Student Name _____

Cell Metabolism

chapter 4

Answer Key: Textbook page references are provided as a guide for answering these questions. A complete answer key was provided for your instructor.

OBJECTIVES

1. Define *metabolism*, *anabolism*, and *catabolism*.
2. Explain the use of carbohydrates in the body, and differentiate between the anaerobic and aerobic metabolism of carbohydrates.
3. Explain the use of fats in the body.
4. Explain the use of proteins in the body.
5. Describe the roles of DNA and RNA in protein synthesis, the structure of a nucleotide, and the steps in protein synthesis.

Part I: Mastering the Basics

MATCHING

Carbohydrates, Fats, and Proteins

Directions: Match the following terms to the most appropriate definition by writing the correct letter in the space provided. Some terms may be used more than once. See text, pp. 48-56.

A. glucose
B. amino acids
C. nonessential amino acids
D. disaccharides
E. cellulose
F. glycogen
G. urea
H. nitrogen
I. essential amino acids
J. monosaccharides
K. lipids
L. organic
M. fatty acids and glycerol

1. _____ Refers to carbon-containing substances
2. _____ A nitrogen-containing waste product
3. _____ Building blocks of lipids
4. _____ Nondigestible polysaccharide found in plants
5. _____ Protein contains this in addition to carbon, oxygen, and hydrogen
6. _____ Building blocks joined together by peptide bonds
7. _____ Amino acids that cannot be synthesized by the body and must therefore be obtained through dietary intake
8. _____ Monosaccharide that provides the primary source of energy for cells
9. _____ Building blocks of protein
10. _____ Sucrose, maltose, and lactose; sometimes called *double sugars*
11. _____ Glucose, fructose, and galactose
12. _____ Glucose is stored as this polysaccharide; also called *animal starch*
13. _____ Amino acids that can be synthesized by the body
14. _____ Classification of triglycerides and steroids
15. _____ "Good" cholesterol and "bad" cholesterol

MATCHING

Metabolism of Carbohydrates, Proteins, and Fats

Directions: Match the following terms to the most appropriate definition by writing the correct letter in the space provided. Some terms may be used more than once. See text, pp. 48-56.

A. gluconeogenesis
B. catabolism
C. CO_2, water, energy (ATP)
D. anabolism
E. enzyme
F. Krebs cycle
G. peptide bond
H. lactic acid
I. ketone bodies
J. glycolysis

1. _____ Chemical reactions that build larger, more complex substances
2. _____ Amine group of alanine joins with the acid part of valine to form this.
3. _____ Produced by the rapid incomplete breakdown of fatty acids
4. _____ Chemical reactions that degrade larger, more complex substances into simpler substances
5. _____ Series of reactions that anaerobically break down glucose to lactic acid
6. _____ Series of aerobic reactions that occur in the mitochondria
7. _____ In the absence of oxygen, pyruvic acid is converted to this substance.
8. _____ End products of the aerobic catabolism of glucose
9. _____ Almost every chemical reaction in the body is catalyzed by this.
10. _____ This series of anaerobic reactions occurs within the cytoplasm
11. _____ Conversion of protein into glucose

READ THE DIAGRAM

Directions: Refer to Figure 4-3 in the textbook and indicate whether the following statements refer to column A or column B. Write A or B in the blanks below. See text, p. 51.

1. _____ Describes the anaerobic breakdown of glucose to lactic acid
2. _____ Some of the chemical reactions occur within the mitochondria.
3. _____ Describes the complete breakdown of glucose into carbon dioxide, water, and energy
4. _____ Most of the energy is formed in this pathway.
5. _____ Pyruvic acid products enter the Krebs cycle for further catabolism.
6. _____ All chemical reactions occur within the cytoplasm.
7. _____ Illustrates the role of the Krebs cycle in the catabolism of glucose
8. _____ Includes oxygen-requiring reactions
9. _____ Pyruvic acid is not converted to lactic acid.
10. _____ Chemical reactions that catabolize glucose incompletely

MATCHING

Nucleotides: DNA and RNA

Directions: Match the following terms to the most appropriate definition by writing the correct letter in the space provided. Some terms may be used more than once. See text, pp. 56-59.

A. DNA
B. tRNA
C. deoxyribose
D. ribose
E. mRNA
F. nucleotide

1. _____ Double-stranded nucleic acid that contains the genetic code; called the *double helix*
2. _____ Substance composed of phosphate, sugar, and base
3. _____ Sugar found in RNA
4. _____ Sugar found in DNA
5. _____ Nucleotide that copies the genetic code from DNA in the nucleus
6. _____ Nucleotide that carries individual amino acids from the cytoplasm to the ribosomes for assembly along the mRNA
7. _____ DNA and this nucleotide are involved in transcription.
8. _____ mRNA and this nucleotide are involved in translation.
9. _____ Nucleotide that is confined to the nucleus
10. _____ Nucleotide that does not use uracil in its coding; uses thymine instead
11. _____ Nucleotide that carries genetic information from the nucleus to the ribosomes

SIMILARS AND DISSIMILARS

Directions: Circle the word in each group that is least similar to the others. Indicate the similarity of the three words on the line below each question.

1. monosaccharide polysaccharide polypeptide disaccharide

2. glucose sucrose galactose fructose

3. sucrose glucose maltose lactose

4. amino acids polypeptide glycogen protein

5. metabolism differentiation anabolism catabolism

6. phenylalanine starch glycogen cellulose

7. cholesterol phospholipid glycogen steroid

8. alanine leucine steroid tyrosine

9. peptide bond fatty acid $-NH_2$ –COOH

10. DNA tRNA glycogen mRNA

11. uracil thymine glycogen adenine

12. cellulose polysaccharide starch urea

13. cellulose glucose glycogen triglyceride

14. peptide bonds fats phospholipids oils

15. phospholipid protein steroid triglyceride

16. essential AA peptide bonds nonessential AA cholesterol

17. ammonia NH_3 cholesterol urea

18. G-C A-T A-U G-U

19. T-A C-G G-G A-T

20. tRNA transcription gluconeogenesis mRNA

21. purine sucrose adenine pyrimidine

Part II: Putting It All Together

MULTIPLE CHOICE

Directions: Choose the correct answer.

1. Glucose
   a. is usually burned as fuel to get energy.
   b. can be converted to protein.
   c. cannot be converted to fat.
   d. must be converted to urea to be excreted from the body.

2. Urea is
   a. produced by the kidneys and excreted by the liver into the bile.
   b. a disaccharide.
   c. a protein.
   d. a nitrogen-containing waste produced in the liver and excreted in the urine.

3. Cellulose is
   a. animal starch.
   b. the storage form of glucose.
   c. a nitrogen-containing waste produced in the liver and excreted in the urine.
   d. a nondigestible carbohydrate.

4. Which of the following best describes the composition of hormones, hemoglobin, and gamma globulins?
   a. carbohydrates
   b. proteins
   c. lipids
   d. glycerol

5. Gluconeogenesis is the process whereby
   a. glucose is converted to protein.
   b. fatty acids are combined with glycerol to form a monosaccharide.
   c. protein is used to make glucose.
   d. glucose is broken down to lactic acid.

6. Which of the following is required by the chemical reactions that occur within the mitochondria?
   a. lactic acid
   b. carbon dioxide
   c. oxygen
   d. cellulose

7. Glycogen
   a. combines with three fatty acids to make fat.
   b. is stored in the liver and skeletal muscle.
   c. is synthesized only in the pancreas.
   d. is a monosaccharide.

8. Glucose, fructose, and galactose
   a. form peptide bonds.
   b. are lipids.
   c. can only be metabolized aerobically.
   d. are monosaccharides.

9. When the blood sugar level decreases, the glycogen in the liver is converted into which substance?
   a. protein
   b. ATP
   c. glucose
   d. lactic acid

10. Glycolysis
    a. is aerobic.
    b. forms CO_2 + water + energy.
    c. occurs only within the mitochondria.
    d. is anaerobic and cytoplasmic.

11. Which of the following is most related to the reactions of the Krebs cycle?
    a. anaerobic
    b. mitochondrial
    c. lactic acidosis
    d. urea-forming

12. Which of the following conditions is caused by a lack of oxygen in a critically ill patient?
    a. lactic acidosis
    b. cancer
    c. decreased blood glucose level
    d. hypertension

13. Which of the following is least descriptive of ammonia?
    a. toxic to the brain
    b. accumulates in the presence of liver failure
    c. nitrogen-containing
    d. primary fuel for "running" the body

14. This protein substance acts as a catalyst, increasing the rate of a chemical reaction.
    a. urea
    b. enzyme
    c. mRNA
    d. ribose

15. If the bases of one side of DNA read A-G-C-T, the complementary (opposite) DNA strand reads
    a. A-C-G-T.
    b. A-G-A-T.
    c. U-C-G-A.
    d. T-C-G-A.

16. Which of the following is most related to the storage of the genetic code?
    a. Krebs cycle
    b. glycolysis
    c. mitosis
    d. base-sequencing within the DNA molecule

17. With regard to base pairing, thymine can only pair with which base?
    a. adenine
    b. uracil
    c. cytosine
    d. guanine

18. The bases in a strand of DNA read T-C-C-A. The transcribed strand of mRNA reads
    a. A-G-G-T.
    b. G-C-G-A.
    c. U-C-C-T.
    d. A-G-G-U.

19. As a person ages, the body is less able to metabolize glucose efficiently, which results in elevated
    a. blood calcium levels.
    b. blood pressure.
    c. serum cholesterol levels.
    d. blood sugar levels.

20. A hormone or drug that suppresses gluconeogenesis
    a. prevents the elevation of the blood glucose level.
    b. produces ketone bodies.
    c. prevents the synthesis of urea by the liver.
    d. prevents the secretion of urea by the kidneys.

CASE STUDY

Until recently, 6-year-old Billie had no apparent health problems. About 1 week ago, she started to lose weight despite a healthy appetite. She urinated frequently and complained of being tired. Her mom noticed that she was very thirsty and was getting up in the middle of the night to urinate. On examination, her blood sugar level was elevated and she had sugar and acetone in her urine. She was diagnosed with type 1 (juvenile-onset) diabetes mellitus.

1. Because the diabetic cells cannot use glucose, it accumulates in the blood, causing this condition.
    a. hypotension
    b. hyperglycemia
    c. lactic acidosis
    d. alkalosis

2. Because the diabetic person cannot use glucose, Billie metabolizes fatty acids rapidly and incompletely, thereby producing excessive amounts of this (these) substance(s).
    a. enzymes
    b. ketone bodies
    c. glycogen
    d. urea

3. Which of the following describes the effect of excess ketone bodies in the blood of a diabetic person?
    a. glucosuria
    b. acidosis
    c. elevated blood pH
    d. hyperglycemia

Part III: Challenge Yourself!

GROUPS AND PUZZLE

1. Which group is incorrect?
    a. monosaccharides: glucose, fructose, galactose
    b. nucleotides: DNA, RNA
    c. lipid-related structures: cholesterol, steroid, fatty acids
    d. amino acids: sucrose, maltose, lactose

2. Which group is incorrect?
    a. amino acids: essential, nonessential
    b. monosaccharides: glucose, fructose, galactose
    c. fatty acids: glycerol, glycogen
    d. ketone bodies: keto acids, acetone

Student Name _____

PUZZLE

Hint: Needs Oxygen... Name and Address

Directions: Perform the following functions on the Sequence of Words that follows. When all the functions have been performed, you are left with a word or words related to the hint. Record your answer in the space provided.

Functions: Remove the following:

1. Building blocks of proteins
2. Monosaccharides
3. Nitrogen-containing waste product
4. Series of reactions that degrade glucose to lactic acid; anaerobic and cytoplasmic
5. Series of reactions that make glucose from protein breakdown products
6. Disaccharides
7. Building blocks of fats
8. Storage form of glucose
9. Term that includes anabolism and catabolism
10. Nucleotide that stores the genetic code within the nucleus
11. Nucleotide that carries the genetic code from the nucleus to the ribosomes in the cytoplasm
12. Two sugars found in DNA and RNA
13. Four bases found in DNA

Sequence of Words

GUANINERIBOSEDNAGLUCONEOGEN
ESISSUCROSEGLUCOSECYTOSINEMALTOS
EGALACTOSEUREAFATTYACIDSGLY
COGENGLYCEROLMETABOLISMDEOX
YRIBOSEAMINOACIDSTHYMINEHAN
SKREBSMITOCHONDRIONADENINEGLYC
OLYSISFRUCTOSELACTOSEMRNA

Answer: _____