibodies, that mark foreign proteins for destruction. The production of these antibodies provides future defense against that particular pathogen.
17. 4 Organs within the digestive system each have a specific function and specific chemical environments. Enzymes have specific pH ranges in which they function efficiently based on their particularly shaped active site. Enzymes in the stomach function best in a very acidic environment. Those same enzymes will not function as well in a less acidic intestinal environment, which may alter their shape rendering them ineffective at binding with a substrate.
18. 2 This example of a feedback mechanism occurs when a stimulus, the perception of a threat, causes a response within the body. The pituitary gland initiates the release of a stress hormone from the adrenal gland. This stress hormone prepares the body for the need to escape or fight as well as incurring an injury. When the threat is removed, the pituitary stops producing the hormone that stimulates the adrenal gland and the body returns to normal stay.

***All Set 1 questions have answers and explanations.***

## GROUP 8

Base your answers to questions 1 through 3 on the information and data tables below and on your knowledge of biology. Use one or more complete sentences to answer each question.

Drinking alcohol during pregnancy can cause the class of birth defect known as fetal alcohol syndrome (FAS). Scientists do not yet understand the process by which alcohol causes damage to the fetus. There is evidence, however, that the more a pregnant woman drinks, the greater the chances that the child will be affected and the birth defects will be serious. Some evidence indicates that even low levels of alcohol consumption can cause intellectual and behavioral problems.

**Infant Characteristics**

Characteristics (Average)	Alcohol Use During Pregnancy	
	Drinker	Nondrinker
Weeks of development before birth	36.9	38.7
Birth weight (g)	3,275	3,594
Birth length (cm)	48.5	50.0
Head circumference (cm)	34.5	35.5

**Physical Abnormalities Detected in Infants at Birth**

Physical Abnormalities	Alcohol Use During Pregnancy	
	Drinker (Percentage of 80 Infants)	Nondrinker (Percentage of 80 Infants)
Low birth weight	73	12
Small brain	33	0
Flattened nasal bridge	8	0
Abnormal facial features	15	0
Spina bifida	8	0
Heart defects	8	0

- Do the data in the tables justify scientists' conclusions that alcohol causes physical abnormalities at birth by interfering with the normal development of the fetus? Defend your position with supporting data.

Circle one: Yes *or* No

Support your answer: \_\_\_\_\_  
 \_\_\_\_\_

- What additional data would be needed to better support the scientists' conclusions?

\_\_\_\_\_  
 \_\_\_\_\_

3. Explain why alcohol consumption by the mother is especially harmful during the early stages of pregnancy.

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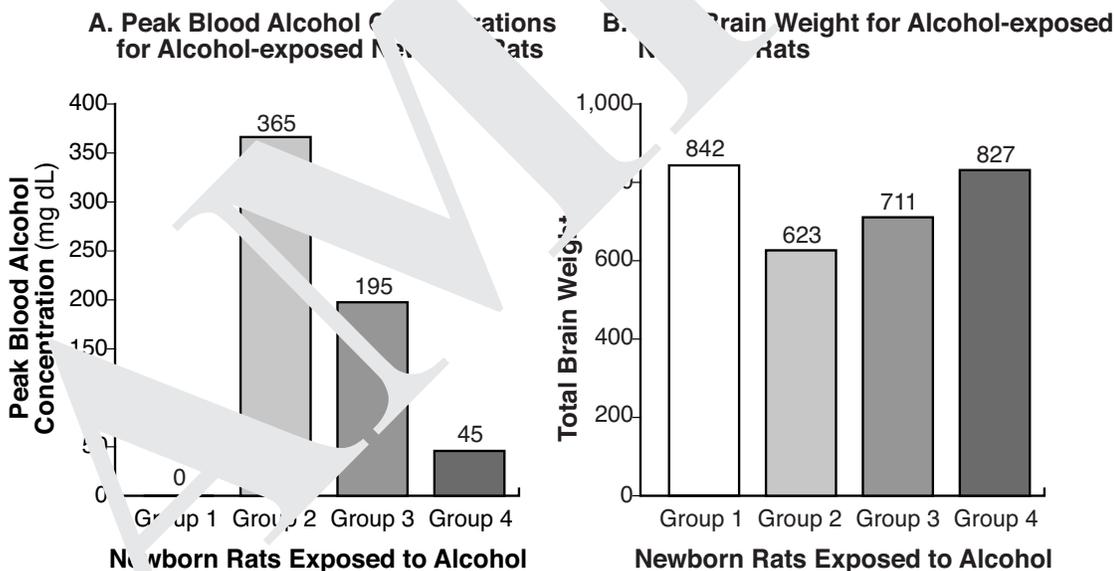
Base your answers to questions 4 and 5 on the information below and on your knowledge of biology.

Scientists are interested in studying the effects of a mother’s alcohol consumption on the brain development of the fetus during pregnancy. In order to collect data, scientists typically use newborn rats because the rats’ brain development after birth is roughly equivalent to that of a human fetus during the third trimester (late in pregnancy). Scientists divided newborn rats into four groups and exposed them to alcohol using the following methods:

**Alcohol Exposure in Newborn Rats**

Rat Group	Alcohol Exposure
1	No alcohol exposure
2	4.5g/kg/day given over a 4-hour period
3	4.5g/kg/day given over an 8-hour period
4	6.6g/kg/day given over a 24-hour period

At the end of the experiment, scientists measured the total brain weight of the newborn rats, as represented in the graphs below.



4. State the relationship between peak blood alcohol concentration and total brain weight for alcohol-exposed newborn rats.

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5. Explain why scientists chose rats for their alcohol study.

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Base your answers to questions 6 through 9 on the information below and on your knowledge of biology.

Folic acid is a type of vitamin that is essential for the normal growth and development of cells in the body. If a woman consumes folic acid in her diet before and during the earliest stages of pregnancy, it can help to reduce her baby's risk for developing a type of birth defect called a neural tube defect. Early in pregnancy, the neural tube forms the brain and spinal cord. If the neural tube does not form properly, serious birth defects may result.

6. Which statement explains why taking folic acid early in pregnancy is important to the prevention of neural tube defect?

- (1) The intake of folic acid promotes the continued growth of the placenta for proper development.
- (2) Vitamins, like folic acid are essential for the development of gametes.
- (3) The intake of folic acid promotes proper neural development in early fetal stages.
- (4) Vitamins, like folic acid, are essential for the mother's nervous system function and are passed through genetic material to the fetus.

6 \_\_\_\_\_

7. Describe how a fetus receives folic acid and other essential materials directly from its mother for its development.

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8. Identify *one* factor, other than a lack of folic acid, that may interfere with the proper development of essential organs during pregnancy.

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9. Many foods, such as breads, cereals, pastas, and rice, are fortified or enriched with folic acid. Explain why adding folic acid to foods is an advantage to people other than pregnant women.

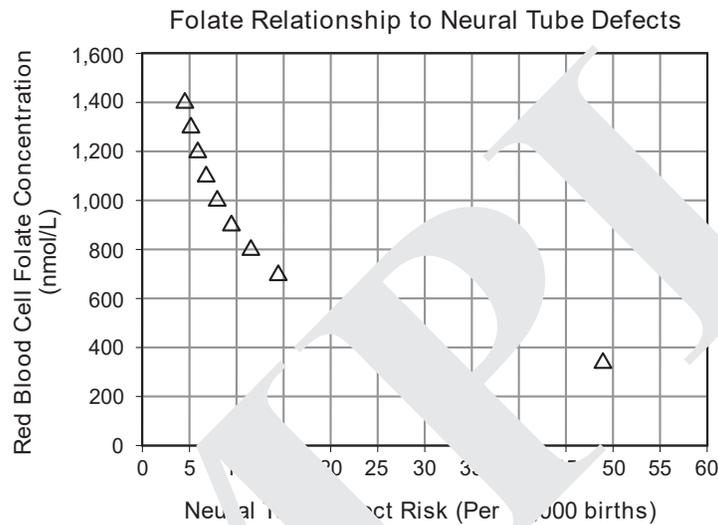
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Base your answers to questions 10 through 11 on the information below and on your knowledge of biology.

One important vitamin that pregnant women should consume is folic acid. Folic acid is converted to folate in the body. It is well known that women who have a diet rich in folic acid show a decreased risk of having babies with neural tube (central nervous system) defects.

Scientists conducted a study to determine the optimal amount of folic acid needed in the mother's diet to prevent neural tube defects. The results are shown in the graph below.



10. According to the graph, what is the minimum amount of folate needed to reduce the risk of neural tube defects to 10 or less per 10,000 births?

- (1) 800 nmol/L      (2) 890 nmol/L      (3) 1000 nmol/L      (4) 1400 nmol/L      10 \_\_\_\_\_

11. The table below shows some of the major milestones in fetal development.

Week	Milestones in Fetal Development
1	Embryonic development begins and continues to develop
3	Embryo has 3 distinct layers
4	Neural tube forms, limbs develop
5	Primitive lens, mouth and digits form
6	Primitive nose forms, neural tube closes, heartbeat can be detected
8	Internal organs can be distinguished
10	Lung buds appear

By what week should women have the optimal amount of folic acid in their diet?  
Support your answer.

***There are a total of 14 Biology Cluster Group questions.***