Test Bank[1] for *Nutrition for Sport & Exercise* 2e
Chapter 2 – Defining and Measuring Energy

Learning Objectives

1. Define and explain bioenergetics, ATP, calorie, kilocalorie, and other energy-related terms.
2. Explain the concept of conservation of energy and how this concept applies to energy utilization in the body.
3. Identify the primary source of energy in the body and explain how it is used by skeletal muscle during exercise.
4. Explain the resynthesis of ATP, including the role of enzymes, and name the major energy systems involved.
5. Explain how the energy content of food and energy expenditure are measured directly and indirectly, and how estimates can be made more accurately.
6. List and explain the components of the energy balance equation.
7. Explain resting metabolic rate, the factors that influence it, and how it is measured or predicted in athletes and nonathletes.
8. Explain the impact of physical activity on energy expenditure.
9. Calculate an estimated energy requirement for a 24-hr period using a simple formula.

Question Information Key

ANS = correct answer
DIF = question classification
REF = page reference
OBJ = learning objective

Multiple Choice

1. The best definition of bioenergetics is:
   a. the study of metabolism.
   b. the physiological processes associated with exercise.
   c. the process of converting food into biological energy.
   d. the transformation of energy to heat.

   ANS: c DIF: Recall REF: 38 OBJ: 2.1

2. The best definition of energy is the:
   a. absence of physical or mental fatigue.
   b. ability to perform work.
   c. generation of tension by contracting muscle.
   d. thermic effect of movement.

   ANS: b DIF: Recall/comprehension REF: 38 OBJ: 2.1

3. Which of the following is true regarding the First Law of Thermodynamics?
   a. Energy is not created or destroyed.
   b. Energy is created but not destroyed.
   c. Energy is destroyed but not created.
   d. Energy is both created and destroyed.

   ANS: a DIF: Recall/comprehension REF: 38 OBJ: 2.2

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4. Kinetic energy refers to:
   a. energy that is stored to be used later.
   b. energy used for skeletal muscle contraction.
   c. the release of stored energy to perform work.
   d. all of the above

   ANS: c DIF: Recall/comprehension REF: 39 OBJ: 2.2

5. ATP is an example of:
   a. chemical energy.
   b. electrical energy.
   c. mechanical energy.
   d. thermal energy.

   ANS: a DIF: Comprehension REF: 39|41 OBJ: 2.2

6. Which of the following is a type of chemical reaction that results in energy being absorbed or stored?
   a. Endergonic
   b. Exergonic
   c. Enderthermic
   d. Excitation

   ANS: a DIF: Recall REF: 39 OBJ: 2.2

7. Which of the following is a type of chemical reaction that results in energy being released?
   a. Endergonic
   b. Exergonic
   c. Enderthermic
   d. Excitation

   ANS: b DIF: Recall REF: 39 OBJ: 2.2

8. Which of the following is an endergonic reaction?
   a. The releasing (triggering) of a mouse trap
   b. The release of water from behind a dam
   c. The breakdown of ATP to ADP
   d. The rephosporylation of ADP

   ANS: d DIF: Comprehension REF: 44 OBJ: 2.4

9. The two most common factors that influence enzyme activity are:
   a. time and temperature.
   b. temperature and pH.
   c. pH and oxygen availability.
   d. oxygen availability and time.

   ANS: b DIF: Comprehension REF: 42 OBJ: 2.4

10. Under the most demanding conditions (e.g., very high-intensity exercise), ATP concentrations in skeletal muscles are not likely to drop more than:
    a. 5-10%.
    b. 10-20%.
    c. 20-30%.
    d. 40-50%.

    ANS: c DIF: Comprehension/application REF: 44 OBJ: 2.3

11. If a food contains 350 Calories, how many kilocalories does it contain?
    a. 148
    b. 350
    c. 1,480
    d. 3,250

    ANS: b DIF: Comprehension REF: 45 OBJ: 2.5

12. The International System of Units (SI units) unit for energy is the:
    a. calorie (lowercase c).
    b. Calorie (uppercase c).
    c. kilocalorie.
    d. joule.

    ANS: d DIF: Recall/comprehension REF: 44 OBJ: 2.5

13. 6,300 kJ is equivalent to how many kilocalories?
    a. 812
    b. 1,500
    c. 2,625
    d. 6,300

    ANS: b DIF: Comprehension/application REF: 45 OBJ: 2.5

14. On a kcal/g basis, the caloric content of carbohydrate is approximately the same as that of:
    a. alcohol.
    b. fat.
    c. protein.
    d. a and c

    ANS: c DIF: Comprehension REF: 46 OBJ: 2.5

15. On average, 1 liter of oxygen consumed is equivalent to _____ kcal of energy expended.
    a. 1
    b. 3
    c. 5
    d. 7

    ANS: c DIF: Comprehension REF: 48 OBJ: 2.5

16. Direct calorimetry works on the principle that:
    a. a rise in body temperature reflects the amount of energy expended.
    b. the body heat that is produced is proportional to the energy expended.
    c. oxygen consumption and carbon dioxide production are related to energy expenditure.
    d. energy expenditure can be predicted if respiration and perspiration are carefully measured.

    ANS: b DIF: Comprehension REF: 47 OBJ: 2.5

17. Indirect calorimetry works on the principle that:
    a. a rise in body temperature reflects the amount of energy expended.
    b. the body heat that is produced is proportional to the energy expended.
    c. oxygen consumption and carbon dioxide production are related to energy expenditure.
    d. energy expenditure can be predicted if respiration and perspiration are carefully measured.

    ANS: c DIF: Comprehension REF: 47 OBJ: 2.5

18. Which of the following should NOT be used to obtain a measurement of energy expenditure during exercise?
    a. Whole-room calorimeter with direct and indirect measurement capabilities
    b. An open-circuit metabolic measurement system
    c. A simplified portable system
    d. Doubly labeled water (DLW)

    ANS: c DIF: Comprehension REF: 49-50 OBJ: 2.5

19. Which of the following statements is NOT true regarding intake when athletes are keeping a food diary?
    a. Food intake is consciously reduced.
    b. Food intake is unconsciously reduced.
    c. Food intake is difficult to record due to frequent snacking.
    d. Food intake is underreported by females but not by males.

    ANS: d DIF: Application/evaluation REF: 52 OBJ: 2.6

20. In the energy balance equation, the only component of "energy in" is:
    a. food.
    b. thermic effect of food.
    c. basal metabolism.
    d. physical activity.

    ANS: a DIF: Recall/comprehension REF: 52 OBJ: 2.6

21. In a sedentary individual, the largest influence on "energy out" is:
    a. resting metabolism.
    b. thermic effect of food.
    c. physical activity.
    d. b and c together

    ANS: a DIF: Recall/comprehension REF: 53 OBJ: 2.6

22. The smallest influence on "energy out" is:
    a. resting metabolism.
    b. thermic effect of food.
    c. physical activity.
    d. basal metabolic rate.

    ANS: b DIF: Recall/comprehension REF: 57 OBJ: 2.6

23. The minimum energy expenditure compatible with life is known as:
    a. resting metabolism.
    b. basal metabolism.
    c. thermic effect of energy.
    d. resting exchange ratio.

    ANS: b DIF: Recall/comprehension REF: 53 OBJ: 2.7

24. When compared to basal metabolic rate, resting metabolic rate is:
    a. essentially the same.
    b. ~10% lower.
    c. ~10% greater.
    d. none of the above

    ANS: c DIF: Comprehension REF: 53 OBJ: 2.7

For questions 25-35, indicate the influence of each factor on resting metabolic rate.

25. Age
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: a DIF: Comprehension REF: 53-55 OBJ: 2.7

26. Amount of fat-free tissue
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: b DIF: Comprehension REF: 53-55 OBJ: 2.7

27. Ascending to high altitude
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: c DIF: Comprehension REF: 53-55 OBJ: 2.7

28. Caffeine
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: c DIF: Comprehension REF: 53-55 OBJ: 2.7

29. Environmental temperature
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: c DIF: Comprehension REF: 53-55 OBJ: 2.7

30. Exercise
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: c DIF: Comprehension REF: 53-55 OBJ: 2.7

31. Gender
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: a DIF: Comprehension REF: 53-55 OBJ: 2.7

32. Genetics
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control

c. Subtle or temporary influence, under some voluntary control

ANS: a DIF: Comprehension REF: 53-55 OBJ: 2.7

33. Height
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: a DIF: Comprehension REF: 53-55 OBJ: 2.7

34. Self-starvation
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: b DIF: Comprehension REF: 53-55 OBJ: 2.7

35. Thyroid hormones
    a. Influence not under voluntary control
    b. Substantial influence, under some voluntary control
    c. Subtle or temporary influence, under some voluntary control

    ANS: a DIF: Comprehension REF: 53-55 OBJ: 2.7

36. Which of the following equations most accurately predicts resting metabolic rate in healthy Caucasian adults?
    a. Harris-Benedict
    b. Mifflin-St Jeor
    c. Owen
    d. WHO/FAO/UNU

    ANS: b DIF: Recall/comprehension REF: 56 OBJ: 2.7

37. Which of the following equations used to predict resting metabolic rate best accounts for the higher-than-normal amount of muscle mass in trained athletes?
    a. Harris-Benedict
    b. Mifflin-St Jeor
    c. Owen
    d. Cunningham

    ANS: d DIF: Recall/comprehension REF: 57 OBJ: 2.7

38. Estimate resting metabolic rate in a 165-lb (75-kg) male using the simplest formula discussed in the text.
    a. 1,620 kcal
    b. 1,800 kcal
    c. 2,275 kcal
    d. 3,650 kcal

    ANS: b DIF: Analysis/synthesis REF: 57 OBJ: 2.9

39. Which of the following macronutrients has the greatest influence on the thermic effect of food?
    a. Carbohydrate
    b. Protein
    c. Fat

    ANS: b DIF: Recall/comprehension REF: 57-58 OBJ: 2.5

40. The "energy out" factor that that can be increased to the greatest degree is:
    a. resting metabolism.
    b. thermic effect of food.
    c. physical activity.

    ANS: c DIF: Recall/comprehension REF: 58 OBJ: 2.8

41. One MET is equal to:
    a. energy expenditure at rest.
    b. energy expenditure during the first 10 minutes of exercise.
    c. energy expenditure prior to the point of fatigue.
    d. 55 kcal/hour.

    ANS: a DIF: Recall/comprehension REF: 59 OBJ: 2.8

42. To maintain energy balance, it is estimated that a sedentary individual requires approximately _____ kcal/kg of body weight daily.
    a. 20
    b. 25
    c. 30
    d. 35

    ANS: c DIF: Recall REF: 61-62 OBJ: 2.9

43. If an athlete's estimated energy need is above 50 kcal/kg of body weight daily, then this athlete is likely engaging in activity described as:
    a. normal.
    b. moderate.
    c. heavy.
    d. exceptional.

    ANS: d DIF: Recall REF: 62 OBJ: 2.9

True/False

1. The terms *calorie* and *Calorie* can be used interchangeably in scientific writing.

    ANS: F DIF: Recall/comprehension REF: 45 OBJ: 2.1

2. The law of Conservation of Energy states that energy is neither created nor destroyed but that it can be transformed.

    ANS: T DIF: Recall/comprehension REF: 38 OBJ: 2.2

3. One liter (1 L) of oxygen is equal to 9 kcal/g.

    ANS: F DIF: Recall REF: 48 OBJ: 2.5

4. When compared to machines, humans are relatively efficient at converting energy.

    ANS: F DIF: Recall/comprehension REF: 38 OBJ: 2.2

5. Reactions in which energy is released are referred to as endergonic reactions.

ANS: F DIF: Comprehension REF: 39 OBJ: 2.2

6. ATP is critical for muscle contraction, but is not involved in muscle relaxation.

ANS: F DIF: Comprehension REF: 42|44 OBJ: 2.3

7. In the excitation-contraction process of generating tension or force in skeletal muscle, ATP is needed only for the "power stroke" part of the process.

ANS: F DIF: Comprehension REF: 42 OBJ: 2.3

8. ATP is the known as the energy currency because it is the primary source of energy in the body.

ANS: T DIF: Recall/comprehension REF: 42 OBJ: 2.3

9. ATP is the direct source of energy for the body to perform work. The energy contained in food must be biochemically transformed to ATP.

ANS: T DIF: Comprehension REF: 44 OBJ: 2.4

10. The majority of ATP stored in skeletal muscle cannot be used for force production, even during very high intensity exercise.

ANS: T DIF: Comprehension REF: 44 OBJ: 2.3

11. ATP can be depleted in skeletal muscle by voluntary, high-intensity exercise.

ANS: F DIF: Comprehension REF: 44 OBJ: 2.3

12. The three energy systems that replenish ATP are creatine phosphate, anaerobic glycolysis, and oxidative phosphorylation.

ANS: T DIF: Recall/comprehension REF: 44 OBJ: 2.4

13. *Bioenergetics* is a term used to describe the physiological process of breaking down foods into usable forms of energy.

ANS: T DIF: Recall/comprehension REF: 38 OBJ: 2.1

14. The precise energy (caloric) content of a food consumed cannot be determined.

ANS: T DIF: Comprehension REF: 46-47 OBJ: 2.5

15. A large portion of the potential energy that is contained in food is converted to heat.

ANS: T DIF: Comprehension REF: 39|47 OBJ: 2.2|2.5

16. To obtain an accurate measurement of resting metabolic rate it is not necessary for an athlete to abstain from resistance or endurance exercise in the hours prior to the test.

ANS: F DIF: Comprehension REF: 49 OBJ: 2.5

17. The greatest source of error when using a food diary is the inaccurate recording of the amount and type of foods and beverages consumed.

ANS: T DIF: Recall/comprehension REF: 52 OBJ: 2.6

18. Most individuals, including athletes, underestimate their energy intake by approximately 15 to 20 percent.

ANS: T DIF: Recall/comprehension REF: 52 OBJ: 2.5

19. Even in sedentary individuals, physical activity is the largest component of "energy out."

ANS: F DIF: Comprehension REF: 53 OBJ: 2.6

20. The thermic effect of food is estimated to be 10% of total energy expenditure.

ANS: T DIF: Recall REF: 53 OBJ: 2.6

21. Basal metabolic rate and resting metabolic rate are typically the same.

ANS: F DIF: Comprehension REF: 53 OBJ: 2.7

22. Self-imposed starvation (severe dieting) can result in a reduced resting metabolic rate and can actually impede weight loss.

ANS: T DIF: Comprehension REF: 54 OBJ: 2.7

23. Resting metabolic rate is reduced due to starvation, but it increases almost immediately when the starvation state is stopped.

ANS: F DIF: Comprehension REF: 54 OBJ: 2.7

24. Fat-free tissue is more metabolically active than adipose tissue.

ANS: T DIF: Comprehension REF: 54 OBJ: 2.7

25. Exercise and hormonal changes may raise resting metabolic rate but their effects are subtle rather than dramatic.

ANS: T DIF: Comprehension REF: 55 OBJ: 2.7

26. Most prediction equations for estimating resting metabolic rate have a small margin of error of about 2-3%.

ANS: F DIF: Recall REF: 56 OBJ: 2.7

27. The Cunningham equation may be the best equation to use with athletes because it accounts more accurately for fat-free mass.

ANS: T DIF: Recall REF: 57 OBJ: 2.7

28. Most of the published estimates of the energy (kcal) expended from a specific physical activity are not for the movement alone, but include resting metabolic rate.

ANS: T DIF: Recall REF: 59 OBJ: 2.8

29. Measuring heart rate during exercise is a practical, fairly accurate way to predict the amount of energy being expended during exercise.

ANS: F DIF: Recall REF: 60 OBJ: 2.8

30. A quick estimate of daily energy expenditure ranges from 30 to > 50 kcal/kg of body weight, depending on the amount of physical activity included.

ANS: T DIF: Recall REF: 62 OBJ: 2.9

Matching

Match the energy measurement technique with the statement that best describes it. Use each answer only once.

a. Gas-exchange method used in many exercise physiological labs
b. Used in free-living situations to measure energy expenditure over weeks
c. Used to directly measure thermal energy in food
d. Direct calorimetry method used with humans for research purposes

1. Room-size calorimeter
2. Metabolic cart
3. Bomb calorimeter
4. Doubly-labeled water

Answers:

1. ANS: d DIF: Comprehension REF: 47-48 OBJ: 2.5
2. ANS: a DIF: Comprehension REF: 48 OBJ: 2.5
3. ANS: c DIF: Comprehension REF: 46 OBJ: 2.5
4. ANS: b DIF: Comprehension REF: 50 OBJ: 2.5

Completion

1. Rephosphorylation is an example of an _____ reaction.

ANS: endergonic
DIF: Recall/comprehension REF: 44 OBJ: 2.2|2.4

2. Carbohydrate foods contain approximately _____ kcal/g.

ANS: 4 DIF: Recall/comprehension REF: 46 OBJ: 2.1|2.5

3. In healthy individuals, the two factors that are known to decrease resting metabolic rate are age and _____.

ANS: starvation (famine or severe dieting)
DIF: Recall/comprehension REF: 54 OBJ: 2.5|2.7

4. The most practical, effective, and healthful way to increase resting metabolic rate is to _____.

ANS: increase skeletal muscle mass
DIF: Recall/comprehension REF: 53-54 OBJ: 2.7

5. The most variable aspect of the "energy out" side of the energy balance equation is _____.

ANS: daily physical activity
DIF: Recall/comprehension REF: 58 OBJ: 2.6|2.7|2.8

6. When "energy in" is greater than "energy out" a person's body weight will _____.

ANS: increase DIF: Recall/comprehension REF: 61 OBJ: 2.6

Essay

1. Explain why calculating the caloric content of one's diet could be both beneficial and detrimental.

   ANS: See pp. 47, 52. DIF: Analysis/synthesis OBJ: 2.6

2. Explain why the measurement of energy by a bomb calorimeter and a human calorimeter is the same or different for the four energy-containing nutrients.

   ANS: See pp. 46-47. DIF: Analysis OBJ: 2.5

3. What are the commonly used units of measure for energy in the fields of nutrition and exercise physiology, and how do they relate to the SI unit of measure for energy?

   ANS: See pp. 44-45. DIF: Recall/comprehension OBJ: 2.1|2.5

4. Distinguish between direct and indirect calorimetry. Compare and contrast several different measures of indirect calorimetry, considering accuracy and ease of use.

   ANS: See pp. 47-50. DIF: Comprehension/analysis/synthesis OBJ: 2.5

5. Explain several reasons why estimates of resting metabolic rate could be inaccurate.

   ANS: See p. 49. DIF: Comprehension OBJ: 2.7

6. List and explain the factors that affect resting metabolic rate. Which factors are considered the most substantial influences? The least substantial? Why?

   ANS: See pp. 53-56. DIF: Analysis OBJ: 2.7

7. Explain to a member of a health and fitness club why severely restricting food intake is not recommended and why it may be detrimental to the goal of permanent weight loss.

   ANS: See p. 54. DIF: Comprehension/analysis OBJ: 2.6|2.7

8. What is the most accurate way of measuring total daily energy expenditure? What are the most practical ways to measure it in a laboratory research setting? In an exercise physiology laboratory? In field research? In a health and fitness club?

   ANS: See pp. 47-50, 53. DIF: Analysis/synthesis OBJ: 2.5

9. What is meant by the statement, "Food = fuel = exercise"?

   ANS: See p. 61. DIF: Analysis OBJ: 2.6