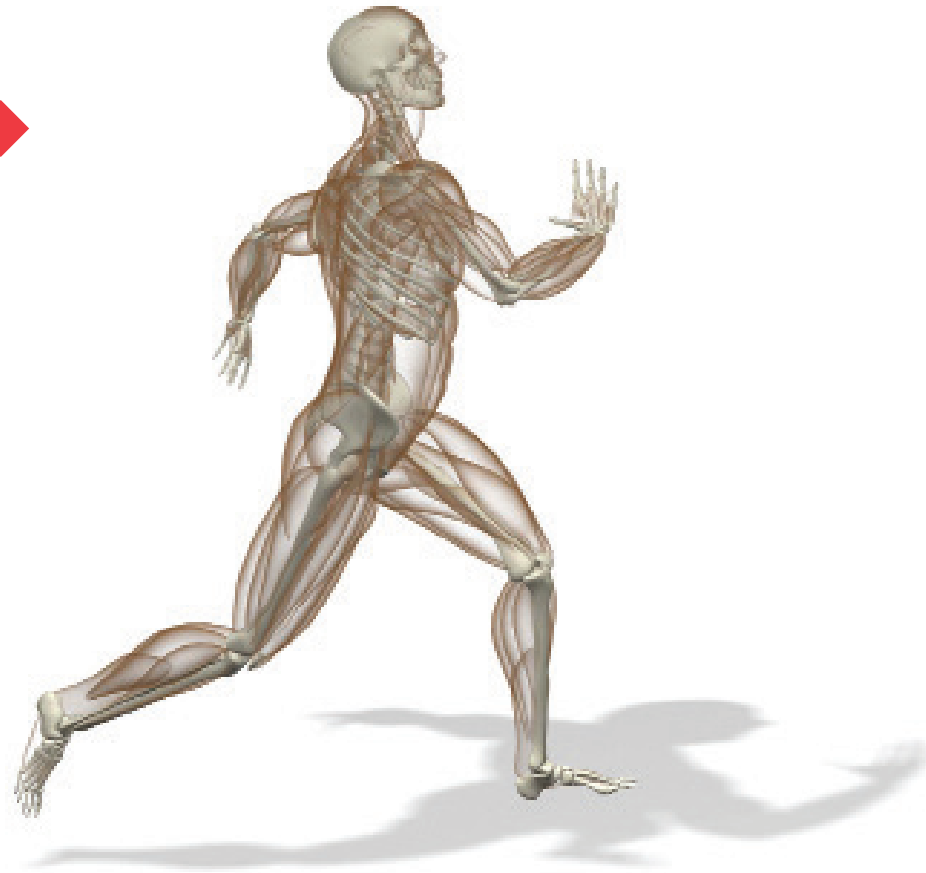
Applied Exercise Science

DOWNLOADABLE ACTIVITIES



Welcome to the Applied Exercise Science Activities.

This bonus material, as part of the ACE Academy Elite Expansion Pack, is designed to help you apply the knowledge you acquired while studying *ACE Essentials of Exercise Science for Fitness Professionals*.

The activities and case studies found in this downloadable booklet enable you to practice the concepts of human anatomy, movement terminology, nutrition and hydration, and exercise physiology as they relate to training clients.

We recommend the following to gain the most benefit from these exercises:

+ Complete the two modules "Client Communication and Rapport" and "Client Assessment" in ACE Academy Elite before completing the following activities and case studies.

+ Complete each activity and case study by typing directly into this PDF, or print the booklet and complete each exercise while on the go.

+ After completing the activities and case studies, compare your responses to ours, which can be found in the back of the booklet.

+ If you have any questions on this content, please contact the ACE Resource Center at www.ACEfitness.org/resourcecenter.

STUDY TIP

The information found here can be used as a study guide while you prepare for the ACE Personal Trainer Exam.

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After completing modules "Client Communication and Rapport" and "Client Assessment" in ACE Academy Elite, please complete Activities 1-5 and Case Studies 1-19.

Movement

ACTIVITY 1

Refer to Chapter 1 of *ACE Essentials of Exercise Science for Fitness Professionals* to fill in the table below.

Completing the information around different joint actions and the muscles associated with that motion will enhance your understanding of movement.

Action	Prime Mover (muscle name)	Synergist(s) (muscle name)	Plane of Motion
Example: Elbow flexion	*Biceps brachii*	*Brachialis*	*Sagittal*
Dorsiflexion			
Foot Inversion (subtalar joint)			
Foot Eversion (subtalar joint)			
Forearm Pronation			
Forearm Supination			
Hip Abduction			
Hip Adduction			
Hip Extension			
Hip Flexion			
Knee Extension			
Knee Flexion			
Plantarflexion			
Scapular Depression			

Action	Prime Mover (muscle name)	Synergist(s)(muscle name)	Plane of Motion
Scapular Elevation			
Scapular Protraction (abduction)			
Scapular Retraction (adduction)			
Arm Adduction			
Arm Abduction			
Shoulder Circumduction			
Shoulder External Rotation			
Shoulder Horizontal Abduction			
Shoulder Horizontal Adduction			
Shoulder Internal Rotation			
Trunk Rotation			

Now, let's apply these concepts to a real-world setting.

1. A push-up is a well-known upper-body exercise. What action at the shoulder does this movement strengthen? In which planes of movement does the humerus move during a push-up?
   a. _____
   b. _____
2. A seated row is an exercise that can strengthen which scapular action?
   a. _____
3. A lateral lunge is an exercise that can strengthen which action at the hip? When stepping sideways to perform the lateral lunge, in which plane is the whole body moving?
   a. _____
   b. _____
4. When performing a squat, which lower body joints are moving in the sagittal plane?
   a. _____
5. Performing a tennis serve or a baseball swing are examples of movement of the trunk in which plane?
   a. _____

CASE STUDY 1

An individual is performing straight-arm lateral raises using 15-pound dumbbells. What is the fulcrum during this movement? In which plane is the axis of rotation? What is the plane of movement? And how could he or she reduce the force needed to lift the dumbbell, assuming the amount of weight being lifted is unchanged?

Fulcrum: _____

Axis of rotation: _____

Plane of movement: _____

Anatomical, Directional, and Regional Terms

ACTIVITY 2

Refer to Chapter 1 of *ACE Essentials of Exercise Science for Fitness Professionals* to complete the following activities.

In the images below, identify the following anatomical, directional or regional terms: superior, inferior, anterior, posterior, medial, lateral, proximal, distal, superficial, deep, cervical, thoracic, lumbar, plantar, dorsal, palmar. Each term is used once throughout the following images.

In the image above, identify the superior and inferior aspects of the body.

1. _____
2. _____

In the image above, indicate which aspect of the arm and shoulder is proximal and which aspect is distal.

3. _____
4. _____

In the image above, indicate which aspect of the body is anterior and which aspect is posterior.

5. _____
6. _____

In the image above, identify which arrows point to the palmar, dorsal and plantar aspects of the body.

7. _____
8. _____
9. _____

In the image above, indicate which aspect of the body is deep and which aspect is superficial.

10. _____
11. _____

In the image above, identify the cervical, thoracic and lumbar regions of the spine.

12. _____
13. _____
14. _____

In the image above, indicate which aspect of the body is medial and which aspect is lateral.

15. _____
16. _____

CASE STUDY 2

An individual who has a largely sedentary job exhibits lordosis in the lumbar spine and poor sitting posture. She has a hip-flexion range of motion of 100 degrees and a hip-extension range of motion of just below 20 degrees. What is the likely cause of this individual's lordosis? What would you recommend to address this issue?

CASE STUDY 3

A client or class participant tells you that she "hates her thighs" and wants to lose the fat along her inner (i.e., medial) thighs. What would you tell this person? Are there any exercises that you would recommend to burn the fat stored in this area?

CASE STUDY 4

While assessing the standing posture of a client who has obesity, you notice that he exhibits clear signs of lumbar lordosis. In what direction is his pelvis tilted? What muscles should be the focus of this client's strengthening program and what muscles should be targeted by the flexibility program?

CASE STUDY 5

An individual who has rounded shoulders read an article that said he needed to strengthen his middle trapezius muscle. To do so, he has been adducting the scapulae in a standing position, but is frustrated with his lack of improvement. Explain why he might not be seeing great results and describe how you would address this postural issue in a resistance-training program.

CASE STUDY 6

An individual impacted by obesity who recently started a walking program based on your recommendation complains of ankle pain during her evening walks and is feeling very discouraged. Give a likely explanation for this ankle pain and explain what modifications you would provide to work around this limitation.

Nutrition

ACTIVITY 3

Refer to Chapter 4 of *ACE Essentials of Exercise Science for Fitness Professionals* to complete the table below and the related nutrition equations.

Macronutrient	Calories Per Gram	% Recommended Daily Intake	How many total calories of the specified macronutrient if food contains 11 grams?	For an average 2,000-calorie diet, how many calories are needed from this macronutrient to meet recommended guidelines?
Carbohydrate				
Protein				
Fat				

CASE STUDY 7

A client who has hired you as his personal trainer with a primary goal of losing weight eats a small snack after his midday workout while getting ready to go back to the office. It is a package of "low-fat" crackers that boasts of being "trans-fat-free" on the front of the wrapper. On closer inspection, you and the client find a small amount of "partially hydrogenated" oil on the food ingredient list. How would explain to this client what is meant by partially hydrogenated oil and why it was found on the ingredient list? What would be your recommendation regarding this snack choice?

CASE STUDY 8

One of the members of your outdoor walking group is taking a prescription diuretic to treat her hypertension. What exercise-related effects will this medication have, and what precautions should be taken to ensure her safety during each ses*sion?*

CASE STUDY 9

An analysis of a female client's dietary habits reveals the following daily consumption. What adjustments would she need to make to be in compliance with the recommendations in the *2015 Dietary Guidelines?*

1. One-third of all grains consumed are whole grains
2. 2,000 mg of sodium
3. Two alcoholic beverages
4. Generally follows the DASH eating plan

CASE STUDY 10

A client or class participant asks for advice about choosing among the many diet plans she's read about in magazines, including the Atkins diet and Jenny Craig. She first asks for your opinion, because she read that people who stick to these programs can lose substantial weight, but also asks you to provide specific eating plans and recipes to help her adhere to a diet long-term. How would you respond?

CASE STUDY 11

A prospective client tells you that she was recently diagnosed with osteoporosis and was given clearance by her physician to start an exercise program to counteract the effects of the disease. She is a smoker (half-pack per day), and knows from a previous gym membership that she enjoys riding the recumbent bike.

1. What changes to her cardiorespiratory training program would you recommend?
2. What general nutritional advice would you give her?
3. Are there any other recommendations you would share?

Energy Systems

ACTIVITY 4

Refer to Chapters 2 and 5 of *ACE Essentials of Exercise Science for Fitness Professionals* to complete the missing information and the following study questions.

Energy System	Rate of ATP production	Duration during 100% effort	Relationship to VT1 and VT2
Phosphogen			
Anaerobic Glycolysis			
Aerobic			

1. In what energy system would an exerciser primarily be working during a 100m dash at 100% effort?

   _____

2. In what energy system would an exerciser primarily be working during a college soccer match?

   _____

3. In what exergy system would an exerciser be working during a marathon or ½ marathon distance event?

   _____

CASE STUDY 12

An individual exercising at a very high intensity at high altitude experiences a painful "burning" in her muscles. Explain the physiological mechanism causing this adverse response to exercise. How would replacing her high-intensity workout with moderate-intensity exercise help change her body's response?

CASE STUDY 13

How would you respond to a client or class participant who wants to keep exercising at a low intensity to lose weight and burn body fat, instead of progressing to more intense workouts?

CASE STUDY 14

An individual performing an aerobic-training session tires after only a few minutes and begins to hyperventilate. What is the likely cause of this rapid fatigue and increased rate of respiration? Explain the physiological mechanisms at work.

CASE STUDY 15

Chronic aerobic exercise causes changes to the cardiorespiratory system, including improved cardiac efficiency, increased respiratory capacity, and increased maximal oxygen consumption. Explain, in layman's terms, how these improvements can enhance a client's quality of life.

CASE STUDY 16

A client or class participant mentions that she is concerned that she has not had a menstrual cycle in several months since increasing the intensity of her training regimen in preparation for college athletics. What might be the reason for this change and is it a real cause for concern?

CASE STUDY 17

During an outdoor training session, an individual begins sweating profusely and complains of headache and nausea. What is the most likely cause of these symptoms? How would you respond to this situation?

CASE STUDY 18

A client or class participant tells you that she recently had a blood pressure reading of 122/80 mmHg, but was not sure exactly what the two numbers represent. How would you explain the meaning of each number and what is taking place physiologically to determine those values?

CASE STUDY 19

One of your clients, an elite college athlete, has been performing high-intensity training with you for several months when he notices a decline in his physical performance during competition. He also mentions that he's been having trouble sleeping and has been feeling a bit irritable. What might be an explanation for his unexpected decline in performance? How would you alter his training program to overcome this obstacle and help him progress his fitness level?

Hydration

ACTIVITY 5

Refer to Chapters 4 and 5 of *ACE Essentials of Exercise Science for Fitness Professionals* to fill in the table below about hydration needs before, during and after exercise.

Hydration Recommendations	Before Exercise	During Exercise	Post Exercise
Water (H_2O)			
Sports Drink (for exercise lasting longer than one hour or for high-intensity exercise in a hot/humid environment)			

Now that you've completed the table above, use this information to fill in the information below about a potential client, Jen, who is an endurance athlete and weighs 140 lbs. Jen is getting ready to do a bike ride that will take 2.5 hours in a mild climate. She usually loses 2 lbs. of body weight during these training sessions.

Hydration Recommendations	Before Exercise	During Exercise	Post Exercise
Water (H_2O)			
Sports Drink (carbohydrate/electrolyte)			

American Council on Exercise™

Now that you have completed all activities and case studies, compare your responses to ours!

If you have any questions regarding these responses, please contact the ACE Resource Center for help. Available at: www.ACEfitness.org/resourcecenter.

Movement

ACTIVITY 1 RESPONSE

Refer to Chapter 1 of ACE Essentials of Exercise Science for Fitness Professionals *to fill in the table below.*

Completing the information around different joint actions and the muscles associated with that motion will enhance your understanding of movement.

Action	Prime Mover (muscle name)	Synergist(s) (muscle name)	Plane of Motion
Example: Elbow flexion	***Biceps brachii***	***Brachialis***	***Sagittal***
Dorsiflexion	Anterior tibilais	Extensor hallicus longus, extensor digitorum, peroneus tertius	Sagittal
Foot Inversion (subtalar joint)	Tibialis anterior and posterior	Flexor and extensor hallicus longus, flexor digitorum longus	Frontal
Foot Eversion (subtalar joint)	Peroneus longus and brevis, and tertius	Extensor digitorum	Frontal
Forearm Pronation	Pronator quadratus, pronator teres	Pronator Teres	Transverse
Forearm Supination	Supinator, biceps brachii	Brachioradialis	Transverse
Hip Abduction	Gluteus max (superior fibers)	Gluteus minimus/medius, TFL	Frontal
Hip Adduction	Adductor magnus	Adductor brevis and longus	Frontal
Hip Extension	Gluteus maximus	Biceps femoris, semitendionosus, semimebranosus	Sagittal
Hip Flexion	Iliopsoas, rectus femoris	TFL, pectineus, adductor longus, sartorius	Sagittal
Knee Extension	Quadriceps	Gracilis, sartorius	Sagittal
Knee Flexion	Hamstrings	Sartorius, gracilis, popliteus	Sagittal
Plantarflexion	Peroneus longus and brevis, gastric, soleus, posterior tibialis, popliteus	Plantaris, flexor hallicus longus, flexor digitorum longus	Sagittal
Scapular Depression	Lower trapezius	Pectoralis minor, subclavius	Frontal

Action	Prime Mover (muscle name)	Synergist(s)(muscle name)	Plane of Motion
Scapular Elevation	Levator scapula	Trapezius, rhomboids	Frontal
Scapular Protraction (abduction)	Serratus anterior, pectoralis minor	Subscapularis, teres major, teres minor	Frontal
Scapular Retraction (adduction)	Rhomboids, middle trapezius	Levator scapulae	Frontal
Arm Adduction	Pectoralis major, latisimus dorsi, teres major	Teres minor, subscapularus	Frontal
Arm Abduction	Deltoid	Supraspinatus	Frontal
Shoulder Circumduction	Combines movements of flexion, extension, abduction and adduction in sequences	(See movements for flexion, extension, abduction and adduction)	Multiplanar
Shoulder External Rotation	Infraspinatus and teres minor	Posterior deltoid	Transverse
Shoulder Horizontal Abduction	Posterior deltoid	Infraspinatus	Transverse
Shoulder Horizontal Adduction	Pectoralis major	Anterior deltoid	Transverse
Shoulder Internal Rotation	Subscapularis, pectoralis major	Teres major	Transverse
Trunk Rotation	Internal and external obliques	Latisumus dorsi, rectus abdominus	Transverse

Now, let's apply these concepts to a real-world setting.

1. A push-up is a well-known upper-body exercise. What action at the shoulder during a push-up? In which planes of movement does the humerus move during a push-up?
   a. Shoulder horizontal adduction
   b. Transverse, and frontal

2. A seated row is an exercise that can strengthen which scapular action?
   a. Scapular retraction (adduction)

3. A lateral lunge is an exercise that can strengthen which action at the hip? When stepping sideways to perform the lateral lunge, in which plane is the whole body moving?
   a. Hip extension and abduction
   b. Frontal

4. When performing a squat, which lower body joints are moving in the sagittal plane?
   a. Ankle, knee, hip

5. Performing a tennis serve or a baseball swing are examples of movement of the trunk in which plane?
   a. Transverse

CASE STUDY 1 RESPONSE

An individual is performing straight-arm lateral raises using 15-pound dumbbells. What is the fulcrum during this movement? In which plane is the axis of rotation? What is the plane of movement? And how could he or she reduce the force needed to lift the dumbbell, assuming the amount of weight being lifted is unchanged?

Fulcrum: The center of the shoulder joint

Axis of rotation: In the sagittal plane

Plane of movement: Frontal plane

The force could be reduced by shortening the lever arm (i.e., bending the elbow) to bring the weight closer to the fulcrum.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 3 and 16–21, for more details on how to respond to this scenario.

Anatomical, Directional, and Regional Terms

ACTIVITY 2 RESPONSE

Refer to Chapter 1 of ACE Essentials of Exercise Science for Fitness Professionals *to complete the following activities.*

In the images below, identify the following anatomical, directional or regional terms: superior, inferior, anterior, posterior, medial, lateral, proximal, distal, superficial, deep, cervical, thoracic, lumbar, plantar, dorsal, palmar. Each term is used once throughout the following images.

In the image above, identify the superior and inferior aspects of the body.

1. Superior (top)
2. Inferior (bottom)

In the image above, indicate which aspect of the arm and shoulder is proximal and which aspect is distal.

3. Proximal (closer to the shoulder)
4. Distal (further away from the shoulder)

In the image above, indicate which aspect of the body is anterior and which aspect is posterior.

5. Anterior (towards the front of the body)
6. Posterior (towards the back of the body)

In the image above, identify which arrows point to the palmar, dorsal and plantar aspects of the body.

7. Palmar (palm)
8. Dorsal (top of foot)
9. Plantar (bottom of foot)

In the image above, indicate which aspect of the body is deep and which aspect is superficial.

10. Superficial (outside)
11. Deep (inside)

In the image above, identify the cervical, thoracic and lumbar regions of the spine.

12. Cervical (C1 through C7)
13. Thoracic (T1 through T12)
14. Lumbar (L1 through L5)

In the image above, indicate which aspect of the body is medial and which aspect is lateral.

15. Medial (toward the midline)
16. Lateral (away from the midline)

CASE STUDY 2 RESPONSE

An individual who has a largely sedentary job exhibits lordosis in the lumbar spine and poor sitting posture. She has a hip-flexion range of motion of 100 degrees and a hip-extension range of motion of just below 20 degrees. What is the likely cause of this individual's lordosis? What would you recommend to address this issue?

This person is exhibiting tightness in the iliopsoas. She should stretch this muscle by standing in a forward lunge position with the front knee flexed and the back leg straight with the foot flat on the floor. From this position, she should activate her abdominal muscles to slightly flex the lumbar spine and hold for at least 15 seconds.

See *ACE Essentials of Exercise Science for Fitness Professionals,* pages 116–135, for more details on how to respond to this scenario.

CASE STUDY 3 RESPONSE

A client or class participant tells you that she "hates her thighs" and wants to lose the fat along her inner (i.e., medial) thighs. What would you tell this person? Are there any exercises that you would recommend to burn the fat stored in this area?

It is important to educate this client about that the concept of spot reduction is a myth. To decrease body-fat stores along the inner thigh, or anywhere else in the body, daily caloric expenditure must consistently exceed daily caloric intake. While hip-adduction exercises will increase muscle strength in the inner thighs, they will not specifically burn fat in this area.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 121, for more details on how to respond to this scenario.

CASE STUDY 4 RESPONSE

While assessing the standing posture of a client who has obesity, you notice that he exhibits clear signs of lumbar lordosis. In what direction is his pelvis tilted? What muscles should be the focus of this client's strengthening program and what muscles should be targeted by the flexibility program?

This client has an anterior pelvic tilt. This can be addressed by focusing on strengthening the abdominal muscles and hip extensor (hamstring) muscles, and stretching the hip flexors (iliopsoas) and spine extensors (erector spinae).

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 128, for more details on how to respond to this scenario.

CASE STUDY 5 RESPONSE

An individual who has rounded shoulders read an article that said he needed to strengthen his middle trapezius muscle. To do so, he has been adducting the scapulae in a standing position, but is frustrated with his lack of improvement. Explain why he might not be seeing great results and describe how you would address this postural issue in a resistance-training program.

His current exercise does not adequately overload the middle trapezius, because he is not lifting resistance or working opposite the pull of gravity. This exercise should be replaced with a standing exercise using elastic resistance or a cable machine (which provide resistance without relying on gravity) or with an exercise performed in a modified forward-lunge position that involves squeezing the shoulder blades together while holding dumbbells.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 140, for more details on how to respond to this scenario.

CASE STUDY 6 RESPONSE

An individual impacted by obesity who recently started a walking program based on your recommendation complains of ankle pain during her evening walks and is feeling very discouraged. Give a likely explanation for this ankle pain and explain what modifications you would provide to work around this limitation.

Many individuals with obesity shift their patterns of walking in a way that takes the force off the knees and displaces it to the ankles. The introduction of cross training is a good solution to this problem. Have this client alternate low-impact exercise on an elliptical trainer or non-weight-bearing exercise on a stationary bike with her walking during each session (e.g., 10 minutes of walking and 10 minutes of stationary cycling instead of 20 minutes of walking). Encourage her by reminding her that by decreasing her weight, she will be significantly decreasing the load or stress on all of her weight-bearing joints.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 144, for more details on how to respond to this scenario.

Nutrition

ACTIVITY 3 RESPONSE

Refer to Chapter 4 of ACE Essentials of Exercise Science for Fitness Professionals *and the article to complete the table below and the related nutrition equations.*

Macronutrient	Calories Per Gram	% Recommended Daily Intake	How many total calories of the specified macronutrient if food contains 11 grams?	For an average 2,000-calorie diet, how many calories are needed from this macronutrient to meet recommended guidelines?
Carbohydrate	4	45–65%	4 x 11 = 44	45–65% of 2000 = 900 to 1300 calories
Protein	4	10–35%, 0.8g/kg daily minimum intake 1.2–1.7 g/kg for strength training and endurance athletes	4 x 11 = 44	10–35% of 2000 = 200 to 700 calories
Fat	9	20–35%	9 x 11 = 99	20–35% of 2000 = 400 to 700 calories

CASE STUDY 7 RESPONSE

A client who has hired you as his personal trainer with a primary goal of losing weight eats a small snack after his midday workout while getting ready to go back to the office. It is a package of "low-fat" crackers that boasts of being "trans-fat-free" on the front of the wrapper. On closer inspection, you and the client find a small amount of "partially hydrogenated" oil on the food ingredient list. How would explain to this client what is meant by partially hydrogenated oil and why it was found on the ingredient list? What would be your recommendation regarding this snack choice?

Partially hydrogenated oil results from a manufacturing effort to make unsaturated fat solid at room temperature to prolong a food item's shelf life. The product is a heart-damaging fat that increases low-density lipoprotein cholesterol (LDL cholesterol—the "bad" cholesterol) even more than saturated fat. Legislation requires food manufacturers to include the amount of trans fat on the nutrition label if it contains more than 0.5 g per serving; if it is found in smaller amounts it does not need to be listed. Therefore, individuals should check the food ingredient list as well, where trans fat will be listed as partially hydrogenated oil. This client should be advised to avoid this food, as well as any others with this unhealthy ingredient.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 162, for more details on how to respond to this scenario.

CASE STUDY 8 RESPONSE

One of the members of your outdoor walking group is taking a prescription diuretic to treat her hypertension. What exercise-related effects will this medication have, and what precautions should be taken to ensure her safety during each session?

Diuretics increase the excretion of water and electrolytes by the kidneys. The loss of water leads to decreased blood volume, which can predispose an exerciser to dehydration. A person taking a diuretic should be advised to consume ample fluids before, during, and after exercise, especially in warm, humid environments.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 185, for more details on how to respond to this scenario.

CASE STUDY 9 RESPONSE

An analysis of a female client's dietary habits reveals the following daily consumption. What adjustments would she need to make to be in compliance with the recommendations in the 2015 Dietary Guidelines?

1. One-third of all grains consumed are whole grains
2. 2,000 mg of sodium
3. Two alcoholic beverages
4. Generally follows the DASH eating plan

1. Increase intake of whole grains to at least 50% of all grains consumed.
2. Sodium intake is consistent with recommendations.
3. Reduce alcohol consumption to no more than one drink per day.
4. This is consistent with recommendations.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 16, for more details on how to respond to this scenario.

CASE STUDY 10 RESPONSE

A client or class participant asks for advice about choosing among the many diet plans she's read about in magazines, including the Atkins diet and Jenny Craig. She first asks for your opinion, because she read that people who stick to these programs can lose substantial weight, but also asks you to provide specific eating plans and recipes to help her adhere to a diet long-term. How would you respond?

Unless you are a medical doctor or registered dietitian, your first response should be that it is outside your scope of practice to provide specific dietary recommendations or recipes. That said, you can share basic information about the many commercial diets on the market. The most important thing to emphasize is that most of these diets are very difficult to adhere to over the long-term (especially those that restrict a certain food group, like the Atkins diet), and can be very expensive. Since permanent weight management is the goal, as opposed to rapid and short-lived weight loss, you should recommend that she adhere to the USDA's Dietary Guidelines or the Choose MyPlate program. You could also refer her to a professional with appropriate nutrition credentials to obtain specific eating plans and recipes.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 16, for more details on how to respond to this scenario.

CASE STUDY 11 RESPONSE

A prospective client tells you that she was recently diagnosed with osteoporosis and was given clearance by her physician to start an exercise program to counteract the effects of the disease. She is a smoker (half-pack per day), and knows from a previous gym membership that she enjoys riding the recumbent bike.

1. What changes to her cardiorespiratory training program would you recommend?
2. What general nutritional advice would you give her?
3. Are there any other recommendations you would share?

1. A client with osteoporosis would benefit from weight-bearing physical activity, so a walking program or use of an elliptical machine should be incorporated in her routine. Cross training (alternating walking or elliptical training with her preferred activities) might be a good choice to improve adherence.
2. Intake of adequate calcium and vitamin D is important for people with osteoporosis.
3. Explain to her that smoking is a risk factor for osteoporosis. Therefore, she should consider making an effort to stop smoking, which would benefit her overall health and well-being.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 186, for more details on how to respond to this scenario.

Energy Systems

ACTIVITY 4 RESPONSE

Refer to Chapters 2 and 5 of ACE Essentials of Exercise Science for Fitness Professionals to complete the missing information and the following study questions.

Energy System	Rate of ATP production	Duration during 100% effort	Relationship to VT1 and VT2
Phosphogen	Very rapid	0–30 seconds	Above VT2
Anaerobic Glycolysis	Rapid	20–120 seconds	Between VT1 and VT2
Aerobic	Slow	110+ seconds	Below VT1

1. *In what energy system would an exerciser primarily be working during a 100m dash at 100% effort?*
   Phosphogen

2. *In what energy system would an exerciser primarily be working during a college soccer match?*
   Anaerobic glycolysis

3. *In what exergy system would an exerciser be working during a marathon or ½ marathon distance event?*
   Aerobic

CASE STUDY 12 RESPONSE

An individual exercising at a very high intensity at high altitude experiences a painful "burning" in her muscles. Explain the physiological mechanism causing this adverse response to exercise. How would replacing her high-intensity workout with moderate-intensity exercise help change her body's response?

Because she is exercising at high altitude, it is likely that the relative availability (i.e., partial pressure) of oxygen in the air is reduced, and the pyruvate in her muscles is being converted to lactate instead of entering the Kreb's cycle, which produces the energy needed to continue exercise. An accumulation of lactate is associated with changes in muscle pH, which contributes to muscle fatigue and may lead to a painful muscle burn. Modifying the intensity of her workout would slow down the accumulation of lactate and allow her to continue exercising for longer durations.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 74–77, for more details on how to respond to this scenario.

CASE STUDY 13 RESPONSE

How would you respond to a client or class participant who wants to keep exercising at a low intensity to lose weight and burn body fat, instead of progressing to more intense workouts?

Studies have shown that while a higher percentage of calories burned during low-intensity exercise come from fat, the total number of fat calories burned is less than during higher-intensity exercise because of the higher total number of calories burned. For example, if 41% of calories burned come from fat during a low-intensity workout (240 total calories burned), and 24% of calories burned come from fat during a high-intensity workout (450 total calories burned), then fewer fat calories were burned during the low-intensity workout (96 vs. 108), despite the higher percentage. Perhaps the most important thing to remind this client is that the total number of calories burned is what determines weight loss, regardless of the source of those calories.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 74–78, for more details on how to respond to this scenario.

CASE STUDY 14 RESPONSE

An individual performing an aerobic-training session tires after only a few minutes and begins to hyperventilate. What is the likely cause of this rapid fatigue and increased rate of respiration? Explain the physiological mechanisms at work.

If exercise intensity is so high that the body cannot meet all of the metabolic demands of the muscles via steady-state aerobic metabolism, the muscles have to supplement ATP production via anaerobic metabolism (i.e., the client has exceeded the anaerobic threshold). At this point, lactate accumulates progressively in the blood, the oxygen deficit and corresponding excess post-exercise oxygen consumption (EPOC) are extremely high, and exercise cannot be performed for more than a few minutes. As the body tries to remove acid metabolites from the system, the carbon dioxide (CO_2) provides a powerful stimulus to the respiratory system, and the body increases respiration in an attempt to "blow off" the excess CO_2.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 78–81 for more details on how to respond to this scenario.

CASE STUDY 15 RESPONSE

Chronic aerobic exercise causes changes to the cardiorespiratory system, including improved cardiac efficiency, increased respiratory capacity, and increased maximal oxygen consumption. Explain, in layman's terms, how these improvements can enhance a client's quality of life.

These improvements provide a greater physiological reserve that will allow a client to perform everyday activities with less stress and strain on the body.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 81–82 and 227–238, for more details on how to respond to this scenario.

CASE STUDY 16 RESPONSE

A client or class participant mentions that she is concerned that she has not had a menstrual cycle in several months since increasing the intensity of her training regimen in preparation for college athletics. What might be the reason for this change and is it a real cause for concern?

Excessively high levels of chronic exercise training and low body weight may decrease estrogen levels to the point where some female athletes no longer have a menstrual cycle, a condition called amenorrhea. Because this condition has been associated with osteoporosis and an increased risk of bone fractures, there is a cause for concern. This individual should be referred to a healthcare professional.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 85, for more details on how to respond to this scenario.

CASE STUDY 17 RESPONSE

During an outdoor training session, an individual begins sweating profusely and complains of headache and nausea. What is the most likely cause of these symptoms? How would you respond to this situation?

The individual is likely suffering from heat exhaustion. He or she should stop exercising, drink fluids, move to a cool, ventilated area, and lay down with the feet elevated 12 to 18 inches. The fitness professional should monitor the individual's body temperature.

See *ACE Essentials of Exercise Science for Fitness Professionals*, pages 85–87 and 224–227, for more details on how to respond to this scenario.

CASE STUDY 18 RESPONSE

A client or class participant tells you that she recently had a blood pressure reading of 122/80 mmHg, but was not sure exactly what the two numbers represent. How would you explain the meaning of each number and what is taking place physiologically to determine those values?

The first number represents the systolic blood pressure (SBP), while the second number represents the diastolic blood pressure (DBP). The systolic pressure represents the pressure on the aorta and other arteries as the heart beats and pushes blood out into the body (SBP, in this case, 122 mmHg). As blood drains from the arteries between beats, the pressure decreases to a minimum, which is the diastolic pressure (DBP, in this case, 80 mmHg).

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 215, for more details on how to respond to this scenario.

CASE STUDY 19 RESPONSE

One of your clients, an elite college athlete, has been performing high-intensity training with you for several months when he notices a decline in his physical performance during competition. He also mentions that he's been having trouble sleeping and has been feeling a bit irritable. What might be an explanation for his unexpected decline in performance? How would you alter his training program to overcome this obstacle and help him progress his fitness level?

This client is likely experiencing overtraining syndrome, which often occurs during periods of intense overload. The best way to prevent overtraining is to follow a periodization training model, which alternates between easy, moderate, and hard periods of training. This type of alternate-intensity training allows the hardest-working muscles fibers to replenish their energy stores and prepare to take on the next intense training session.

See *ACE Essentials of Exercise Science for Fitness Professionals*, page 232, for more details on how to respond to this scenario.

Hydration

ACTIVITY 5 RESPONSE

Refer to Chapters 4 and 5 of ACE Essentials of Exercise Science for Fitness Professionals *to fill in the table below about hydration needs before, during and after exercise.*

Hydration Recommendations	Before Exercise	During Exercise	Post Exercise
Water (H_2O)	Drink 500–600 mL 2 hours before exercise.	Every 10–20 minutes, drink 200–300 mL; drink based on sweat loss.	Drink 450–675 mL for every 0.5 kg of body weight lost during activity.
Sports Drink (for exercise lasting longer than one hour or for high-intensity exercise in a hot/humid environment)	Drink 17–20 ounces 2 to 3 hours prior to exercise and 10–12 ounces within 10 minutes of exercise.	For exercise lasting longer than 1 hour, consume 30–60g of carbohydrate for every hour of training; a concentration of less than 6–8% is recommended.	Aim to correct any fluid imbalances that occurred during the exercise session including water to restore hydration, carbohydrate to replenish glycogen and electrolyte to speed up rehydration.

Now that you've completed the table above, use this information to fill in the information below about a potential client, Jen, who is an endurance athlete and weighs 140 lbs. Jen is getting ready to do a bike ride that will take 2.5 hours in a mild climate. She usually loses 2 lbs. of body weight during these training sessions.

Hydration Recommendations	Before Exercise	During Exercise	Post Exercise
Water (H_2O)	Drink 500–600 mL 2 hours prior to exercise.	Consume water based on sweat rate	Drink a minimum of 1800 mL or about 2 L of water.
Sports Drink (carbohydrate/electrolyte)	Drink 17–20 ounces 2 to 3 hours prior to exercise and 10–12 ounces within 10 minutes of exercise.	Consume a carbohydrate drink with a concentration of less than 8% carbs at a rate of approximately 45 g per hour.	Aim to correct any fluid imbalances that occurred during the exercise session including water to restore hydration, carbohydrate to replenish glycogen and electrolyte to speed up rehydration. This should include both electrolytes and a carbohydrate mix.

Getting People Moving

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