1. Which of the following connects the oxygen atom to the hydrogen atoms in a water molecule?
   A. ionic bond
   B. peptide bond
   C. covalent bond
   D. hydrogen bond
   E. phosphodiester bond

2. Which of the following are properties of the carboxyl functional group?
   A. polar and basic
   B. polar and acidic
   C. neutral and basic
   D. non-polar and basic
   E. non-polar and acidic

3. Which atoms tend to have high electronegativity?
   A. carbon
   B. nitrogen
   C. hydrogen
   D. potassium
   E. phosphorus

4. How many of the following substances have hydrogen bonding: DNA, cellulose, hemoglobin, and ATP?
   A. 0
   B. 1
   C. 2
   D. 3
   E. 4

5. Two water molecules are produced by the union of glucose molecules during dehydration synthesis. The new molecule that is formed is
   A. a dipeptide.
   B. a polypeptide.
   C. a disaccharide.
   D. a polysaccharide.
   E. a monosaccharide.

6. What determines the secondary level of protein structure?
   A. dehydration synthesis of amino acids
   B. hydrogen bonding between amino acids
   C. two or more polypeptides forming the molecule
   D. peptide bonding between two adjacent amino acids
   E. covalent bonding between the R-groups of amino acids

7. A chemical reaction occurs slowly at body temperature. When molecule X is added, the reaction speeds up. Which of the following is a monomer of molecule X?
   A. a fatty acid
   B. a nucleotide
   C. an amino acid
   D. a water molecule
   E. a glucose molecule

8. What is the difference between a molecular formula and a structural formula?


10. Create a table comparing carbohydrates, nucleic acids, proteins, and lipids according to the following categories: cellular structure, an example of a polymer, and an example of a monomer.
11. Complete the following table comparing the three types of carbohydrates.

<table>
<thead>
<tr>
<th>Monomer</th>
<th>Cellulose</th>
<th>Starch</th>
<th>Glycogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Cell or Animal Cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. Give the structure and functions of each of the different types of fats.

<table>
<thead>
<tr>
<th>Fat</th>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triglyceride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phospholipid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steroid Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsaturated Fatty Acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturated Fatty Acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wax</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. List the function of each of the following types of proteins. Give an example of each type.
   a. catalyst
   b. transport
   c. structural
   d. movement
   e. regulatory
   f. defense

14. Describe the term induced fit.

Self Study Guide

<table>
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<tr>
<th>Question</th>
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<td>SG-21</td>
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# Bringing It All Together

Complete the chart to compare the different biological molecules.

<table>
<thead>
<tr>
<th>Biological Molecule</th>
<th>Structure and Composition</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>cellulose</td>
<td></td>
<td>structural component of plant cell wall</td>
</tr>
<tr>
<td>starch</td>
<td>polysaccharide with few glucose side chains monomer: glucose (monosaccharide)</td>
<td></td>
</tr>
<tr>
<td>glycogen</td>
<td></td>
<td>energy storage in animals</td>
</tr>
<tr>
<td>triglyceride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phospholipid</td>
<td>glycerol molecule and two fatty acids polar, hydrophilic head nonpolar, hydrophobic tails</td>
<td></td>
</tr>
<tr>
<td>steroid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>saturated fatty acid</td>
<td>carbon chain with only single bonds and no double bonds</td>
<td></td>
</tr>
<tr>
<td>unsaturated fatty acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>protein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNA</td>
<td></td>
<td>carries the genetic information of the cell determines what proteins are made</td>
</tr>
<tr>
<td>RNA</td>
<td>single-stranded nucleic acid with ribose sugar, phosphate group, and nitrogenous base (uracil, cytosine, guanine, and adenine) monomer: nucleotide</td>
<td></td>
</tr>
<tr>
<td>ATP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
middle section of the Venn diagram should be labeled "Both Saturated and Unsaturated Fatty Acids" and contain the phrase: are in the form of a lipid.

2. A triglyceride is composed of a glycerol molecule and three fatty acid chains, while a phospholipid has a glycerol molecule, two fatty acid chains, and a phosphate group.

3. A phospholipid is the structural component of a cell membrane.

**Proteins (1.2), page SG-16**

1. An amino acid has a central carbon atom bonded to an amino group, a carboxyl group, a functional group and a hydrogen atom.

2. R-group or functional group

3. The primary structure of protein is represented by the amino acid sequence. The secondary structure of protein is local folding due to the interactions between the amino group of one amino acid and the carboxyl group of another amino acid. The tertiary structure is long range folding due to the interactions between the different R-groups. This gives the protein a three-dimensional shape. The quaternary structure consists of one or more polypeptide bonded together.

**Nucleic Acids (1.2), page SG-17**

1. DNA and RNA are both nucleic acids made up of nucleotides linked together. They both have a five-carbon sugar, a phosphate group, and a nitrogenous base. The nitrogen base that are similar in DNA and RNA are cytosine, adenine, and guanine.

2. RNA is single-stranded (DNA is double-stranded) and has uracil, instead of thymine.

3. Phosphodiester bond

**Biochemical Reactions (1.3), page SG-20**

1. Buffers are needed to prevent a change in pH. A change in pH can affect many enzymes and their functions.

2. A redox reaction is a combination of a reduction reaction (gain in electrons) and an oxidation reaction (loss of electrons).

3. 

**Enzymes Catalyze Biological Reactions (1.3), page SG-21**

1. A catalyst lowers the activation energy and speeds up a chemical reaction.

2. An enzyme has an active site where a substrate can bind. The binding of an enzyme to its specific substrate forms an enzyme-substrate complex.

3. When the enzyme binds to its substrate, the enzyme undergoes a conformational change, called the induced fit.

**Enzyme Activity Is Influenced by Surrounding Conditions (1.3), page SG-22**

1. Factors include temperature, pH, and concentration of enzymes and substrate.

2. A competitive inhibitor competes with the substrate for the enzyme's active site, while a non-competitive inhibitor binds to the enzyme at the allosteric site.

3. The enzyme will denature and lose its shape.

**Chapter 1 Practice Test, page SG-24**


8. A molecular formula shows the number of each type of atom in an element, while a structural formula shows how the different atoms of a molecule are bonded together.

9. Sugars are the monomers, and polysaccharides are the polymers. Amino acids are the monomers and polypeptides are the polymers.

Sugars: e.g., glucose, glycogen, starch
Polysaccharides: used for structural tissue such as cell wall, and for energy storage
Proteins: e.g., enzymes, e.g. amylase, hemoglobin
Nucleic acids: DNA and RNA
Lipids: e.g., phospholipids like phosphatidylcholine
Cell membranes: store, replicate, and pass genetic information, direct cell activities

Cells are composed of four main types of biological molecules.

10. Cellular Structure | Polymer | Monomer
---|---|---
Starch grains in a chloroplast | Starch | Monosaccharide
Chromosomes | DNA strand | Nucleotide
Intermediate filament | Polypeptide | Amino acid
Cell wall | Adipose cell with fat droplets | Triglyceride

11. | Cellulose | Starch | Glycogen
---|---|---|---
Monomer | glucose | glucose | glucose
Structure | no side chains | some side chains | many side chains
Plant Cell or Animal Cell | plant cell | plant cell | animal cell
Function | structural component of cell wall | energy storage in plants | energy storage in animals

12. | Fat | Structure | Function
---|---|---|---
Triglyceride | glycerol molecule + 3 fatty acids | long-term energy storage acts as cushion for organs and insulation
Phospholipid | glycerol + 2 fatty acids + phosphate group | structural component of cell membrane
Steroid Hormone | 4 fused rings | produces secondary sexual characteristics
Cholesterol | 4 fused rings | structural component of cell membrane
Unsaturated Fatty Acids | long chain of carbons with only single bonds | energy storage
Saturated Fatty Acids | long chain of carbons with some double bonds | energy storage
Wax | | prevents water loss in plants

13. a. Catalyst speeds up chemical reactions (for example, salivary amylase).

b. Transport proteins move specific substances (for example, hemoglobin).

c. Structural proteins provide support (for example, collagen).

d. Movement allows things to move (for example, actin).
ANSWERS

e. Regulatory proteins carry cellular messages (for example, hormones).

f. Defense proteins help fight infections (for example, antibodies).

14. a. A substrate fits into the active site of an enzyme like a key fits into a lock. Upon binding, the enzyme undergoes a conformational change and adjusts its shape. The change in shape to accommodate the substrate is called the induced fit. The substrate reacts with the enzyme, producing the products of the enzyme-catalyzed reaction.

b. The active site of an enzyme changes shape to accommodate the substrate. Intermolecular bonds form between the enzyme and the substrate as the enzyme adjusts its shape.

Chapter 2 Self Assessment, page SG-26


Structures and Functions of Eukaryotic Cells (2.1), page SG-29

1. A cell is the basic unit of life.

2. nucleus, cell membrane, cytoplasm

3. a. cell membrane
   b. nucleus

The Nucleus (2.1), page SG-30

1. chromatin, chromosomes, nucleolus, nucleoplasm, nuclear matrix, nuclear envelope, nuclear pore complexes

2. DNA, RNA

3. DNA replication occurs in the nucleus and transcription occurs in the nucleolus.

The Endoplasmic Reticulum (2.1), page SG-31

1. Rough ER
   - studded with ribosomes
   - synthesizes proteins
   - transports materials

2. Smooth ER
   - membrane-bound tubules and sacs
   - detoxifies drugs and alcohol

2. Liver and pancreatic cells would have a lot of rough ER. Cells in the testes and ovaries have a lot of smooth ER.

The Endomembrane System: Protein Modification and Transport (2.1), page SG-32

1. The Golgi apparatus receives the proteins from the endoplasmic reticulum and modifies, sorts, and packages the proteins for export.

2. Lysosomes are membrane-enclosed sacs with hydrolytic enzymes for intracellular digestion.

Peroxisomes (2.1), page SG-33

<table>
<thead>
<tr>
<th>Structure</th>
<th>Peroxisome</th>
<th>Lysosome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site of Formation</td>
<td>buds off endoplasmic reticulum</td>
<td>buds off Golgi apparatus</td>
</tr>
<tr>
<td>Type of Reaction</td>
<td>redox reactions</td>
<td>hydrolysis</td>
</tr>
<tr>
<td>Type of Enzymes</td>
<td>oxidases catalase</td>
<td>hydrolytic enzymes</td>
</tr>
</tbody>
</table>

| Function                | breaks down toxic molecules,   | breaks down old cells; breaks down macromolecules |
|                        | alcohol; synthesize cholesterol and bile acids | |

0071360391 Answers - MHR SG-227
2. Testosterone is responsible for the development and functioning of the male reproductive organs. It also promotes the development of secondary male sexual characteristics at puberty.

**Structures and Functions of the Female Reproductive System (9.4), page SG-166**

1. ovaries → oviducts → uterus
2. 

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ovary</td>
<td>produces egg and sex hormones (estrogen and progesterone)</td>
</tr>
<tr>
<td>oviduct (fallopian tube)</td>
<td>conducts egg, site of fertilization</td>
</tr>
<tr>
<td>uterus</td>
<td>site of embryo/fetus development</td>
</tr>
<tr>
<td>cervix</td>
<td>contains opening to uterus, dilates during labour</td>
</tr>
<tr>
<td>vagina</td>
<td>receives penis during sexual intercourse, serves as birth canal</td>
</tr>
</tbody>
</table>

3. The endometrium of the uterus breaks down and is shed through the vagina, along with blood.

**Hormonal Regulation of the Female Reproductive System (9.4), page SG-167**

1. gonadotropin releasing hormone (GnRH), follicle-stimulating hormone (FSH), and luteinizing hormone (LH)
2. ovarian cycle and uterine cycle

**The Ovarian Cycle (9.4), page SG-168**

1. The ovarian cycle occurs in the ovaries and focuses on the development of the egg due to the levels of FSH and LH. In contrast, the uterine cycle occurs in the uterus and involves the thickening and breaking down of the endometrium due to the levels of estrogen and progesterone.

<table>
<thead>
<tr>
<th>Ovarian Cycle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicular phase</td>
<td>secretion of FSH, follicle matures, secretion of estrogen</td>
</tr>
<tr>
<td>Ovulation</td>
<td>high levels of LH (LH surge), mature egg is released</td>
</tr>
<tr>
<td>Luteal phase</td>
<td>secretion of LH continues, corpus luteum forms, progesterone secretion is prominent</td>
</tr>
</tbody>
</table>

**The Uterine Cycle (9.4), page SG-169**

1. estrogen and progesterone
2. 

<table>
<thead>
<tr>
<th>Uterine Cycle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstruation</td>
<td>endometrium breaks down</td>
</tr>
<tr>
<td>Proliferative phase</td>
<td>endometrium starts to thicken</td>
</tr>
<tr>
<td>Ovulation</td>
<td>mature egg is released</td>
</tr>
<tr>
<td>Secretory phase</td>
<td>endometrium doubles in thickness and glands are secretory</td>
</tr>
</tbody>
</table>

**Menopause and Hormone Replacement Therapy (9.4), page SG-170**

1. menopause
2. HRT relieves the side effects of menopause.
3. heart disease, strokes, blood clots, breast cancer, colorectal cancer, and dementia

**Chapter 9 Practice Test, page SG-172**

1. C
2. D
3. E
4. A
5. B
6. A
7. D
9. low blood glucose → stimulates pancreas → glucagon released by alpha cells of pancreas → liver converts glycogen into glucose → glucose released into the blood
10. In long-term stress response, stress causes the neurosecretory cells in the hypothalamus to produce hypothalamic-releasing hormone. This initiates a nerve impulse being sent to the anterior pituitary gland. The anterior pituitary gland secretes ACTH that then acts on the adrenal cortex. The adrenal cortex releases glucocorticoids, which causes protein and fat metabolism and reduction of inflammation by suppressing the immune system cells. The adrenal cortex also secretes mineralocorticoids, which cause the kidneys to reabsorb sodium ions and water. This results in an increase in blood volume and blood pressure.

In short-term stress response, stress stimulates the hypothalamus to send a nerve impulse to the spinal cord that then sends another nerve impulse to cause the adrenal medulla to secrete epinephrine and norepinephrine. These hormones cause the heartbeat and blood pressure to increase, the blood glucose level to rise, and the muscles to become energized.

11. Oxytocin: When the fetus’ head puts pressure on the cervix, a message is sent to the posterior pituitary gland to secrete oxytocin. Oxytocin causes the uterus to contract, which causes more oxytocin to be secreted until the uterine contractions get stronger.

Oxytocin: A baby sucking on its mother’s nipple causes the release of oxytocin. The more the baby sucks at the nipples, the more oxytocin is secreted.

12. GnRH released by the hypothalamus causes the anterior pituitary to secrete FSH and LH. FSH causes the follicle to secrete estrogen and LH stimulates the corpus luteum to secrete progesterone. As levels of estrogen and progesterone increase, this exerts feedback control over the hypothalamus, causing it to inhibit the secretion of GnRH, therefore stopping the anterior pituitary from secreting LH and FSH.


14. too much water → detected by water sensors in the hypothalamus → secretion of ADH is inhibited → water is excreted → water level balanced

too little water → detected by water sensor in the hypothalamus → stimulates secretion of ADH → water reabsorbed in collecting duct of kidneys → water level balanced

Chapter 10 Self Assessment, page SG-174

13. C

Overview of the Excretory System (10.1), page SG-177

1. Excretion is the process that removes metabolic waste and excess fluids from the body.

2. excretion of metabolic wastes, maintenance of water-salt balance, maintenance of acid-base balance, secretion of hormones

3. kidneys, ureter, bladder, and urethra

4. to store urine

The Kidneys (10.1), page SG-178

1. The kidney is composed of an inner layer called the renal medulla and an outer layer called the renal cortex. The third region, the renal pelvis, empties into the ureter.

2. The renal artery carries blood from the heart to the kidneys and the renal vein carries blood from the kidneys back to the heart.

3. Urine is composed of nitrogenous wastes, water, and solutes.
CHAPTER 9  Practice Test

1. Which of the following describes testosterone?
   i. involved in a negative feedback loop
   ii. cells of the seminiferous tubules secrete testosterone
   iii. secretions from the anterior pituitary control the production of testosterone

   A. i only  B. i and ii only  C. i and iii only  D. ii and iii only  E. i, ii, and iii

2. Which of the following describes estrogen?
   i. is released by the corpus luteum
   ii. causes the thickness of the uterine lining to increase
   iii. causes breast development and the distribution of fat in females

   A. iii only  B. i and ii only  C. i and iii only  D. ii and iii only  E. i, ii, and iii

3. What are the effects of the hormonal secretions by the anterior pituitary gland during days 15 to 28 of the uterine cycle?

   A. The follicle-stimulating hormone (FSH) surge causes the follicle to release an egg.
   B. The endometrium breaks down and blood vessels rupture.
   C. The follicle matures producing large amounts of estrogen.
   D. Increased amounts of progesterone are produced causing the endometrium to become secretory.
   E. Increased amounts of gonadotrophin-releasing hormone (GnRH) causes a decrease in progesterone production causing the corpus luteum to disintegrate.

4. Which of the following hormones is released by the posterior pituitary gland?

   A. prolactin (PRL)  B. antidiuretic hormone (ADH)  C. human growth hormone (hGH)  D. thyroid-stimulating hormone (TSH)  E. adrenocorticotropic hormone (ACTH)

5. When is the parathyroid hormone (PTH) produced?

   A. in response to the secretions of thyroxin in the blood
   B. in response to low concentrations of calcium in the blood
   C. in response to high concentrations of calcium in the blood
   D. in response to low concentrations of glycogen in the blood
   E. in response to the hormonal secretions by the thyroid glands

6. Which of the following hormones is correctly paired with its function?

   A. calcitonin – decreases the levels of calcium in the blood
   B. prolactin – causes smooth muscle contraction in the uterus
   C. anti-diuretic hormone – stimulates milk production in the mammary glands
   D. thyroxin – decreases the cellular activities and chemical reactions in the body
   E. thyroid stimulating hormone – stimulates hormone secretions in the parathyroid gland

7. Which of the following raise blood glucose levels?

   A. cortisol and insulin
   B. insulin and glucagon
   C. adrenocorticotropic hormone and glucagon
   D. cortisol and glucagon
   E. aldosterone and cortisol

8. Insulin and glucagon are controlled by negative feedback mechanisms. Put the following steps in the correct order, starting from when you eat a meal.

   a. Glucose enters the bloodstream faster than cells can use it.
   b. Glucose levels rise.
   c. Beta cells of the pancreas are stimulated to release insulin into the blood.
   d. Cells take up glucose.
   e. Cells of the liver convert glucose to glycogen.
   f. The level of glucose in the blood returns to normal
g. Between meals, blood glucose levels decrease.

h. Alpha cells of the pancreas are stimulated to secrete glucagon into the bloodstream.

i. Cells of the liver covert glycogen to glucose, which enters the bloodstream.

j. Rising glucose levels return blood glucose to its normal level.

9. Create a flow chart to show how insulin and glucagon regulate blood glucose levels.

10. Explain how the body responds differently to long-term stress versus short-term stress.

11. Name the hormone in the female reproductive system that is involved in a positive feedback loop and explain one of its functions.

12. Describe the negative feedback loop in the female reproductive system.

13. Create a flow chart showing negative feedback in the male reproductive system.

14. Create a flow chart to show hormonal regulation of water in the blood.

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<td>SG-154, SG-156</td>
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