

# Nutrition and Metabolism

Most of us love to eat, but do the foods we enjoy provide us with the basic food types necessary for good nutrition? The body, a finely tuned machine, requires a balance of carbohydrates, fats, proteins, vitamins, and minerals to function properly. These nutrients must be digested, absorbed, and circulated to cells constantly to accommodate the numerous activities that occur throughout the body. The use the body makes of foods once these processes are completed is called "metabolism."

The liver plays a major role in the metabolism of food. It helps maintain a normal blood glucose level, removes toxins from the blood, processes blood immediately after it leaves the gastrointestinal tract, and initiates the first steps of protein and fat metabolism.

This chapter also discusses basal metabolic rate (BMR). The BMR is the rate at which food is catabolized under basal conditions. This test and the measurement of the amount of protein-bound iodine (PBI) are indirect measures of thyroid gland functioning. The total metabolic rate (TMR) is the amount of energy, expressed in calories, used by the body each day.

Finally, maintaining a constant body temperature is a function of the hypothalamus and a challenge for the metabolic factors of the body. Review of this chapter is necessary to provide you with an understanding of the "fuel" or nutrition necessary to maintain your complex homeostatic machine—the body.

## TOPICS FOR REVIEW

Before progressing to Chapter 16, you should be able to define and contrast catabolism and anabolism. Your review should include the metabolic roles of carbohydrates, fats, proteins, vitamins, and minerals. Your study should conclude with an understanding of the basal metabolic rate and the physiological mechanisms that regulate body temperature.

# THE ROLE OF THE LIVER

*Fill in the blanks.*

The liver plays an important role in the mechanical digestion of lipids because it secretes (1) \_\_\_\_\_. It also produces two of the plasma proteins that play an essential role in blood clotting: (2) \_\_\_\_\_ and (3) \_\_\_\_\_. Additionally, liver cells store several substances, notably vitamins A and D and (4) \_\_\_\_\_. Finally, the liver is assisted by a unique structural feature of the blood vessels that supply it. This arrangement, known as the (5) \_\_\_\_\_, allows toxins to be removed from the bloodstream before nutrients are distributed throughout the body.

## NUTRIENT METABOLISM

*Match the term on the left with the proper selection on the right.*

- |   |                  |
|---|------------------|
| _____ 6. Used if cells have inadequate amounts of glucose to catabolize | A. Carbohydrates |
| _____ 7. Preferred energy food  | B. Fats          |
| _____ 8. Amino acids  | C. Proteins      |
| _____ 9. Fat soluble  | D. Vitamins      |
| _____ 10. Required for nerve conduction                                 | E. Minerals      |
| _____ 11. Glycolysis  |                  |
| _____ 12. Inorganic elements found naturally in the earth               |                  |
| _____ 13. Pyruvic acid  |                  |

*Circle the one that does not belong.*

- |                    |                   |                |             |
|--------------------|-------------------|----------------|-------------|
| 14. Glycolysis     | Citric acid cycle | ATP            | Bile        |
| 15. Adipose        | Amino acids       | Triglycerides  | Glycerol    |
| 16. A              | D                 | M              | K           |
| 17. Iron           | Proteins          | Amino acids    | Essential   |
| 18. Hydrocortisone | Insulin           | Growth hormone | Epinephrine |
| 19. Sodium         | Calcium           | Zinc           | Folic acid  |
| 20. Thiamine       | Niacin            | Ascorbic acid  | Riboflavin  |



*If you have had difficulty with this section, review pages 390-394.*

## METABOLIC RATES BODY TEMPERATURE

*Circle the correct answer.*

21. The rate at which food is catabolized under basal conditions is the:
- A. TMR
  - B. PBI
  - C. BMR
  - D. ATP

22. The total amount of energy used by the body per day is the:
- A. TMR
  - B. PBI
  - C. BMR
  - D. ATP
23. Over \_\_\_\_\_ of the energy released from food molecules during catabolism is converted to heat rather than transferred to ATP.
- A. 20%
  - B. 40%
  - C. 60%
  - D. 80%
24. Maintaining thermoregulation is a function of the:
- A. Thalamus
  - B. Hypothalamus
  - C. Thyroid
  - D. Parathyroids
25. Transfer of heat energy to the skin and then to the external environment is known as:
- A. Radiation
  - B. Conduction
  - C. Convection
  - D. Evaporation
26. A flow of heat waves away from the blood is known as:
- A. Radiation
  - B. Conduction
  - C. Convection
  - D. Evaporation
27. A transfer of heat energy to air that is continually flowing away from the skin is known as:
- A. Radiation
  - B. Conduction
  - C. Convection
  - D. Evaporation
28. Heat that is absorbed by the process of water vaporization is called:
- A. Radiation
  - B. Conduction
  - C. Convection
  - D. Evaporation
29. A/an \_\_\_\_\_ is the amount of energy needed to raise the temperature of 1 gram of water 1° centigrade.
- A. Calorie
  - B. Kilocalorie
  - C. ATP
  - D. BMR



*If you have had difficulty with this section, review pages 394-398.*

# UNSCRAMBLE THE WORDS

30. L R I E V  
 □ □ ○ ○ ○
31. T A O B A L I C I M S  
 □ ○ ○ □ □ □ □ □ □ □
32. O M N I A  
 ○ □ □ □ ○ ○
33. Y P U R C V I  
 ○ □ □ □ □ □ ○ □



Take the circled letters, unscramble them, and fill in the statement.

**How the magician paid his bills.**

34. □ □ □ □ □ □ □ □ □ □

# APPLYING WHAT YOU KNOW

35. Dr. LaGasse was concerned about Deborah. Her daily food intake provided fewer calories than her TMR. If this trend continues, what will be the result? If it continues over a long period of time, what eating disorder might Deborah develop?

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36. Mrs. Bishop was experiencing fatigue and a blood test revealed that she was slightly anemic. What mineral will her doctor most likely prescribe? What dietary sources might you suggest that she emphasize in her daily intake?

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37. Mr. Thivierge was training daily for an upcoming marathon. Three days before the 25 mile event, he suddenly quit his daily routine of jogging and switched to a diet high in carbohydrates. Why did Mr. Thivierge suddenly switch his routine of training?

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### 38. WORD FIND

Can you find 18 terms from this chapter? Words may be spelled top to bottom, bottom to top, right to left, left to right, or diagonally.

C C C B W E F F L J V G G S  
A T N L W E U O Z I E L I B  
R K K P Z F R I T P O Y K L  
B Q M I N E R A L S J C C P  
O S S N C X M I D B D O W P  
H S I Y O I T X H I N L S N  
Y E L N N I K W W D S Y N S  
D G O S O W T I U E H S C N  
R M B Y T I W C Z N N I A A  
A R A Q W A T B E I G S J M  
T E T F N I F A E V E W T Y  
E V A P O R A T I O N D T E  
S I C N E S O P I D A O F E  
H L Y K I R E B V P A H C J  
I W E E P A D F T E A R G G

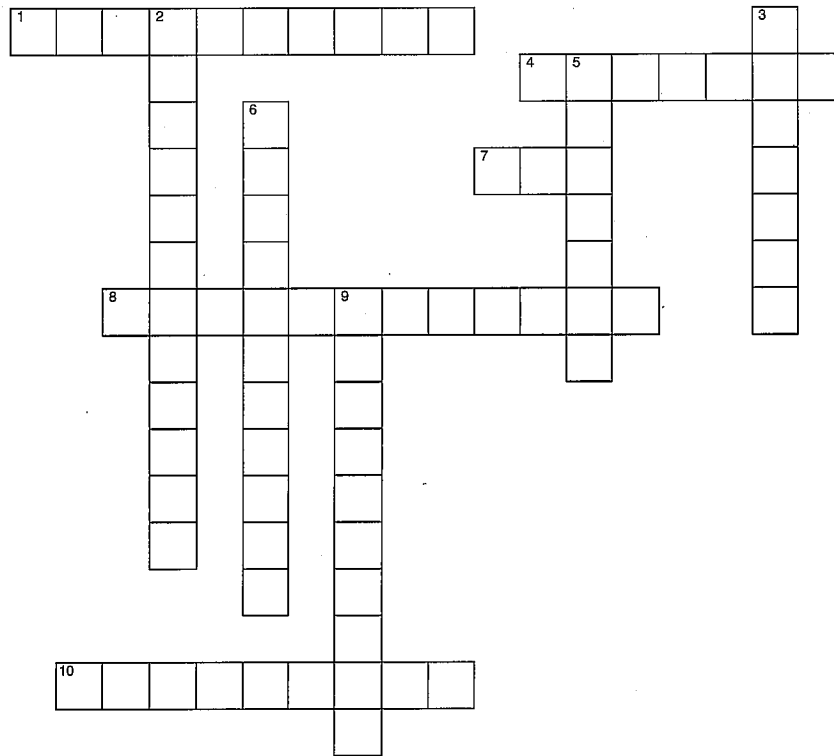
ATP	Conduction	Liver
Adipose	Convection	Minerals
BMR	Evaporation	Proteins
Bile	Fats	Radiation
Carbohydrates	Glycerol	TMR
Catabolism	Glycolysis	Vitamins

### DID YOU KNOW?

The amount of energy required to raise a 200-pound man 15 feet is about the amount of energy in one large calorie.

# NUTRITION/METABOLISM

Fill in the crossword puzzle.



## Across

1. Breaks food molecules down releasing stored energy
4. Amount of energy needed to raise the temperature of 1 gram of water 1° centigrade
7. Rate of metabolism when a person is lying down but awake (abbreviation)
8. A series of reactions that join glucose molecules together to form glycogen
10. Builds food molecules into complex substances

## Down

2. Occurs when food molecules enter cells and undergo many chemical changes there
3. Organic molecule needed in small quantities for normal metabolism throughout the body
5. Oxygen-using
6. A unit of measure for heat, also known as a large calorie
9. Takes place in the cytoplasm of a cell and changes glucose to pyruvic acid

# CHECK YOUR KNOWLEDGE

## Multiple Choice

Circle the correct answer.

1. What is the process by which pyruvic acid is broken down into carbon dioxide called?
  - A. Glycogenesis
  - B. Citric acid cycle
  - C. Glycolysis
  - D. Pyruvic acid cycle
2. The anabolism of glucose produces which of the following?
  - A. Glycogen
  - B. Amino acid
  - C. Rennin
  - D. Starch
3. Which of the following is a major hormone in the body that aids carbohydrate metabolism?
  - A. Oxytocin
  - B. Epinephrine
  - C. Insulin
  - D. Growth hormone
4. The total metabolic rate is which of the following?
  - A. The amount of fats we consume in a 24-hour period.
  - B. The same as the BMR.
  - C. The amount of energy expressed in calories used by the body per day.
  - D. Cannot be calculated
5. When your consumption of calories equals your TMR, your weight will do which of the following?
  - A. Increase
  - B. Remain the same
  - C. Fluctuate
  - D. Decrease
6. Which of the following is a normal glucose level?
  - A. 40 to 80 mg/100 ml blood
  - B. 80 to 120 mg/100 ml blood
  - C. 100 to 140 mg/100 ml blood
  - D. 180 to 220 mg/100 ml blood
7. When glucose is *not* available, the body will next catabolize which of the following energy sources?
  - A. Fats
  - B. Proteins
  - C. Minerals
  - D. Vitamins
8. Maintaining the homeostasis of the body temperature is the responsibility of which of the following?
  - A. Hypothalamus
  - B. Environmental condition in which we live
  - C. Circulatory system
  - D. None of the above

9. The liver plays an important role in the mechanical digestion of lipids because it secretes:
  - A. Glucose molecules
  - B. Bile
  - C. Glycogen
  - D. Citric acid
10. What is the primary molecule the body usually breaks down as an energy source?
  - A. Amino acid
  - B. Pepsin
  - C. Maltose
  - D. Glucose

## Completion

Complete the following statements using the terms listed below. Some words may be used more than once.

- |                  |                      |
|------------------|----------------------|
| A. Vitamins      | G. ATP               |
| B. Insulin       | H. Sodium            |
| C. Carbohydrates | I. Proteins          |
| D. Fats          | J. Citric acid cycle |
| E. Glycolysis    | K. Calcium           |
| F. Heat          | L. Glycogen loading  |

11. Proper nutrition requires the balance of the three basic food types: \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
12. The process that changes glucose to pyruvic acid is called \_\_\_\_\_.
13. Once glucose has been changed to pyruvic acid, another process in which pyruvic acid is changed to carbon dioxide takes place. This reaction is known as the \_\_\_\_\_.
14. A direct source of energy for doing cellular work is \_\_\_\_\_.
15. The only hormone that lowers blood glucose level is \_\_\_\_\_.
16. When cells have an inadequate amount of glucose to catabolize, they will catabolize \_\_\_\_\_.
17. Some athletes consume large amounts of carbohydrates 2 to 3 days before an athletic event to store glycogen in skeletal muscles. This practice is called \_\_\_\_\_.
18. Organic molecules needed in small amounts for normal metabolism are \_\_\_\_\_.
19. Two minerals necessary for nerve conduction and contraction of muscle fibers are \_\_\_\_\_ and \_\_\_\_\_.
20. During catabolism, food molecules are converted to \_\_\_\_\_ rather than being transported to ATP.