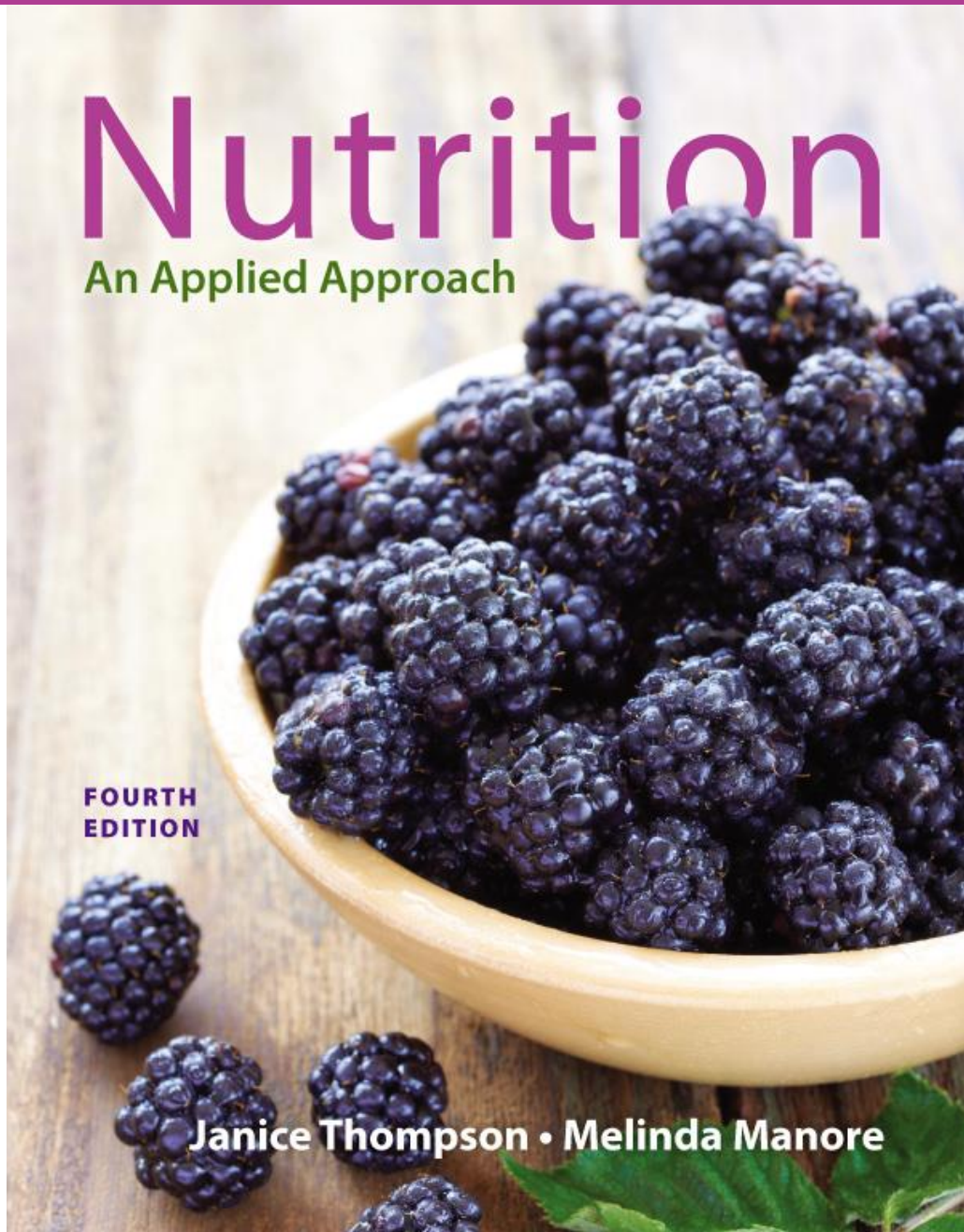
Nutrition and Physical Activity: Keys to Good Health



Physical Activity and Fitness

Physical activity: any muscle movement that increases energy expenditure

Leisure-time physical activity: any activity unrelated to a person's occupation

- For example, hiking, walking, biking
- Includes exercise—purposeful, planned physical activity

Physical Activity and Fitness

Physical fitness: the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies

The components of physical fitness are

- Cardiorespiratory fitness
- Musculoskeletal fitness
- Flexibility
- Body composition

Components of Fitness

TABLE 12.1 The Components of Fitness

Fitness Component	Examples of Activities One Can Do to Achieve Fitness in Each Component
Cardiorespiratory	Aerobic-type activities, such as walking, running, swimming, cross-country skiing
Musculoskeletal fitness:	Resistance training, weight lifting, calisthenics, sit-ups, push-ups
Muscular strength	Weight lifting or related activities using heavier weights with few repetitions
Muscular endurance	Weight lifting or related activities using lighter weights with more repetitions
Flexibility	Stretching exercises, yoga
Body composition	Aerobic exercise, resistance training

Physical Activity and Fitness

The components of physical fitness are achieved through three types of exercise

- Aerobic exercise
- Resistance training
- Stretching

Physical Activity and Chronic Disease

Regular physical activity

- Reduces the risk of heart disease, stroke, and high blood pressure
- Reduces the risk for obesity
- Reduces the risk for type 2 diabetes
- May reduce the risk of colon cancer
- Reduces the risk for osteoporosis

Health Benefits of Physical Activity

Reduces risk of heart disease, strengthens heart, reduces risk of high blood pressure

Increases lung efficiency and capacity

Reduces risk of type 2 diabetes

Reduces risk of colon cancer

Strengthens immune system

Strengthens bones

Reduces risk of bone, muscle, and joint injuries

Promotes healthful body composition and weight management

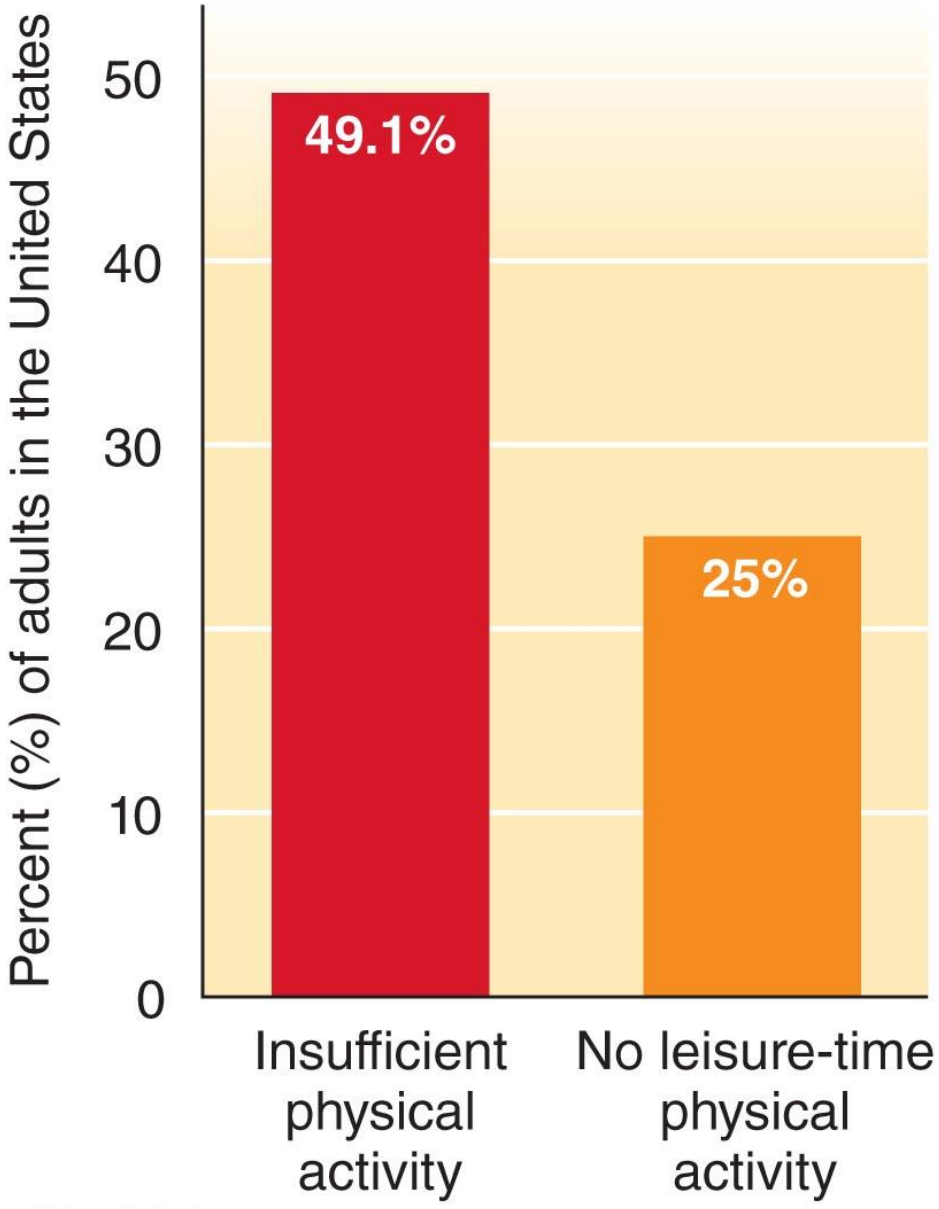
Benefits psychological health and stress management

Physical Activity and Most Americans

Despite the clear benefits of regular physical activity,

- Almost half of all U.S. adults do not perform sufficient physical activity
- 25% of U.S. adults admit to doing no leisure-time physical activity at all
- Less than 30% of girls and 35% of boys participate in daily physical education (PE)

Rates of Physical Activity in the U.S.



Designing a Sound Fitness Program

For a sound fitness program:

- Start by assessing your current level of fitness
- Identify your personal fitness goals
- Make your program varied, consistent, and fun
- Appropriately overload your body
- Include a warm-up and cool-down period
- Start out slowly and gradually build up the time you spend each day until you reach 30 minutes

Sound Fitness Program

A sound physical fitness program meets your personal fitness goals

An individual's fitness program may vary depending on whether he or she is

- Training for athletic competition
- Working toward cardiorespiratory fitness
- Trying to maintain overall health

Sound Fitness Program

A sound physical fitness program is fun

An individual's fitness program should focus on what he or she enjoys

- Outdoor activities
- Social recreation

Sound Fitness Program

A sound physical fitness program includes variety and consistency

Variety can be achieved by

- Combining aerobic exercise, resistance training, and stretching
- Combining indoor and outdoor exercises
- Taking different routes when walking or jogging
- Including entertainment such as music
- Participating in different activities each week

Sound Fitness Program

A sound physical fitness program appropriately overloads the body

Overload principle: put additional physical demands on the body to improve fitness

- Too much physical exertion is *not* recommended
- The FITT principle can be used to determine appropriate overload

The FITT Principle

The FITT principle

- Frequency: the number of activity sessions per week
  - Desired frequency varies with fitness goals
- Intensity: the amount of effort expended or how difficult the activity is to perform
  - Desired intensity may be based on maximal heart rate

The FITT Principle

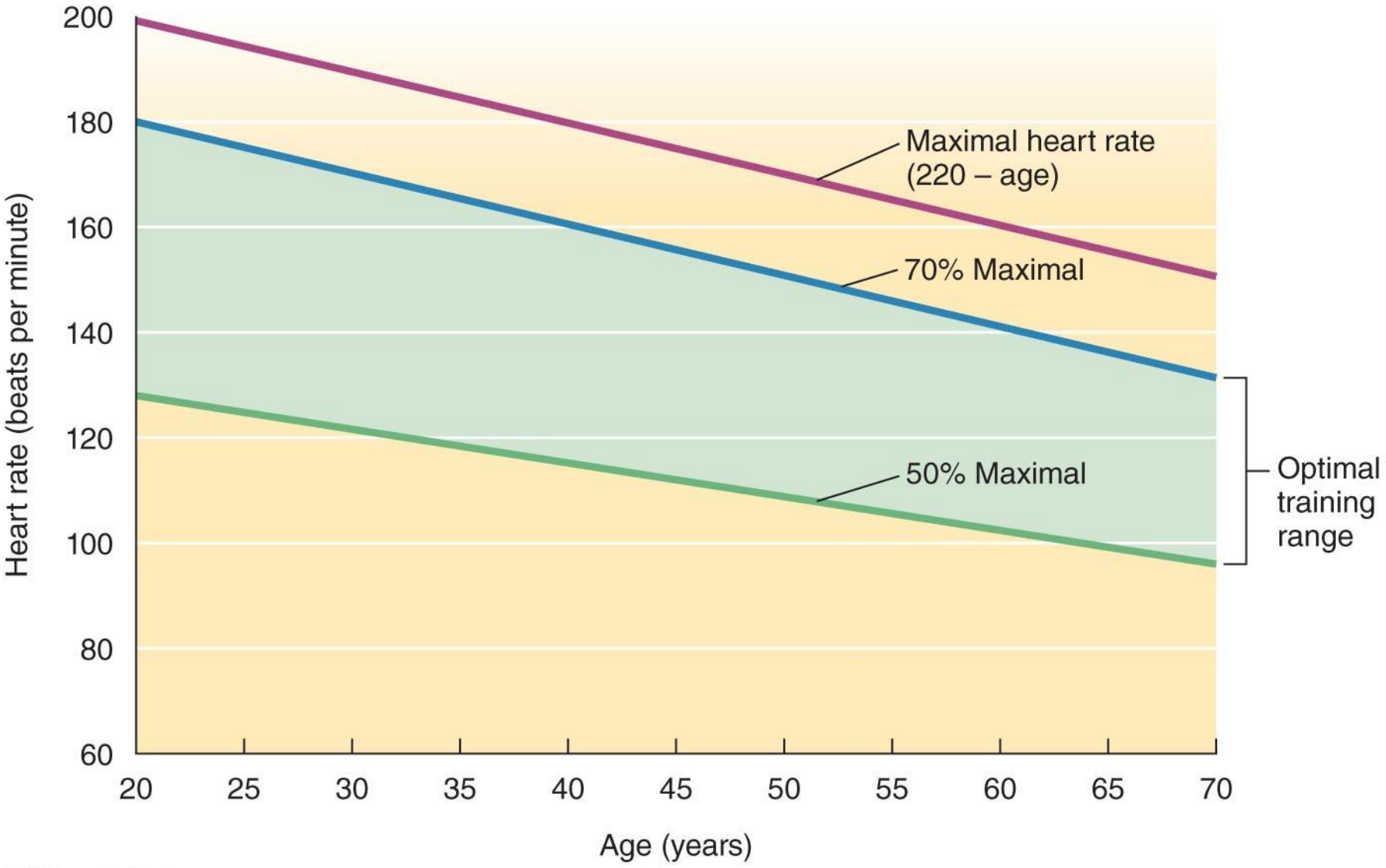
The FITT principle

- Time of activity: how long each session lasts
- Type of activity: the range of activities engaged in to promote health and physical fitness

Using the FITT principle

	Frequency	Intensity	Time and Type
Cardiorespiratory fitness 	At least 30 minutes most days of the week	50–70% maximal heart rate for moderate intensity; 70–85% maximal heart rate for vigorous intensity	At least 30 consecutive minutes Choose swimming, walking, running, cycling, dancing, or other aerobic activities
Muscular fitness 	2–3 days per week	70–85% maximal weight you can lift	1–3 sets of 8–12 lifts for each set A minimum of 8–10 exercises involving the major muscle groups such as arms, shoulders, chest, abdomen, back, hips, and legs, is recommended.
Flexibility 	2–4 days per week	Stretching through full range of motion	For stretching, perform 2–4 repetitions per stretch. Hold each stretch for 15–30 seconds. Or try yoga, tai chi, or other flexibility programs.

Maximal Heart Rate Training Chart



Sound Fitness Program

A sound physical fitness program includes a warm-up period and a cool-down period

Warm-up

- Should be brief (5 to 10 minutes), gradual, and sufficient to increase muscle and body temperature
- Includes aerobics, calisthenics, and stretching
- Enhances flexibility and helps prepare you psychologically for the activity to come

Sound Fitness Program

A sound physical fitness program includes a warm-up period and a cool-down period

Cool-down

- Should be gradual
- Includes some of the same activities as in the exercise session, along with stretching
- Assists in preventing injury and may help reduce muscle soreness

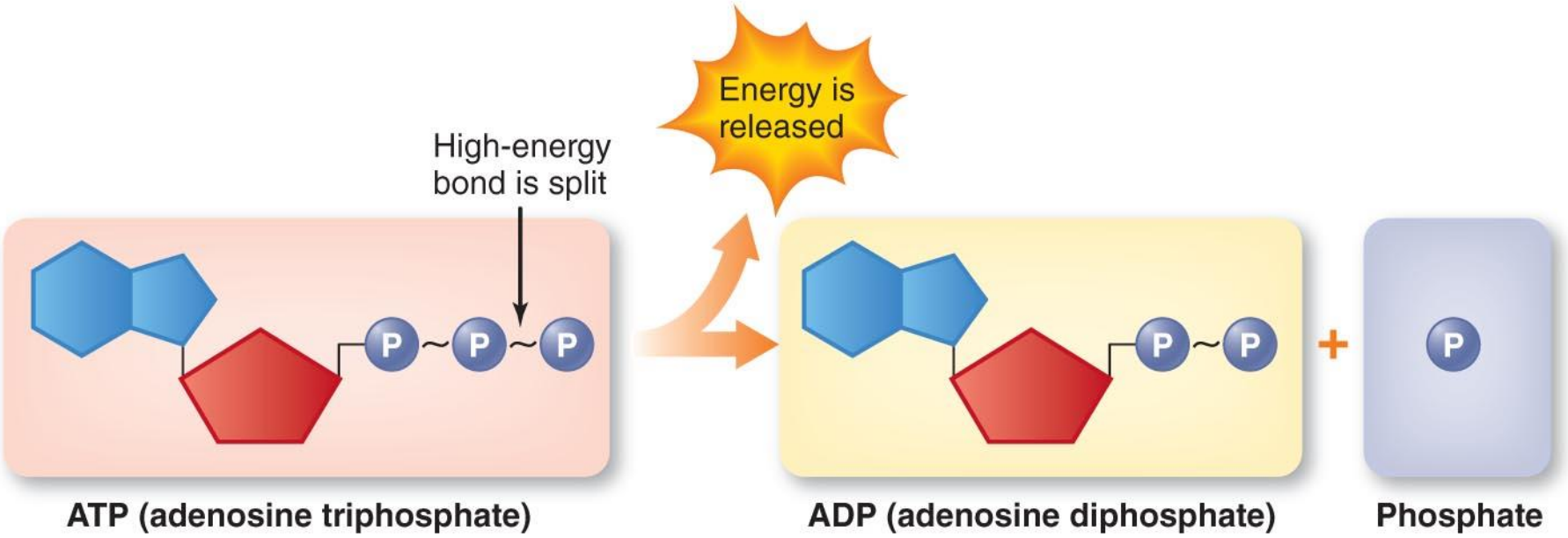
Fuel for Physical Activity

The common currency for energy in the body is adenosine triphosphate, or ATP

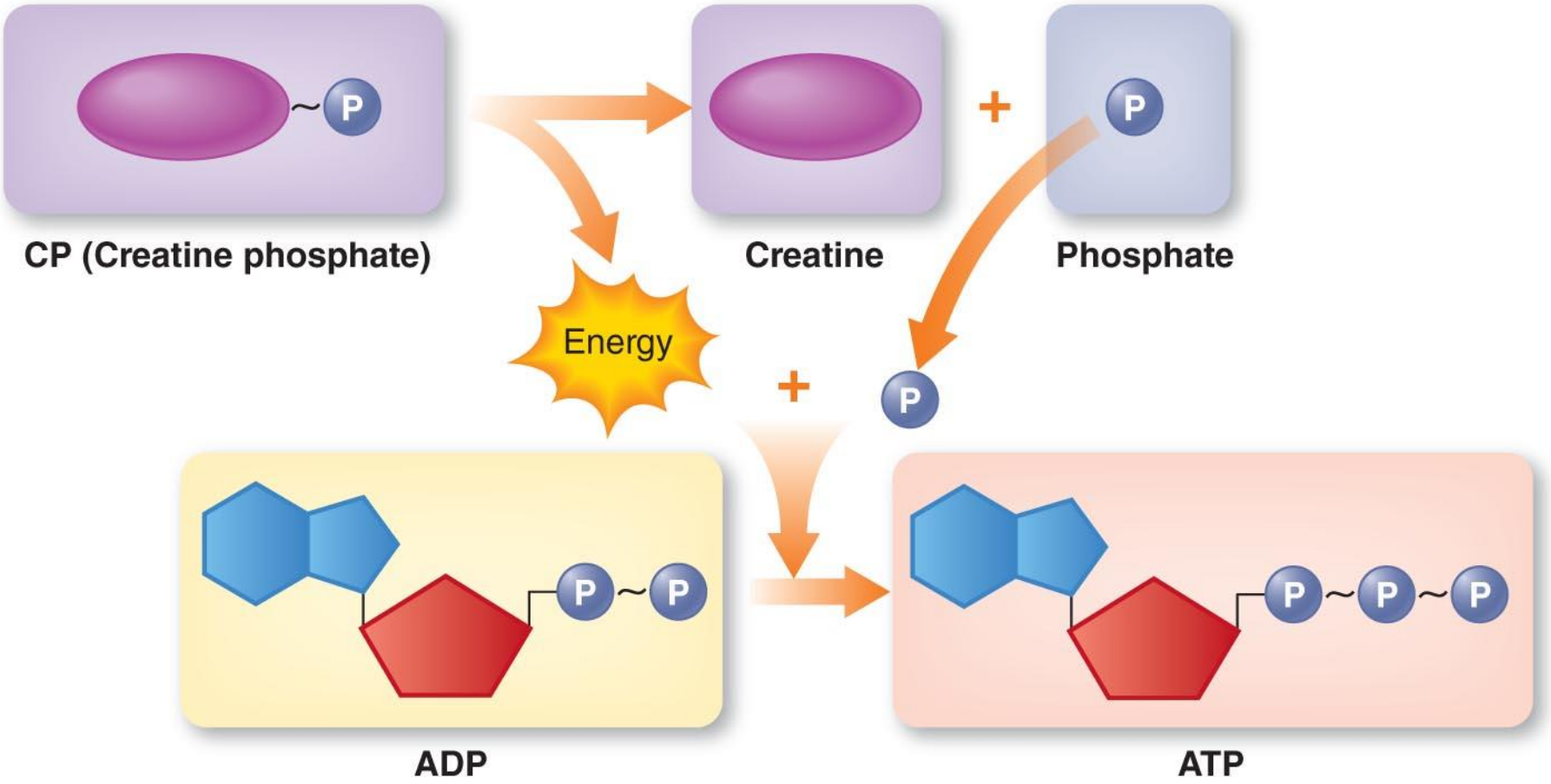
After depleting ATP stores, muscles turn to other energy sources

- Creatine phosphate (CP) stores energy that can be used to generate ATP
  - Creatine phosphate can be broken down to support the regeneration of ATP for enough energy for 3–15 seconds of maximal physical effort

Adenosine Triphosphate (ATP)



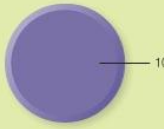
Creatine Phosphate (CP)



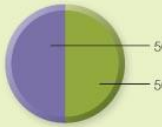
Energy Balance

Depending on the duration and intensity of the activity, our bodies may use ATP-CP, carbohydrate, or fat in various combinations to fuel muscular work. Keep in mind that the amounts and sources shown below can vary based on the person's fitness level and health, how well fed the person is before the activity, and environmental temperatures and conditions.

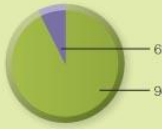
SPRINT START (0–3 seconds)
A short, intense burst of activity like sprinting is fueled by ATP and creatine phosphate (CP) under anaerobic conditions.



100-M DASH (10–12 seconds)
ATP and CP provide energy for about 10 seconds of quick, intense activity, after which energy is provided as ATP from the breakdown of carbohydrates.

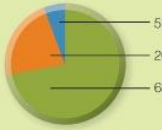


1500-M RACE (4–6 minutes)
Energy derived from ATP and CP is small and would be exhausted after about 10 seconds of the race. At this point, most of the energy is derived from aerobic metabolism of primarily carbohydrates.



10-KM RACE (30–40 minutes)
During moderately intense activities such as a 10-kilometer race, ATP is provided by fat and carbohydrate metabolism. As the intensity increases, so does the utilization of carbohydrates for energy.

MARATHON (2.5–3 hours)
During endurance events such as marathons, ATP is primarily derived from carbohydrates, and to a lesser extent, fat. A very small amount of energy is provided by the breakdown of amino acids to form glucose.



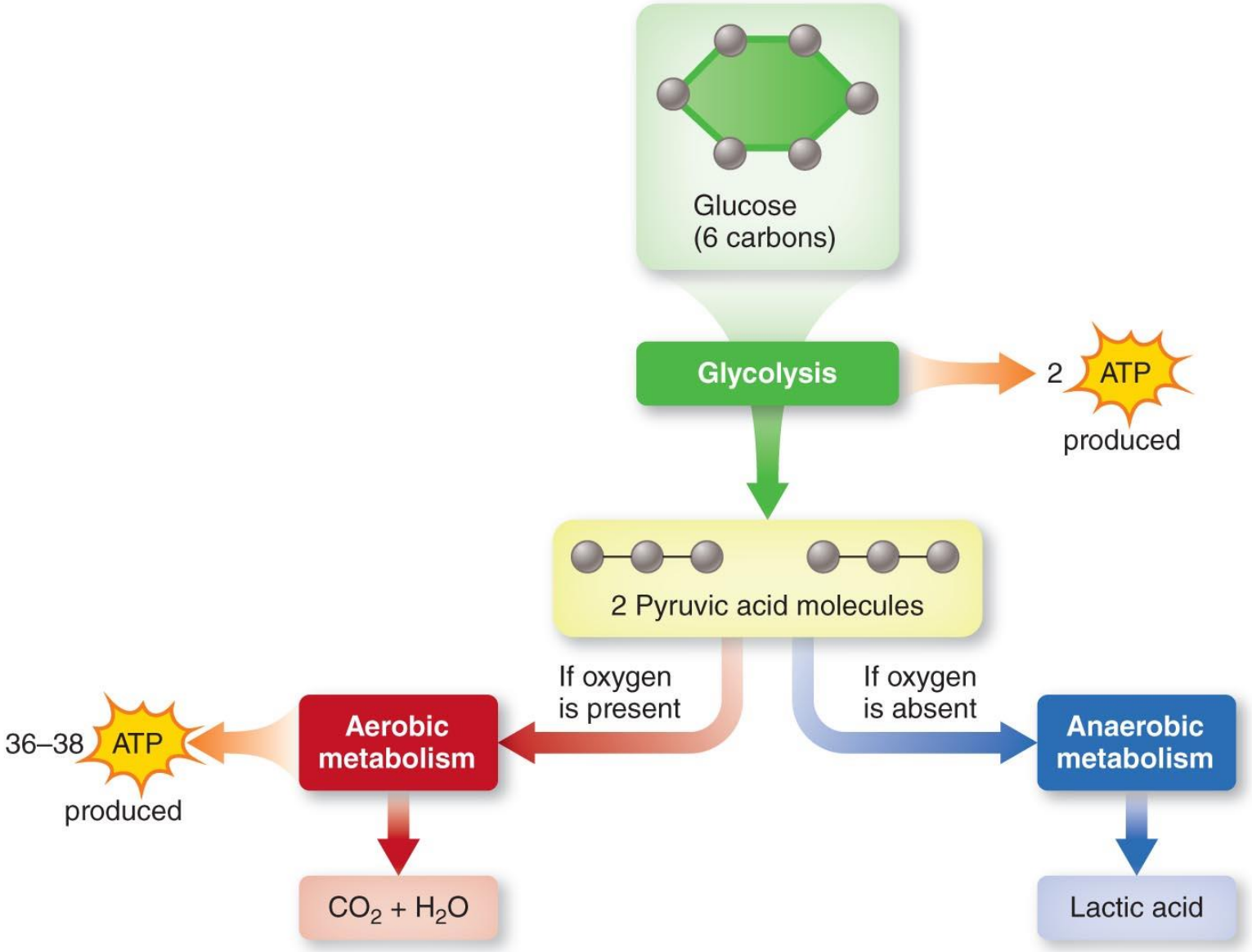
DAY-LONG HIKE (5.5–7 hours)
The primary energy source for events lasting several hours at low intensity is fat (free fatty acids in the bloodstream) which derive from triglycerides stored in fat cells. Carbohydrates contribute a relatively smaller percentage of energy needs.

Fuel for Physical Activity

Metabolism of glucose

- Anaerobic (without oxygen) breakdown of glucose yields two ATP molecules
  - Lactic acid is produced
- Aerobic (with oxygen) breakdown of glucose yields 36–38 molecules of ATP
  - CO_2 and H_2O are produced

Metabolism of Glucose



Fuel for Physical Activity

Stored triglycerides (fats) can be metabolized to generate ATP

- For low-intensity exercise
- For exercise of long duration
- A very abundant energy source, even in lean people
- Provides more than two times the energy per gram as carbohydrate

Fuel for Physical Activity

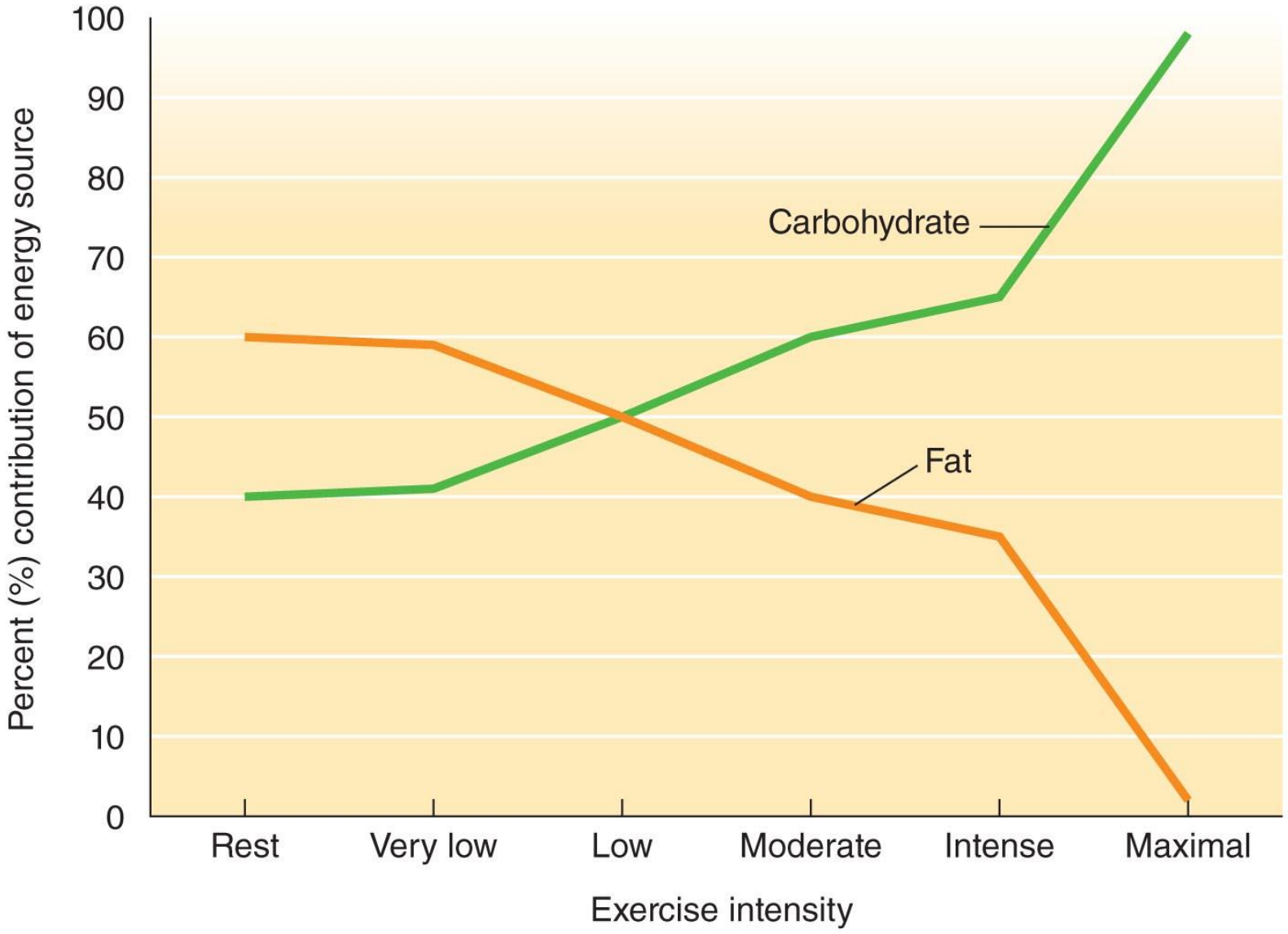
Carbohydrates and fats can both be used as energy sources for the production of ATP

- Carbohydrates are mostly used for high-intensity activity
- Fats are used for low-intensity exercise

Proteins (amino acids) are not a major fuel source for exercise

- 1–6% of energy needs during exercise

Fat and Carbohydrate Contributions



Energy Needs for Physical Activity

Energy needs

- Energy needs may be higher for athletes
- Different energy needs for males and females
- Depend on body size
- Depend on the type, intensity, and duration of physical activity

Nutrients for Vigorous Physical Activity

TABLE 12.2 Suggested Intakes of Nutrients to Support Vigorous Exercise

Nutrient	Functions	Suggested Intake
Energy	Supports exercise, activities of daily living, and basic body functions	Depends on body size and the type, intensity, and duration of activity For many female athletes: 1,800 to 3,500 kcal/day For many male athletes: 2,500 to 7,500 kcal/day
Carbohydrate	Provides energy, maintains adequate muscle glycogen and blood glucose; high complex carbohydrate foods provide vitamins and minerals	45–65% of total energy intake Depending on sport and gender, should consume 6–10 g of carbohydrate per kg body weight per day
Fat	Provides energy, fat-soluble vitamins, and essential fatty acids; supports production of hormones and transport of nutrients	20–35% of total energy intake
Protein	Helps build and maintain muscle; provides building material for glucose; energy source during endurance exercise; aids recovery from exercise	10–35% of total energy intake Endurance athletes: 1.2–1.5 g per kg body weight Strength athletes: 1.3–1.8 g per kg body weight
Water	Maintains temperature regulation (adequate cooling); maintains blood volume and blood pressure; supports all cell functions	Consume fluid before, during, and after exercise Consume enough to maintain body weight Consume at least 8 cups (64 fl. oz) of water daily to maintain regular health and activity Athletes may need up to 10 liters (170 fl. oz) every day; more is required if exercising in a hot environment
B-vitamins	Critical for energy production from carbohydrate, fat, and protein	May need slightly more (one to two times the RDA) for thiamin, riboflavin, and vitamin B_6
Calcium	Builds and maintains bone mass; assists with nervous system function, muscle contraction, hormone function, and transport of nutrients across cell membrane	Meet the current RDA: 14–18 years: 1,300 mg/day 19–50 years: 1,000 mg/day 51–70 years: 1,000 mg/day (men); 1,200 mg/day (women) 71 and older: 1,200 mg/day
Iron	Primarily responsible for the transport of oxygen in blood to cells; assists with energy production	Consume at least the RDA: Males: 14–18 years: 11 mg/day 19 and older: 8 mg/day Females: 14–18 years: 15 mg/day 19–50 years: 18 mg/day 51 and older: 8 mg/day

Eating for Athletes

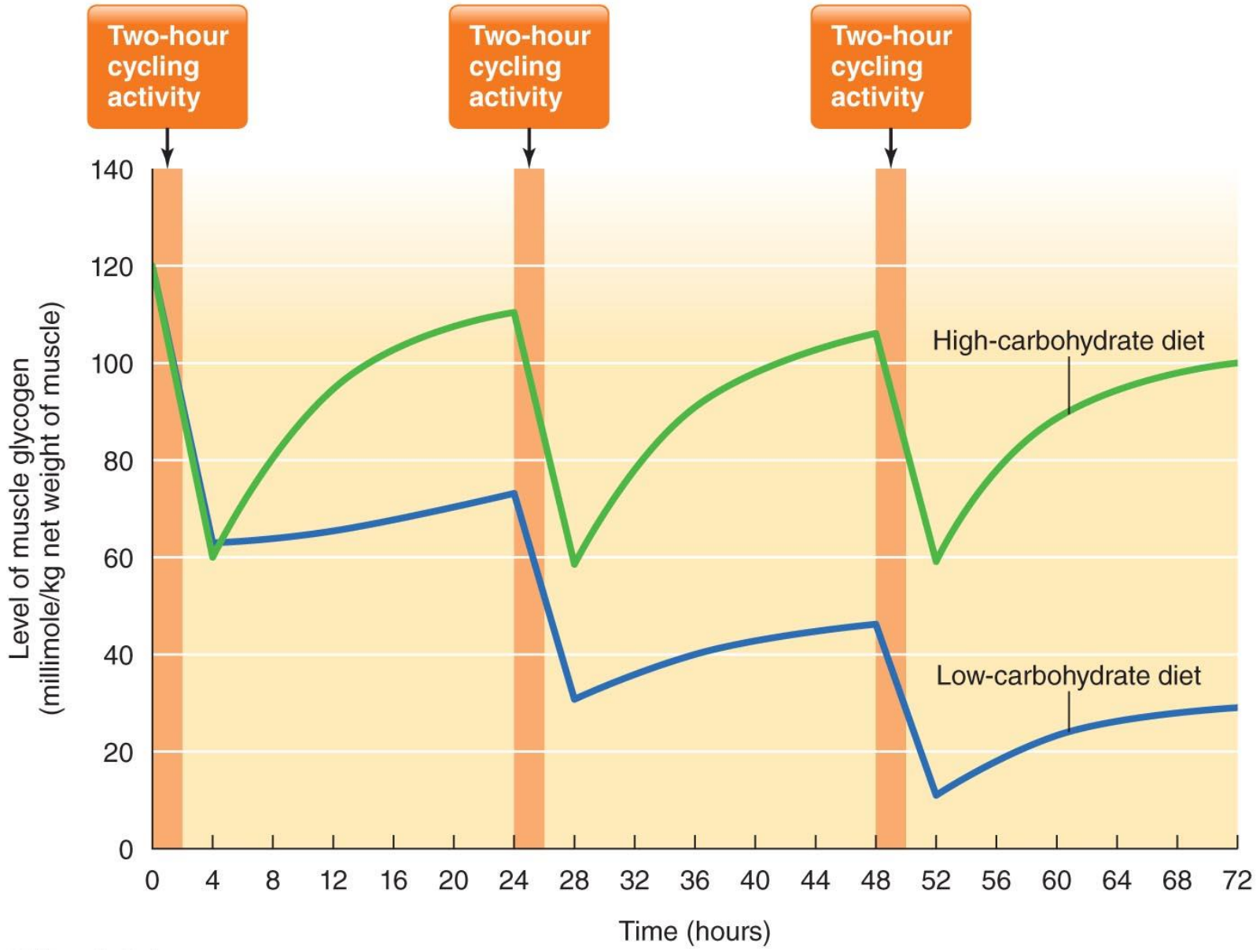
Eating for Athletes: Meeting High Energy Demands

	About 1,800 kcal/day	About 4,000 kcal/day
Breakfast	 1 cup Cheerios 4 oz skim milk 1 medium banana 6 fl. oz orange juice	 1½ cups Cheerios 8 fl. oz skim milk 1 medium banana 2 slices whole-wheat toast 1 tbsp. butter 6 fl. oz orange juice
Snack	 1 small apple	 1 large apple 2 tbsp. peanut butter
Lunch	 Turkey sandwich with: 2 slices whole-wheat bread 3 oz turkey lunch meat 1 oz Swiss cheese slice 1 leaf iceberg lettuce 2 slices tomato 1 cup tomato soup (made with water)	 Two turkey sandwiches with: 2 slices whole-wheat bread 3 oz turkey lunch meat 1 oz Swiss cheese slice 1 leaf iceberg lettuce 2 slices tomato 2 cups tomato soup (made with water) Two 8-oz containers of low-fat fruit yogurt 12 fl. oz Gatorade
Snack	 1 8-oz nonfat fruit yogurt ¼ cup dried, sweetened cranberries	 ¼ cup trail mix
Dinner	 4 oz grilled skinless chicken breast 1½ cups mixed salad greens 1 tbsp. French salad dressing 1 cup steamed broccoli ½ cup cooked brown rice 4 fl. oz skim milk	 6 oz grilled skinless chicken breast 3 cups mixed salad greens 3 tbsp. French salad dressing 2 cups cooked spaghetti noodles 1 cup spaghetti sauce with meat 8 fl. oz skim milk

Carbohydrate Intake for Physical Activity

- Athletes should consume carbohydrate within the AMDR of 45–65% of total energy intake
- Athletes should consume a daily carbohydrate intake of 6–10 grams per kg body weight to optimize glycogen stores
- Good sources are fiber-rich, less processed foods such as whole grains, cereals, vegetables, and juices

Carbohydrates and Muscle Glycogen Stores



Carbohydrate in Various Foods

TABLE 12.3 Carbohydrate and Total Energy in Various Foods

Food	Amount	Carbohydrate (g)	Energy from Carbohydrate (%)	Total Energy (kcal)
Sweetened applesauce	1 cup	50	97	207
Large apple with	1 each	50	82	248
saltine crackers	8 each			
Whole-wheat bread	1-oz slice	50	71	282
with jelly	4 tsp.			
and skim milk	12 fl. oz			
Spaghetti (cooked)	1 cup	50	75	268
with tomato sauce	1/4 cup			
Brown rice (cooked)	1 cup	100	88	450
with mixed vegetables	1/2 cup			
and apple juice	12 fl. oz			
Grape-Nuts cereal	1/2 cup	100	84	473
with raisins	3/8 cup			
and skim milk	8 fl. oz			
Clif Bar (chocolate chip)	2.4 oz	43	75	230
Meta-Rx (fudge brownie)	100 g	41	41	400
Power Bar (chocolate)	1 bar	45	75	240
PR Bar Ironman	50 g	22	44	200

Data adapted from: Manore, M. M., N. L. Meyer, and J. L. Thompson. 2009. *Sport Nutrition for Health and Performance,* 2nd edn. Champaign, IL: Human Kinetics.

Carbohydrate Intake for Physical Activity

Carbohydrate loading, or glycogen loading, involves altering training and carbohydrate intake so that muscle glycogen storage is maximized

- May benefit athletes competing in marathons, distance swimming, cross-country skiing, and triathlons
- Does not always improve performance
- Can lead to adverse side effects

Carbohydrate Loading Guidelines

TABLE 12.4 Recommended Carbohydrate Loading Guidelines for Endurance Athletes

Days Prior to Event	Exercise Duration (in minutes)	Carbohydrate Content of Diet (g per kg body weight)
6	90 (at 70% max effort)	5 (moderate)
5	40 (at 70% max effort)	5 (moderate)
4	40 (at 70% max effort)	5 (moderate)
3	20 (light training)	10 (high)
2	20 (light training)	10 (high)
1	Rest	10 (high)
Day of race	Competition	Precompetition food and fluid

Data adapted from: Current Trends in Performance Nutrition, by Marie Dunford. Copyright © 2005 by Human Kinetics, Champaign, IL. Reprinted with permission.

Fat Intake for Physical Activity

Fat intake of 20–35% of total energy intake is generally recommended for both athletes and non-athletes, with less than 10% as saturated fat

Fat provides energy, fat-soluble vitamins, and essential fatty acids

- Inadequate levels can prove detrimental to training and performance

Protein Intake for Physical Activity

- Protein intakes suggested for active people range from 1.0 to 1.8 grams per kg of body weight
- Athletes who train 5–7 times a week for more than an hour a day may benefit from protein intakes as high as 1.8 to 2.0 grams per kg per day
- High-quality sources include lean meats, poultry, fish, eggs, low-fat dairy products, legumes, and soy products

Fluid Intake for Physical Activity

Fluids

- Enable the body's primary cooling mechanism, evaporative cooling
- Are necessary to prevent dehydration and heat-related illnesses

Fluid intake is critical for physically active people

- Drink fluids before, during, and after exercise
- Consume enough to maintain body weight
- Training in hot environments requires careful attention to water intake

Dehydration Symptoms

Symptoms of Dehydration During Heavy Exercise:

- Decreased exercise performance
- Increased level in perceived exertion
- Dark yellow or brown urine color
- Increased heart rate at a given exercise intensity
- Decreased appetite
- Decreased ability to concentrate
- Decreased urine output
- Fatigue and weakness
- Headache and dizziness

Guidelines for Fluid Replacement

TABLE 12.5 Guidelines for Fluid Replacement

Activity Level	Environment	Fluid Requirements (liters per day)
Sedentary	Cool	2–3
Active	Cool	3–6
Sedentary	Warm	3–5
Active	Warm	5–10

Before Exercise or Competition:

- Drink adequate fluids during the 24 hours before event; should be able to maintain body weight.
- Slowly drink about 0.17 to 0.24 fl. oz per kg body weight of water or a sports drink at least 4 hours prior to exercise or event to allow time for excretion of excess fluid prior to event.
- Slowly drink another 0.10 to 0.17 fl. oz per kg body weight about 2 hours before event.
- Consuming beverages with sodium and/or small amounts of salted snacks at a meal will help stimulate thirst and retain fluids consumed.

During Exercise or Competition:

- Drink early and regularly throughout event to sufficiently replace all water lost through sweating.
- Amount and rate of fluid replacement depend on individual sweating rate, exercise duration, weather conditions, and opportunities to drink.
- Fluids should be cooler than the environmental temperature and flavored to enhance taste and promote fluid replacement.

During Exercise or Competition That Lasts More Than 1 Hour:

- Fluid replacement beverage should contain 5–10% carbohydrate to maintain blood glucose levels; sodium and other electrolytes should be included in the beverage in amounts of 0.5–0.7 g of sodium per liter of water to replace the sodium lost by sweating.

Following Exercise or Competition:

- Consume about 3 cups of fluid for each pound of body weight lost.
- Fluids after exercise should contain water to restore hydration status, carbohydrates to replenish glycogen stores, and electrolytes (for example, sodium and potassium) to speed rehydration.
- Consume enough fluid to permit regular urination and to ensure the urine color is very light or light yellow in color; drinking about 125–150% of fluid loss is usually sufficient to ensure complete rehydration.

In General:

- Products that contain fructose should be limited, as these may cause gastrointestinal distress.
  Caffeine and alcohol should be avoided, as these products increase urine output and reduce fluid retention.
  Carbonated beverages should be avoided, as they reduce the desire for fluid intake due to stomach fullness.

Data adapted from: Murray, R. 1997. Drink more! Advice from a world class expert. *ACSM's Health and Fitness Journal* 1:19–23; American College of Sports Medicine Position Stand. 2007. Exercise and fluid replacement. *Med. Sci. Sports Exerc.* 39(2):377–390; and Casa, D. J., L. E. Armstrong, S. K. Hillman, S. J. Montain, R. V. Reiff, B. S. E. Rich, W. O. Roberts, and J. A. Stone. 2000. National Athletic Trainers' Association position statement: fluid replacement for athletes. *J. Athl. Train.* 35:212–224.

Micronutrient Intake for Physical Activity

The requirements for some vitamins and minerals may be elevated in athletes

- B-vitamins
- Calcium
- Iron

Adequate intake of these nutrients can be met with a healthy, balanced diet and should not require supplementation