

Section 1: Professional Development and Responsibility

Chapter 1. The Modern State of Health and Fitness

- The focus on scientific principles makes NASM's systems and methodologies safe and effective for any client working toward any fitness goal.
- NASM recommends that all fitness professionals maintain a focus on an evidence-based practice to attain the highest levels of success.
- Evidence-based practice is the conscientious use of current best evidence in making decisions about patient or client care.
- NASM's proprietary approach to exercise training, the OPT model, was developed with evidence-based practice as a core guiding philosophy.
- Acute disease is any suddenly occurring medical condition that can be treated and healed in a short period of time.
- A chronic disease is a medical condition that persists without quickly going away or being cured altogether.
- The terms *overweight* and *obesity* refer to a body weight that is greater than what is considered normal or healthy for a certain height, specifically due to excess body fat.
- Being overweight or obese greatly increase the chances of developing a chronic disease.
- *Cardiovascular disease* is a broad term describing numerous problems of the heart and blood vessels, including stroke, heart attacks, heart failure, heart valve problems, and arrhythmias.
- Hypertension is one of the primary risk factors for heart disease and stroke, which are the global leading causes of death.
- Cholesterol is a waxy substance found in the blood that is made up of a combination of protein and fatty acids.
- Diabetes is a disease in which blood glucose levels are too high. Glucose comes from the foods we eat.
- Insulin is a hormone produced by the pancreas that helps glucose get into cells to provide the energy for work.
- Cancer is an abnormal growth of cells that can result from a wide range of genetic and environmental factors.
- *COPD* is an umbrella term for lung diseases characterized by increased breathlessness, airflow limitation, and accelerated decline of lung function.

- Two of the most common issues at the foot and ankle are sprains and plantar fasciitis. An ankle sprain occurs when a person rolls, twists, or turns an ankle, which stretches or tears ligaments, whereas plantar fasciitis causes pain in the plantar fascia tissue located on the underside of the foot.
- The LPHC is made up of the lumbar spine (low-back area), pelvis, abdomen, and hip musculoskeletal structures; it is more commonly referred to as the “core.” The LPHC is an important anatomical structure because it connects the upper and lower halves of a person’s body.
- Shoulder dysfunction is very common in the greater population, especially in those who frequently lift objects overhead.
- Regular exercise and increased physical activity have been frequently shown by research to improve numerous types of musculoskeletal dysfunction and chronic disease.
- Understanding the scopes of practice for all adjacent allied health professionals, as well as all relevant local laws and regulations, will ensure CPTs are always working within their own scope of practice.
- Networking with other allied health professionals and certified fitness professionals can lead to great levels of success in the fitness industry.
- An NASM-CPT must always adhere to the NASM Code of Professional Conduct.

Chapter 2. The Personal Training Profession

- From working in a large health club, to training clients in their own homes, fitness professionals have numerous options to establish a personal training practice with a consistent flow of clients.
- Another employment choice for fitness professionals is starting a fitness business, which could include working with clients in their homes, running outdoor group workout programs, or opening a studio.
- As technology is evolving, there are many options for offering training services online.
- Working as an independent contractor allows a fitness professional to establish his or her own pay rates and to earn the entire amount, but operational expenses, insurance costs, and taxes must also be accounted for.
- The first step in succeeding as a CPT is offering uncompromising customer service.
- Selling personal training services is about asking a client to make a commitment to an exercise program to improve his or her own health, wellness, and fitness, which makes selling an activity of uncovering client needs and presenting solutions to those problems.
- If rapport is properly built with a prospective client, sales will feel natural and automatic.

- Forecasting techniques should be used to predict how many clients will need to be serviced to support a desired annual financial goal.
- Marketing is the process of communicating how a specific product or service will meet the wants and needs of a potential client.
- The Four Ps of marketing include product, price, promotion, and place.
- Social media and other digital marketing campaigns are extremely important for growing a modern fitness business.
- Continuing education courses are not just necessary for recertification; they can teach fitness professionals how to work with niche populations and enable the expansion of a fitness business to new and exciting areas.
- The most popular methods of earning CEUs are attending workshops or conferences or completing online education programs. Additionally, CEUs can be earned by participating in livestream webinars, reading fitness articles and passing a quiz or test, or contributing to the industry by creating content for fitness education programs, speaking at conferences, and presenting webinars.

Section 2: Client Relations and Behavioral Coaching

Chapter 3. The Psychology of Exercise

- Psychology is an important component to behavioral change and plays a key role in adopting a regular habit to exercise.
- Psychologists and psychiatrists are trained and licensed professionals who treat people with mental illnesses.
- Sport and exercise psychology is a subtopic of psychology that focuses on understanding why people participate in sports and exercise, including motives and barriers to participation.
- Extrinsic motivation happens when someone does something for rewards or recognition.
- Intrinsic motivation describes the motivation to do something that comes from within an individual; it is strongly related to long-term adherence.
- Motivation to exercise differs among individuals and will change over time; therefore, motives should be reevaluated over time.
- Common barriers to exercise include lack of time, unrealistic goals, lack of social support, social physique anxiety, lack of convenience, and ambivalence, but all barriers can be either eliminated or minimized with some basic strategies that provide realistic solutions or alternatives.
- Lack of time can be minimized by improving time management and reevaluating daily priorities.
- Setting unrealistic goals can become a barrier to exercise, therefore, the fitness professional should assist clients with setting appropriate outcome and process goals.
- Social physique anxiety refers to people feeling anxious about how others perceive their bodies and can be a barrier to exercise participation. Helping clients find activities that reduce this type of anxiety will help create a comfortable exercise environment.
- The perception barrier of exercise as inconvenient can be overcome by making the exercise experience as appealing as possible, both by providing excellent customer service in clean facilities and by helping clients find ways to exercise outside of a fitness facility.
- Ambivalence to exercise occurs when someone has mixed feelings about exercise and likely sees pros and cons to participation.
- Social influences on exercise can come from other people, the internet, or the environment; these influences can lead people both toward and away from exercise.

- Social support consists of a source (who or what provides it) and a type (instrumental, emotional, informational, and companionship), and clients will have different needs and expectations of social support.
- Instrumental support includes the tangible things that assist people with the ability to exercise, such as providing transportation to a fitness facility, assisting with childcare, or packing someone's gym bag.
- Emotional support comes from being caring, empathetic, and concerned about someone's experience with exercise.
- Showing empathy includes the ability to relate to the way another person feels or views a situation.
- Informational support is one of the main reasons why someone will seek out a fitness professional; it includes providing accurate and current information about fitness and exercise.
- Companionship support is when someone exercises with another person.
- Group influences on exercise refer to the influence held by other people over whether or not someone exercises and can come from family members, parents, exercise leaders, exercise groups, or the surrounding community.
- Parental influence is important for children and adolescents, whereas instrumental support is often cited as the most influential type of support.
- The exercise leader sets the tone of the class and is responsible for creating an inviting and inclusive exercise environment.
- Once formed, exercise groups often feel distinct from others and can lead to additional accountability and encouragement.
- The community influences exercise by the safety level of the exercise environment and the number of opportunities for exercise, which includes sidewalks, green spaces, playgrounds, and walking trails.
- Exercise provides several psychological benefits that can enhance overall well-being, including improved mood, better sleep quality, increased self-esteem, improved body image, and fewer depression and anxiety symptoms.

Chapter 4. Behavioral Coaching

- Clients expect professionalism; thus, it is crucial to build relationships and maintain a facility that supports training competency.
- Program designs should be based on the clients' abilities and should address their health concerns and goals.
- Self-efficacy is one of the strongest determinants of physical activity in adults; most coaching efforts are directed at increasing a person's self-efficacy.
- Planning and self-monitoring are essential techniques in developing a self-regulatory strategy to improve self-efficacy.

- Affective judgments and subjective norms can impact a person's readiness to perform resistance training.
- CPTs should assess a client's stage of change and promote competency in exercise.
- The stages of change include precontemplation, contemplation, preparation, action, and maintenance.
- Both verbal and nonverbal forms of communication are important for developing professional client relationships.
- Active listening refers to having a genuine interest in understanding the client's health and fitness goals. It involves asking appropriate questions, avoiding distractions and inner dialogue, and providing appropriate feedback.
- Motivational interviewing is a style of coaching that is used to enhance intrinsic motivation for change. CPTs can use some techniques from motivational interviewing, such as developing a discrepancy between a client's current state and ideal state, promoting change talk, and assessing readiness, willingness, and perceived ability to change.
- BCTs are used to enhance the determinants of behavior. CPTs may use any number of strategies to enhance a client's confidence, motivation, or self-regulation skills through planning, self-monitoring, and goal setting.
- Cognitive strategies that can help change behaviors include positive self-talk, imagery, and the practice of psyching up before activity.
- Goals that clients set should be SMART: specific, measurable, attainable, realistic, and timely. Clients should also focus on both process goals and outcome goals.
- For the best outcomes, clients should determine long-term bigger goals, then develop a series of smaller goals that help drive progress to the main goal.

Section 3: Basic and Applied Sciences and Nutritional Concepts

Chapter 5. The Nervous, Muscular, and Skeletal Systems

Nervous System

- The human movement system includes an integration of the nervous, skeletal, and muscular systems.
- The nervous system provides sensory (afferent) and motor (efferent) information.
- The neuron is the functional unit of the nervous system.
- The nervous system includes the CNS (brain and spinal cord) and PNS (somatic and autonomic nervous system).
- The PNS contains different types of sensory receptors such as mechanoreceptors, nociceptors, chemoreceptors, and photoreceptors.
- The muscle spindle and Golgi tendon organ are two important sensory receptors (mechanoreceptors).
- The PNS contains two subdivisions: the somatic and autonomic nervous systems.
- The nervous system requires different electrolytes for proper function, which include sodium, potassium, magnesium, and water.
- Motor skill development often occurs in three stages: cognitive, associative, and autonomous.
- The nervous system develops as humans age from childhood to adulthood.

Skeletal System

- The skeletal system provides support for the body and protects the internal organs.
- The skeletal system has two divisions: axial and appendicular.
- Human bones act as attachment sites and levers (rigid rods) to produce movement when muscles contract.
- Bone growth occurs throughout life and remodels itself with specialized cells called osteoblasts and osteoclasts.
- There are five categories of bones: long, short, flat, irregular, and sesamoid.
- The vertebral column has five distinct regions: cervical, thoracic, lumbar, sacrum, and coccyx.
- In between each vertebra is an intervertebral disc that acts as a shock absorber and assists with movement.
- Joints are formed by one bone articulating with another and can be categorized by their shape, structure, and function.

- Osteokinematic describes bone movement, and arthrokinematic describes movement at the joint surface.
- Synovial joints are unique with a synovial capsule but also contain other connective tissues, such as ligaments and fascia that provide support.
- Synovial joints have six classifications: gliding (plane), condyloid, hinge, saddle, pivot, and ball-and-socket joints.
- Exercise and proper nutrition can have a major positive impact on bone mass with the aging adult.

Muscular System

- The muscular system links the nervous and skeletal systems and generates force to move the human body.
- Muscles have a complex structure that includes different layers of connective tissue that surround the contractile muscle fibers.
- Myofibrils consist of repeating sarcomeres and the myofilaments actin and myosin, which create the muscle contraction called the sliding filament theory. Adenosine triphosphate is also needed to create energy for this process.
- Excitation-contraction coupling describes the steps in the muscle contraction process involving the nervous and muscular systems.
- The electrolyte calcium and neurotransmitter acetylcholine are involved in the excitation-contraction coupling process.
- The all-or-nothing principle describes how a motor unit either maximally contracts or does not contract at all.
- Muscles involved with fine motor skills have motor units with fewer innervated fibers. Motor units involved in gross motor control have motor units with more innervated fibers.
- Type I, slow-twitch, muscle fibers are smaller in size, produce less force, and are fatigue resistant.
- Type II, fast-twitch, muscle fibers are larger in size, produce more force, and fatigue quickly.

Chapter 6. The Cardiorespiratory, Endocrine, and Digestive Systems

- The cardiorespiratory system is comprised of the heart, blood, blood vessels, and lungs.
- The respiratory system is comprised of the respiratory airways, lungs, and respiratory muscles.
- The heart is contained in an area referred to as the mediastinum.
- A normal heart rate ranges from 60 to 100 beats per minute.
- Each side of the heart has two chambers: an atrium and a ventricle.
- The body will increase the heart rate in response to exercise and decrease the heart rate during sleep.

- The electrical conduction system of the heart is responsible for its function and begins with the sinoatrial node, which is in the right atrium.
- The sinoatrial node is referred to as the pacemaker of the heart and sends the electrical signal to the atrioventricular node and ultimately into the ventricles.
- The right atrium gathers deoxygenated blood returning to the heart from the body and then sends it to the right ventricle and to the lungs for oxygenation.
- The left atrium receives oxygenated blood from the lungs and sends it to the left ventricle to be pumped out into the body.
- Special valves are present in the heart to ensure that blood is pumped in a one-way fashion.
- The pulmonary artery transports deoxygenated blood from the right ventricles to the lungs, whereas the pulmonary vein transports oxygenated blood from the lungs to the left atrium.
- As part of the normal integrated functioning of the cardiorespiratory system, the carbon dioxide from the deoxygenated blood pumped into the lungs from the right ventricle is ultimately expelled to the environment through normal expiration.
- Stroke volume is the amount of blood pumped out of the heart with each contraction.
- End-diastolic volume is the volume of blood in the ventricle prior to contraction, whereas the end-systolic volume is the amount of blood present in the ventricle after contraction.
- Stroke volume is ultimately a product of end-systolic volume minus end-diastolic volume.
- Cardiac output is the volume of blood pumped out of the heart in a minute and is a function of both heart rate and stroke volume.
- Normal blood pressure is a systolic less than 120 mm Hg with a diastolic of less than 80 mm Hg.
- Arteries transport blood away from the heart to the body, whereas veins transport blood back to the heart, and capillaries function as an exchange channel between the vessels and bodily tissues.
- Breathing (ventilation) is divided into two phases, referred to as inspiration and expiration.
- The respiratory system is tasked with bringing in oxygen, filtering air from inspiration, and subsequently oxygenating blood from the heart as well as exhaling carbon dioxide.
- A normal respiratory rate is 12 to 16 breaths per minute and relies on the primary respiratory muscles (diaphragm and intercostals).
- During normal inspiration, active contraction of respiratory muscles occurs, whereas relaxation occurs during expiration.
- During forced or heavy breathing, expiratory ventilation relies on secondary muscles to compress the thoracic cavity and force air out.

- *Diffusion* is a term used to describe the process of getting oxygen from the environment to the body's tissues.
- Abnormal breathing patterns will affect exercise performance and may be identified by shallow breaths, which often are associated with the use of secondary respiratory muscles (sternocleidomastoid, upper trapezius, or scalenes).
- A respiratory rate of less than 8 breaths per minute would be considered too slow (bradypnea), whereas a rate of greater than 24 breaths per minute is considered too high (tachypnea).
- The endocrine system is comprised of glands that secrete hormones.
- When hormones are released into the bloodstream, they are protected by transporters, which carry them to the intended organ or structure, where they bind with a receptor to stimulate a particular function.
- The hypothalamus and pituitary gland control a majority of functions for the endocrine system.
- Cortisol, which is stimulated by the adrenal cortex, may be used to aid in recovery from exercise and as a marker of overtraining.
- Insulin and glucagon both function to control blood glucose levels and work opposite to each other; glucagon aids in the metabolism of glucose, and insulin aids in the cellular uptake and storage of glucose.
- The catecholamines, which consist of epinephrine and norepinephrine, are immediately stimulated from the adrenal medulla in response to exercise.
- Cortisol, considered a catabolic hormone, is produced by the adrenal cortex and is sensitive to blood sugar and sleep.
- Although testosterone levels decline with age, they can be stimulated through intense exercise.
- Growth hormones are responsible for growth and development as well as lipolysis and are produced from the pituitary gland.
- One of the most potent of the anabolic hormones is insulin-like growth factor, which is produced by the liver in response to growth hormones binding on liver receptors.
- Testosterone, growth hormones, and insulin-like growth factors are stimulated in response to anaerobic resistance training as well as vigorous aerobic activity (e.g., high-intensity training styles).
- Thyroid hormones serve numerous functions in the body, including metabolism and increasing bone mineral density through the secretion of calcitonin.
- Adequate sleep is a necessary requirement for glucose metabolism, hormone function, and muscle recovery.
- The digestive system consists of the oral cavity (head and mouth), the upper GI system (stomach, small intestine [duodenum, jejunum, and ileum], and the lower GI tract (large intestine, rectum, and anus), as well as the liver, gall bladder, and pancreas.

- Ingested foods and liquids are first processed in the oral cavity where mastication (the mechanical process of chewing and breaking down food) begins the digestive process.
- Once food is broken down, it passes through the esophagus into the stomach where gastric juices aid in digestion, kill bacteria, and turn food into chyme, which is then passed into the small intestine.
- The small intestine has a key function of absorption of carbohydrates, lipids, calcium, amino acids, and iron. Additionally, electrolytes including water, are absorbed into the small intestines.
- The large intestine absorbs electrolytes and vitamins and serves to pass waste from nondigested food into the rectum.
- While fluids are absorbed into both the small and large intestine, the large intestine uses water to help pass waste into the rectum.
- The liver, gall bladder, and pancreas produce and store digestive juices, which are secreted into the small intestine to help with digestion.
- Evidence suggests that exercise can improve digestive function by increasing transit time of food from the upper to the lower GI tracts.

Chapter 7. Human Movement Science

- Movement is described in three dimensions that are based on planes, which include the sagittal, frontal, and transverse planes.
- Osteokinematic describes the observable movement of a limb, whereas arthrokinematic describes the movement taking place at the joint itself.
- Movement is described using biomechanical terminology that is universal to all professions in the allied health industry.
- The sagittal plane is an imaginary line that bisects the body into right and left sides. Movements in the sagittal plane include flexion and extension and plantar flexion and dorsiflexion of the foot and ankle.
- The frontal plane bisects the body to create front and back halves. Movements in the frontal plane include abduction and adduction of the limbs (relative to the trunk), lateral flexion of the spine, and eversion and inversion at the foot and ankle complex.
- The transverse plane bisects the body to create upper and lower halves. Movements in the transverse plane include internal rotation and external rotation for the limbs, right and left rotation for the head and trunk, horizontal abduction and horizontal adduction of the limbs, and radioulnar pronation and supination.
- Motions of the scapulae include scapular retraction, scapular protraction, scapular depression, and scapular elevation.
- Muscle actions are described as isotonic, isometric, and isokinetic.
- Isotonic muscle actions can be broken down into the concentric and eccentric phases.

- Muscles can play the role of agonist, synergist, stabilizer, or antagonist depending on the movement being performed.
- Closed-chain movements anchor the body to the ground or immovable object, whereas open-chain movement involves the distal limb moving freely in space.
- Placing a muscle in a shortened position or lengthening a muscle beyond optimal length may reduce force output, because optimal length is the position with maximal overlap of actin and myosin filaments.
- The stretch-shortening cycle involves three phases, which include the eccentric phase, amortization phase, and concentric phase.
- The term *force-couple* is used to describe muscles that work in a synergistic function around a joint.
- The local muscular system involves muscles that generally attach on or near the spine and provide stability for the LPHC.
- The global muscle system can be broken down into subsystems, which include the deep longitudinal, posterior oblique, anterior oblique, and lateral subsystems.
- The subsystems describe the integrated function of muscle groups to transfer force for complex multi-joint movements and stabilization of the HMS.
- The amount of force produced by the HMS relies on not only muscle recruitment but also the lever type of the joint that is moving.
- Lever systems are classified as first, second, and third class. Third-class levers are the most predominate levers in the human body.
- Muscle synergies describe the cooperative function of multiple muscles recruited by the nervous system to complete a given movement pattern.
- Proprioception is the intrinsic awareness of movement and bodily position in space.
- Feedback can come from internal or external sources and aids the process of motor learning.
- Motor learning is the integration of motor control processes, with practice and experience, leading to a relatively permanent change in the capacity to produce skilled movements.

Chapter 8. Exercise Metabolism and Bioenergetics

- The human body needs a constant supply of energy to function properly and meet the demands of exercise.
- The energy molecule used to do cellular work is called adenosine triphosphate (ATP), and it is made from food substrates consumed in the diet.
- The first law of thermodynamics states that energy can neither be created nor destroyed, only converted from one form into another.

- The fuels used to create ATP are glucose from carbohydrates, free fatty acids from fat, amino acids from protein, and ketone bodies. These fuels are mostly obtained through the diet.
- Carbohydrates in the diet are broken down into glucose, which can produce ATP quickly via the process of glycolysis.
- Glucose is stored in the form of glycogen; the amount of glycogen that can be stored in the body is much less than the amount of fat that can be stored.
- Free fatty acids are the by-products of the breakdown of stored or consumed fats. They are oxidized exclusively via the aerobic pathway, which uses oxygen to create ATP.
- Amino acids are the by-product of protein breakdown or digestion.
- Amino acids can be metabolized via oxidative phosphorylation, but this is not typical in healthy people because protein is usually reserved for muscle building rather than ATP production.
- Ketone bodies are produced by the liver during periods of low energy intake or low carbohydrate availability. They can be oxidized via the oxidative phosphorylation pathway to create ATP.
- Exercise is categorized by two factors: intensity and duration. The higher the intensity of the activity, the shorter the duration must be.
- To perform exercise, the body needs fuel, which comes from food that is broken down through a series of chemical reactions to provide energy (ATP) and heat.
- The ATP-PC pathway is the simplest and fastest way to generate ATP. This system can only support short duration activities because the supply of PC is limited.
- Glycolysis is an anaerobic process and generates ATP quickly, but not a tremendous amount. The end products of glycolysis are ATP and pyruvate, which can become lactate under anaerobic conditions.
- Oxidative phosphorylation is a process that uses oxygen to create ATP from substrate molecules at a relatively slow rate.
- Oxidative phosphorylation can use pyruvate (starting from glucose), fatty acids, amino acids, or ketone bodies as substrate molecules. This oxidative metabolism produces carbon dioxide as a by-product, which is then exhaled.
- The most important factors determining the type of energy use during exercise are intensity and duration.
- The intensity and duration of an activity are inversely related, which means that as intensity goes up, duration must go down.
- Steady-state exercise is defined as a situation in which a person engages in the same level of activity, without increases or decreases in intensity, for several minutes.
- Intermittent exercise is defined as frequent changes in the work requirement (intensity) during an activity.
- Exercise increases metabolic rate, and breathing rate increases in proportion with it.

- When breathing rate becomes too rapid to allow talking, the body has shifted to oxidizing almost exclusively carbohydrate to fuel the activity.
- Lower-intensity activities use a higher percentage of fat as a fuel but generally do not burn a lot of calories unless performed for a very long time.
- Higher-intensity activities have a higher percentage of energy coming from carbohydrate and usually burn more total calories in a given time.
- Daily food (energy) intake needs to be adequate to maintain a healthy body weight, allow for proper bodily function, and support physical activity.
- If daily food intake is matched to energy needs, a person is said to be in energy balance.
- Calories are the basic unit of energy provided by food, and the total number of calories that a person burns in a day is called the total daily energy expenditure (TDEE).
- The resting metabolic rate (RMR) is the minimum number of calories needed at rest to keep a person alive and meet all functional needs of the body.
- The thermic effect of food (TEF) is the number of calories that are used to digest a meal.
- Non-exercise activity thermogenesis (NEAT) involves burning calories in activities that are not structured exercise.
- Exercise activity thermogenesis (EAT) is the calories burned during structured physical activity or purposeful exercise.

Chapter 9. Nutrition

- Registered and licensed dietitians and nutritionists are authorized to provide nutrition counseling, medical nutrition therapy, and meal plans.
- Fitness professionals (who are not also registered or licensed dietitians or nutritionists) can provide general nutrition guidelines, direct clients to credible nutrition resources, refer clients to dietitians and nutritionists, and provide accountability and support with dietary changes.
- Credible and reliable nutrition information includes peer-reviewed research and scholarly sources.
- Protein is comprised of 20 amino acids; 9 are essential and must be obtained via the diet.
- The role of protein is the synthesis of tissues, organs, hormones, enzymes, and peptides.
- Dietary sources of complete proteins include soy and animal foods, such as meat, poultry, seafood, and dairy. Plant-based, incomplete protein foods include legumes, grains, and vegetables.
- Protein contains 4 calories per gram.
- The RDA for protein is 0.8 g/kg bodyweight (considered a minimum to maintain nitrogen balance).
- The AMDR for protein is 10% to 35% of total calories.

- Carbohydrates include simple sugars, complex carbohydrates, glycogen, and fiber.
- Carbohydrates are an important energy source of exercising individuals and athletes.
- Dietary sources of carbohydrates include plant foods and dairy, including grains, vegetables, legumes, fruit, milk, and yogurt.
- Simple sugars include the monosaccharides (glucose, fructose, galactose) and disaccharides (lactose, sucrose, maltose).
- Complex carbohydrates are long chains of glucose units called polysaccharides, which are slower to digest and raise blood glucose levels slowly.
- Sources of complex carbohydrates include starches, legumes, and vegetables.
- The glycemic index reflects the effect of a carbohydrate on blood sugar levels; low GI foods cause smaller rises in blood glucose compared to high GI foods.
- Glycemic load is a better indicator of a carbohydrate's effect on blood sugar levels, because it accounts for the glycemic index and the quantity of carbohydrates consumed.
- Carbohydrates contain 4 calories per gram.
- Glycogen is the storage form of carbohydrates in animals and humans. Glycogen is stored in the liver and skeletal muscle.
- Fiber is indigestible carbohydrates associated with various health benefits and includes both soluble and insoluble fiber.
- The AMDR for carbohydrate is 45% to 65% of calories in the diet.
- Fiber recommendations: 25–28 g of fiber a day for women (aged 19–50 years) and 30–34 g of fiber a day for men aged 19–50 years.
- Lipids are commonly referred to as fats and include triglycerides, phospholipids, and sterols.
- Saturated fat sources include animal fats, full-fat dairy, coconut, and palm oil.
- Polyunsaturated fat sources include omega-6 (nuts, seeds, oils), omega-3 (fatty fish, flaxseed, walnuts, chia seeds, fortified milk/eggs, dairy from grass-fed cows, and green vegetables).
- Monounsaturated fat sources include olives, olive oil, avocado, peanuts, and canola.
- Phospholipid sources include meats, egg yolks, seafood, poultry, soybeans, and grains.
- Sterols sources include cholesterol from animal foods, egg yolks, and plant sterols.
- Lipids contain 9 calories per gram.
- The AMDR for lipids is 20% to 35% of total calories.
- Vitamins and minerals are inorganic compounds essential to regulating metabolic processes, such as energy metabolism. Deficiencies and insufficiencies can contribute to health issues.
- Vitamins include two groups: fat soluble and water soluble.
- Vitamins A, D, E, and K are fat soluble.

- Water-soluble vitamins include vitamin C and B vitamins (thiamin, riboflavin, niacin, folate, B12, pantothenic acid, biotin).
- A balanced diet with a wide variety of minimally processed foods will likely supply adequate vitamins.
- Minerals include major minerals and trace minerals.
- Fluid recommendations (general population): approximately 11.5 cups a day (2.7 L) of fluid for women and approximately 15.5 cups (3.7 L) for men.
- Hydration guidelines for athletes include 12–16 oz of fluid every 10–15 minutes for activities longer than 60 minutes.
- Athletes should replace fluid at 1.25 times the amount of body weight lost during an event.
- Sports drinks may be hypotonic (lower concentration than body fluids), isotonic (similar concentration as body fluids), or hypertonic (higher concentration than body fluids).
- Sports drinks are likely unnecessary for short-duration exercise lasting less than 60 minutes (unless in hot or humid temperatures).
- Strategy combinations are used to help clients achieve their weight goals, primarily including modification of energy intake and physical activity.
- The first law of thermodynamics states that energy cannot be created or destroyed but only converted from one form to another.
- Weight gain is the result of energy intake exceeding energy output, whereas weight loss is the result of energy output exceeding energy intake.
- Other factors that influence weight include sleep, medications, and endocrine disorders.
- Food labels convey information on the nutritional value and content of products via the nutrition facts panel and the ingredients list.
- Food labels can help clients make informed decisions about how a food item contributes to their nutrition and fitness goals.
- Fat loss requires a net calorie deficit but with the goal of minimizing loss of lean body mass and any reduction in TDEE due to adaptive thermogenesis.
- Adequate caloric intake, especially adequate protein intake combined with resistance training, remains an essential element for increasing muscle mass.
- Nutrition strategies for improved sports performance are numerous and include ensuring adequate energy (calories) and macronutrient intake. Meal timing and hydration are also important to maximize sport performance.

Chapter 10. Supplementation

- Dietary supplements are products (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients: vitamins; minerals; herbs or other botanicals; amino acids; dietary supplements used by humans to supplement the diet by increasing the total dietary intake; or concentrates, metabolites, constituents, extracts, or combination of any previously described ingredient.
- In the United States, dietary supplements are regulated by the FDA according to the Dietary Supplement Health and Education Act. However, supplements do not require review or approval prior to being marketed and sold.
- The fitness professional should understand the required components of the dietary supplement label, including the active ingredients, other ingredients, pertinent warnings, total contents, usage instructions, and serving size.
- Dietary supplements may be used for health and/or performance goals.
- Dietary supplements used specifically for performance are classified as ergogenic aids.
- Vitamin and mineral supplements may be used by individuals to correct or supply insufficient dietary intake in an effort to consume the DV each day.
- Vitamin and mineral intake should not exceed the UL unless by the direction of a dietitian or physician.
- Dietary supplements and other ergogenic aids may produce adverse effects or serious adverse effects. Such effects may arise from the dietary supplements themselves or from a change to or the contamination of the products.
- Protein supplements are convenient methods to increase total daily protein intake, the most important consideration for protein intake. Protein needs depend on the activity level, body size, and body composition goal of the individual.
- An effective dose of creatine is at least 0.03 g per kg body weight, but a typical dose at 5 g per day ensures complete muscle saturation.
- An effective dose of caffeine is 3 to 6 mg/kg (1.4–2.7 mg/lb) per day.
- Banned substances may not always be illegal substances, and athletes must check with their governing body (such as the NCAA or WADA) prior to consuming a dietary supplement. It is also wise for athletes to choose a supplement with third-party verification from Informed Choice or NSF.
- It is beyond the scope of practice for a fitness professional to prescribe dietary supplements to clients to treat a medical condition or disease. It is appropriate for the fitness professional to provide general education about supplements or to direct a client to consult with a dietitian or medical professional.

Section 4: Assessment

Chapter 11. Health, Wellness, and Fitness Assessments

- The general purposes of conducting physiological assessments are to collect baseline data to help fitness professionals develop personalized exercise programs.
- The PAR-Q+ is considered an appropriate minimal screening tool for conducting a HRA.
- Fitness professionals should also gather additional information, through the use of a HHQ, that may prove useful in selecting fitness assessments, designing exercise programs, and monitoring progress.
- A HHQ includes information about a client's medical history (e.g., injuries, surgeries, medications, and chronic disease) and lifestyle habits (e.g., exercise, diet, sleep, stress, and occupation).
- Resting and exercising heart rate and blood pressure responses provide valuable information pertaining to health risks and training adaptations.
- There are many anatomical locations that can be used to measure a client's RHR. However, for accuracy, safety, and ease of administering, NASM recommends that fitness professionals measure a client's radial pulse.
- Blood pressure (BP) is defined as the outward pressure exerted by blood on the arterial walls. BP scores are important because higher scores indicate greater risks for developing cardiovascular disease, which can become life-threatening. A normal BP reading is less than 120/80 mm Hg.
- Anthropometry is the field of study of the measurement of living humans for purposes of understanding physical variation in size, weight, and proportion.
- Many different anthropometric measures exist, including body fat assessments, BMI, and circumference measurements. Anthropometric measurements provide useful information related to predicting a client's risk for mortality and morbidity.
- There are many methods for measuring a client's body fat percentage, including underwater weighing, skinfold measurements, and bioelectrical impedance analysis. While all methods are valid, for ease of use, bioelectrical impedance is arguably the most popular method used in fitness facilities.
- Cardiorespiratory assessments help the fitness professional identify safe and effective starting exercise intensities as well as appropriate modes of cardiorespiratory exercise for clients. Examples of cardiorespiratory assessments include $\dot{V}O_{2\max}$ testing, the YMCA 3-minute step test, the Rockport walk test, and the 1.5 mile run test.
- $\dot{V}O_{2\max}$ testing is considered the gold standard for identifying a client's level of cardiorespiratory fitness, but it requires specialized equipment and training to conduct.

In addition, it requires the client to exert maximal effort. Consequently, this test is not commonly used outside of exercise laboratories or medical facilities.

- The talk test is an informal cardiorespiratory assessment used to gauge the intensity of cardiorespiratory activity based on the client's ability to hold a conversation.
- The VT1 test is an incremental test performed on any device (e.g., treadmill, bike) that gradually progresses in intensity level and relies on the interpretation of how a person talks to determine a specific event at which the body's metabolism undergoes a significant change. A key point to this protocol is to remember that it is an aerobic test that aims to estimate the intensity where the body is using a balance of fuels (i.e., 50% fat, 50% carbohydrates).
- The VT2 talk test measures the intensity where the body can work at its highest sustainable steady-state intensity for more than a few minutes.

Chapter 12. Posture, Movement, and Performance Assessments

- Static posture is typically assessed in standing position and is used to identify the three postural distortions: pes planus distortion syndrome, upper crossed syndrome, and lower crossed syndrome.
- Pes planus distortion syndrome is characterized by flat feet, knee valgus, and internally rotated and adducted hips.
- Lower crossed syndrome is characterized by an anterior pelvic tilt and excessive lordosis of the lumbar spine.
- Upper crossed syndrome is characterized by a forward head and protracted shoulders.
- The OHSA is the first movement assessment performed for clients and serves as the basis for all other movement assessments. It evaluates dynamic posture, core stability, and neuromuscular control of the whole body during a squatting motion.
- During the OHSA, notate all movement impairments to identify potential muscle imbalances. From the anterior view, look for feet turning out or knees caving in. From the lateral view, look for low-back arching, excessive forward lean of the torso, or arms falling forward.
- The single-leg squat assessment should be used by clients who have performed well in the OHSA, or if the fitness professional is considering single-leg exercises in their programming. This test is a good assessment of an individual's ability to balance, which is an important functional consideration for activities of daily living and exercise programming.
- Pushing and pulling assessments evaluate function of the upper extremity and concurrent core stability. They can be used as an intake assessment or an integrated part of the actual programming.
- When performing pushing or pulling assessments, look for the following movement impairments: low-back arching, shoulders elevating, or head jutting forward.

- Performance assessments can be used for clients looking to improve athletic performance, and measure maximal strength, power, muscular endurance, and speed and agility.
- The push-up test measures muscular endurance of the upper extremities during a pushing movement.
- The bench press and squat strength assessments measure maximal strength capabilities. These tests are advanced assessments for strength-specific goals and may not be suitable for clients with limited experience with resistance training.
- The vertical jump and long jump assessments measure lower-body power.
- The LEFT test is designed to test lateral speed and agility. LEFT is considered an advanced assessment for speed and performance-specific goals.
- The 40-yard dash assessment evaluates reaction capabilities, acceleration, and maximal sprinting speed.
- The pro shuttle (5-10-5) test assesses acceleration, deceleration, agility, and control. This test is most appropriate for clients with athletic goals seeking to assess agility and sprinting speed.
- All assessments need to be sequenced in a specific order to help guarantee accurate results. Non-fatiguing assessments, such as a preparticipation health screening and physiological and body composition assessments, should be conducted prior to posture, movement, cardio, and performance assessments.
- Fitness professionals should always use caution when implementing movement and performance assessments with their clients. Certain populations, such as overweight or obese, youths, older adults, and prenatal clients, may need to modify or avoid certain movement and performance assessments. Some assessments are not applicable because they do not relate to the client's goals. Other assessments may cause safety concerns.

Section 5: Exercise Technique and Training Instruction

Chapter 13. Integrated Training and the OPT Model

- Integrated training combines flexibility, cardiorespiratory, core, balance, plyometric, SAQ, and resistance training into one system.
- When an exercise program is progressive and systematic, using a progressive overload approach, the body becomes stronger by adapting to the new demands placed on it.
- Fundamental movement patterns include squatting, hip hinge, pulling, pushing, and pressing.
- Maintaining ideal posture places the client's body in the most optimal state to perform movement patterns safely and effectively.
- Optimal ROM allows joints to move freely.
- Fitness professionals should provide programming that requires movement in all three planes of motion: sagittal, frontal, and transverse.
- The acute variables for training include repetitions, sets, training intensity, repetition tempo, rest interval, training volume, training frequency, training duration, exercise selection, and exercise order.
- An ever-changing integrated training approach provides a systematic and progressive approach to fitness training; its components include flexibility, cardiorespiratory, core, balance, plyometric (reactive), SAQ, and resistance training.
- Benefits of flexibility training include increased joint ROM, possible decrease in muscle soreness, and a potential reduction in injury risk.
- Benefits of cardiorespiratory training include decreased heart rate and blood pressure while increasing stroke volume and cardiac output.
- Benefits of core training include enhanced posture; better bodily function for daily living; increased balance, stabilization and coordination of the kinetic chain; minimized low-back pain; and improved skill-related movements.
- Benefits of balance training include reducing risk of falls and ankle sprains while improving proprioception and agility-based activities.
- Benefits of plyometric (reactive) training include improved bone mineral density and soft tissue strength, expression of power and explosiveness, while also increasing metabolic expenditures required for weight management.
- Benefits of SAQ training include improved top speed, change in direction, and rate of acceleration and deceleration.

- Benefits of resistance training include increased endurance, strength, and power; muscular hypertrophy; and weight management.
- The OPT model is based on the scientific rationale of human movement science and uses the principles of integrated training.
- The OPT model is divided into three different levels of training: stabilization, strength, and power, which are subdivided into five phases.
- Phase 1 Stabilization Endurance Training is designed to teach optimal movement patterns (e.g., pushing, pulling, pressing, squatting, hip hinging), core and joint stability, and helps clients become familiar with various modes of exercise.
- The goal of Phase 2 Strength Endurance Training is to enhance stabilization endurance while increasing prime mover strength.
- Phase 3 Muscular Development Training is designed for individuals who have the goal of maximal muscle growth or altered body composition (i.e., fat loss).
- Phase 4 Maximal Strength Training works toward the goal of maximal prime mover strength by lifting heavy loads.
- The goal of phase 5 Power Training is to increase maximal strength and rate of force production.

Chapter 14. Flexibility Training Concepts

- Flexibility is defined as the normal extensibility of all soft tissues that allows the complete ROM of a joint.
- Flexibility has a major influence on mobility during dynamic motion.
- Poor flexibility can lead to the development of relative flexibility, which is the process in which the HMS seeks the path of least resistance during functional movements.
- The HMS, also known as the kinetic chain, comprises the muscular, skeletal, and nervous systems. The body's kinetic chain can be further classified into two regional chains: upper kinetic chain and lower kinetic chain.
- Muscle imbalance can be caused by postural distortions, repetitive movement, cumulative trauma, emotional duress, poor training technique, poor bodily control, and biased training patterns.
- Muscle imbalance may result in altered reciprocal inhibition, synergistic dominance, and osteo- and arthrokinematics dysfunction.
- Synergistic dominance is a neuromuscular phenomenon that occurs when synergists take over function for a weak or inhibited prime mover (agonist). This leads to altered reciprocal inhibition of the antagonist muscle.
- Osteokinematics describes how the bones and joints are moving through a ROM, and arthrokinematics describes the motion at the joint surfaces. Altered joint motion can be caused by altered muscle length-tension relationships, force-couple relationships, and poor joint surface motion, which results in poor movement efficiency.

- Neuromuscular efficiency is the ability of the nervous system to recruit the correct muscles, produce force, reduce force, and dynamically stabilize the body's structure in all three planes of motion. To allow for optimal neuromuscular efficiency, individuals must have proper flexibility in all three planes of motion.
- The scientific rationale for flexibility training is illustrated through the concept of pattern overload and the cumulative injury cycle.
- Common types of flexibility exercise include self-myofascial techniques and static, active, and dynamic stretching.
- Self-myofascial rolling is thought to produce both local mechanical and neurophysiological effects on the myofascial tissues.
- Static stretching is the process of passively taking a muscle to the point of tension and holding the stretch for a minimum of 30 seconds.
- Active stretching is the process of using agonists and synergists to dynamically move the joint into a ROM, holding for 1 to 2 seconds and repeating for 5 to 10 repetitions.
- Dynamic stretching uses the force production of a muscle and the body's momentum to take a joint through the full available ROM.
- Fitness professionals should have a comprehensive understanding of controversial stretches, medical precautions, and contraindications to program a safe flexibility program for clients of all fitness levels.

Chapter 15. Cardiorespiratory Fitness Training

- Cardiorespiratory fitness reflects the ability of the cardiovascular and respiratory systems to supply oxygen-rich blood to skeletal muscles during sustained physical activity.
- Cardiorespiratory fitness is one of five components to health-related physical fitness; the others include muscular strength, muscular endurance, flexibility, and body composition.
- Research has confirmed that an individual's cardiorespiratory fitness level is a strong predictor of morbidity and mortality.
- Research demonstrates that cardiorespiratory exercise and physical activity provide many benefits that enhance health, longevity, and weight loss.
- Cardiorespiratory exercise must be individually determined and should use the FITTE-VP principle. FITTE-VP stands for frequency, intensity, type, time, enjoyment, volume, and progression.
- Frequency refers to the number of training sessions in a given time period, usually expressed as per week.
- Moderate-intensity exercise (e.g., brisk walking) should be performed at least five times per week, whereas vigorous-intensity exercise (e.g., jogging or running) should be

performed at least three times per week, or a combination of moderate-intensity and vigorous-intensity is also acceptable.

- Intensity refers to the level of demand that a given activity places on the body.
- Some methods for monitoring cardiorespiratory exercise intensity include calculating $\dot{V}O_2$ max, using percentages of maximal heart rate (HR_{max}), heart rate reserve (HRR), metabolic equivalents (METs), ratings of perceived exertion (RPE), and the talk test.
- Time refers to the length of time engaged in an activity or exercise training session and is typically expressed in minutes.
- Adults should accumulate 2 hours and 30 minutes (150 minutes) of moderate-intensity aerobic activity (i.e., brisk walking) every week or 1 hour and 15 minutes (75 minutes) of vigorous-intensity aerobic activity (i.e., jogging or running) every week, or an equivalent mix of moderate- and vigorous-intensity aerobic activity.
- Type refers to the mode of activity selected, such as cycling, running, or swimming.
- Enjoyment refers to the amount of pleasure derived from engaging in a specific exercise or activity.
- Volume of exercise represents the total amount of work performed in each timeframe, typically 1 week.
- Progression refers to how an exercise program advances.
- Each exercise training session should also include a warm-up phase, conditioning phase, and cool-down phase.
- Stage 1 is designed to help improve cardiorespiratory fitness levels in apparently healthy sedentary clients using a target intensity below ventilatory threshold 1 (VT1) and involves steady-state aerobic exercise.
- A stage 2 workout consists of a mix of recovery intervals just below VT1 (moderate intensity) and work intervals performed at an intensity just above VT1 (challenging to hard intensity).
- Once clients become accustomed to stage 2 intervals and have shown positive signs of adapting to the physical demands, they can begin performing moderately intense steady-state cardio exercise just above VT1, if desired.
- A stage 3 workout includes the client moving in and out of training zones 1, 2, and 3.
- A stage 4 workout involves interval training integrating all four training zones.
- Stage 5 focuses on drills that help improve conditioning using linear, multidirectional, and sport-specific activities performed as conditioning and often combines high-intensity interval training with small-sided games and agility drills.
- Common postural deviations that clients may exhibit while engaging in cardiorespiratory training include round shoulders and forward head, an anterior pelvic tilt, or adducted and internally rotated knees and pronated feet.
- Caution should be made to monitor a client's posture during cardiorespiratory exercise.

Chapter 16 Core Training Concepts

- Core training is critical for improving posture, enhancing performance, increasing injury resistance, and accelerating injury rehabilitation.
- The core is defined by the structures that make up the lumbo-pelvic-hip complex (LPHC) and includes the global and local core musculature.
- Local core muscles generally attach on or near the vertebrae. Local muscles provide dynamic control of the spinal segments, limiting excessive compression, shear, and rotational forces between spinal segments.
- Global core muscles are more superficial on the trunk. Global muscles act to move the trunk, transfer loads between the upper and lower extremities, and provide stability of the spine by stabilizing multiple segments together as functional units.
- When designing a core training program, the local and global muscles should both be trained to develop proper core stability and overall movement efficiency.
- Core strength is imperative for maintaining the natural curvatures of the spine, both at rest and during movement.
- Large curvatures of the spine away from midline are considered abnormal and may be considered either structural or functional scoliosis.
- Core training has been demonstrated to improve injury resistance by contributing to more coordinated motion between the trunk and lower extremities during high-energy, sport-specific activities.
- When developing a core training program, emphasize increasing proprioceptive demand initially instead of increasing the external resistance. Additionally, emphasize quality of movement across the LPHC.
- There are many variables that can be manipulated when designing a core training program, including planes of motion, ranges of motion, speed of motion, volume, and exercise modalities. Be cautious not to change too many variables at one time when progressing an exercise program to ensure that the client is able to demonstrate appropriate mastery at each stage.
- Initially, start with core exercises that involve little motion of the spine and target the local core musculature. Example exercises include (but are not limited to) marching, floor/ball bridge, floor/ball cobra, plank, side plank, dead bug, and Palloff press.
- The next-level core exercise progression incorporates more motion at the spine that also targets global core muscles. Example exercises include (but are not limited to) floor/ball crunch, back extension, reverse crunch, knee-up, and cable rotation, lift, and chop.
- The last core exercise progression involves explosive movement through the trunk and extremities. Example exercises include (but are not limited to) medicine ball chest pass, ball medicine ball pullover throw, front medicine ball oblique throw, side medicine ball

oblique throw, medicine ball soccer throw, medicine ball woodchop throw, and medicine ball overhead throw.

Chapter 17 Balance Training Concepts

- Balance training is a critical component of an exercise program to optimize performance, improve injury resistance, and enhance injury rehabilitation.
- Maintaining balance involves the ability of an individual to control the position of the center of gravity over the base of support.
- Types of balance include static (stationary body position), semi-dynamic (the base supporting the body is in movement), and dynamic (ever-changing base of support) and can be manipulated to change the level of difficulty during a balance training program.
- The balance mechanism involves three key senses:
 - Vision, which is typically used to provide information to the central nervous system about the body's location in space
 - The vestibular senses, which are controlled by sensory receptors in the inner ear and provide the brain information about spatial orientation and the movement of the head in space
 - Somatosensation, which is the ability to feel changes in pressure on the skin, muscle length, and joint angles
- Balance training has been shown to improve performance and reduce injury rates in athletes when incorporated into a comprehensive injury prevention program that is carried throughout the course of an athletic season.
- Strong evidence demonstrates that balance training programs can reduce the risk of falls in healthy older adults.
- Fitness professionals should always emphasize safety when designing a progressive balance training program, especially for clients with a history of injuries or a current injury.
- When developing a balance training program, emphasize a safe and progressive increase in proprioceptive demand based on the client's performance.
- Many variables can be manipulated when designing a balance training program, including planes, range, and speed of motion, as well as the proprioceptive environment. Be cautious not to change too many variables at one time when progressing an exercise program to ensure that the client is able to demonstrate appropriate mastery at each stage.

Chapter 18 Plyometric (Reactive) Training Concepts

- Plyometric training, also known as jump or reactive training, is a form of exercise that

uses explosive movements, such as bounding, jumping, or powerful upper body movements, to develop muscular power.

- Employing plyometric training develops efficient control and production of ground reaction forces, which can be used to project the body with a greater velocity or speed of movement.
- Clients must possess adequate core strength, joint stability, and range of motion and must balance efficiently prior to performing explosive plyometric exercises.
- The integrated performance paradigm states that to move with precision, forces must be loaded (eccentrically), stabilized (isometrically), and then unloaded or accelerated (concentrically).
- The three distinct phases of the stretch-shortening cycle involved in a plyometric exercise include the eccentric or loading phase, the amortization phase or transition phase, and the concentric or unloading phase.
- Plyometric exercises increase rate of force production (power) and motor unit recruitment.
- Plyometric exercises should progress from simple to intermediate to advanced movements and from low intensity to moderate intensity to high intensity.
- Intensity should be prescribed by the client's ability to execute the movement and maintain adequate training technique. If technique is lost, the intensity should drop until proper technique is achieved.
- Plyometric intensity describes the amount of effort or stress applied by the muscles, connective tissue, and joints during plyometric drills and by the distance covered (height of a jump).
- Plyometric volume is expressed as the number of foot contacts, throws, or catches. An example would be the completion of three sets of five squat jumps, equating to a volume of 15.
- A general recommendation is to allow at least 1 day between intense plyometric training sessions. At least 48 to 72 hours between sessions are the recommended guidelines when implementing plyometrics for novice individuals.
- Since plyometric training involves jumping, bounding, and other explosive movements, it is essential to teach proper landing and rebounding mechanics.
- As a general rule, recovery times of 60 to 120 seconds between drills should be sufficient for full recovery, but this is dictated by the client's fitness level.
- When introducing plyometric exercises—especially to new or beginner clients—the movements should initially involve small jumps, and clients should hold the landing position for 3–5 seconds and make any adjustments necessary to correct faulty postures before performing the next jump.
- The next progression is to involve jumps with more amplitude and dynamic motion

performed with a repetitive tempo.

- The last progression includes exercises that are performed as fast and as explosively as possible.

Chapter 19 Speed, Agility, and Quickness Training Concepts

- SAQ training is a useful and effective method of fitness training stimulating muscular, neurological, connective tissue, and even cardiovascular fitness adaptations.
- SAQ exercises can promote improvements in physical performance and sustain youthful movement throughout life.
- SAQ training will allow clients to enhance their ability to accelerate, decelerate, and dynamically stabilize their entire body during high-velocity movements in all planes of motion.
- Speed, the product of stride rate and stride length, refers to the velocity of distance covered divided by time.
- Agility necessitates the ability to start (or accelerate), stop (or decelerate and stabilize), and change direction while maintaining postural control.
- Quickness refers to the ability to react to a stimulus and appropriately change the motion of the body in response to that stimulus.
- Stride rate is the number of strides taken in a given amount of time (or distance).
- Stride length is the distance covered in one stride.
- Proper running mechanics will enable the client to maximize force generation through biomechanical efficiency.
- Components of an SAQ program can significantly improve the physical health profile of apparently healthy, sedentary, nonathletic adults and those with medical or health limitations.
- SAQ programs for youth have been found to decrease the likelihood of athletic injury, increase the likelihood of exercise participation later in life, and improve physical fitness.
- SAQ training for older adults may help prevent age-related decreases in bone density, coordinative ability, and muscular power.
- The high-intensity, short bouts of SAQ drills make them a valid choice for interval training protocols with appropriate nonathletic populations, including weight-loss clients.

Chapter 20 Resistance Training Concepts

- The GAS model outlines three stages of response to stress: alarm reaction, resistance development, and exhaustion.

- The alarm reaction stage, the initial reaction to a stressor, can include fatigue, joint stiffness, or delayed onset muscle soreness.
- The resistance development stage involves numerous physiological changes that ultimately lead to training adaptations that promote increases in performance.
- Prolonged or intolerable amounts of stress lead to the exhaustion stage, which is characterized by stress fractures, muscle strains and ligament sprains, joint pain, and emotional fatigue.
- The principle of specificity, often referred to as the SAID principle, describes the body's responses and adaptations to exercise.
- Mechanical specificity refers to the weight and movements placed on the body.
- Neuromuscular specificity refers to the speed of contraction and exercise selection.
- Metabolic specificity refers to the energy demand placed on the body.
- The main adaptations that occur from resistance training include stabilization, muscular endurance, hypertrophy, strength, and power.
- Stabilization is the body's ability to provide optimal dynamic joint support to maintain correct posture during all movements.
- Muscular endurance is the ability to produce and maintain force production for prolonged periods of time.
- Muscular hypertrophy is the enlargement of skeletal muscle fibers.
- Strength is the ability of the neuromuscular system to produce internal tension, specifically in the muscles and connective tissues that pull on the bones, to overcome an external force.
- Power is the ability of the neuromuscular system to produce the greatest possible force in the shortest possible time.
- Acute variables include repetitions, sets, training intensity, repetition tempo, rest intervals, training volume, training frequency, training duration, exercise selection, and exercise order.
- There are numerous training systems that can be used to structure resistance training programs for a variety of effects. Several of the most common training systems include warm-up set, single set, multiple set, pyramid, superset, complex training, drop set, giant set, rest-pause set, circuit training, peripheral heart action, split routine, vertical loading, and horizontal loading.
- Fitness professionals must safeguard their clients from harm. This requires maintaining a safe environment, ensuring proper equipment set up, using appropriate spotting procedures, and monitoring exercise technique using the five kinetic chain checkpoints.
- Resistance exercises should initially focus on optimizing ideal movement patterns. Once a client displays adequate movement competency, resistance exercises should progress

in a systematic fashion using three steps: (1) stabilization-focused exercises, (2) strength-focused exercises, and (3) power-focused exercises.

Section 6: Program Design

Chapter 21. The Optimum Performance Training Model

- Exercise programs need individuality, based on the client's assessment results, to make them impactful for clients, which likely increases adherence to the program.
- Fitness professionals should adopt an integrated, multicomponent approach to program design that includes flexibility, cardiorespiratory, core, balance, plyometric, SAQ, and resistance training.
- Exercise programs must consider many variables, such as teaching proper movement patterns, improving mobility and stability, enhancing endurance, and reducing the likelihood of injury.
- A training plan determines the forms of training to be used, how long it will take, how often it will change, and what specific exercises will be performed.
- Periodization is a systematic approach to program design that varies the amount and type of stress placed on the body to produce a physical adaptation and reduce the likelihood of overtraining and injury.
- An annual training plan, or macrocycle, demonstrates the long-term training program and how it progresses each month.
- A monthly training plan, or mesocycle, typically outlines a training plan for one month.
- A weekly plan, or microcycle, describes the specific workouts for the week.
- Linear periodization gradually increases the intensity of the training program while simultaneously decreasing volume over a specific period of time.
- Undulating periodization uses changes in volume, intensity, and exercise selection to provide loading differences on a daily or weekly basis.
- The OPT model consists of three levels: stabilization, strength, and power.
- The OPT model includes five unique phases of training: Phase 1 Stabilization Endurance Training, Phase 2 Strength Endurance Training, Phase 3 Muscular Development Training, Phase 4 Maximal Strength Training, and Phase 5 Power Training.
- The OPT workout template is divided into six parts: Warm-up, Activation, Skill Development, Resistance Training, Client's Choice, and Cool-down. Cardiorespiratory training can be integrated into any section of the OPT template.
- Phase 1 Stabilization Endurance Training teaches clients how to perform proper movement patterns, including pushing, pulling, pressing, squatting, hip hinging, trunk rotation, and overall movement competency.
- Once clients display adequate movement patterns, Phase 1 programs are progressed by placing a greater emphasis on enhancing proprioception, balance, and postural control.

- Phase 2 Strength Endurance Training is a hybrid form of training that involves the use of superset training in which a strength-focused exercise is immediately followed by a stabilization-focused exercise with similar biomechanical motions.
- Phase 3 Muscular Development Training is designed to enhance muscle hypertrophy using a high volume of strength-focused exercises.
- Phase 4 Maximal Strength Training requires the inclusion of heavy resistance training exercises to increase muscular strength.
- Phase 5 Power Training uses superset techniques to increase rate of force production. These superset techniques include performing a heavy resistance training exercise immediately followed by an explosive power-based exercise with similar biomechanical motions.
- The OPT model is an exercise program model that uses both linear and undulating periodization to help clients of all levels and abilities achieve a variety of different goals, including but not limited to reduced body fat, increased muscle mass, and improved athletic performance.

Chapter 22. Introduction to Exercise Modalities

- Exercise modalities are tools that are designed to enhance an exercise or movement to create a desired outcome.
- There are many types of exercise modalities, including resistance training equipment, balance tools, and fitness trackers.
- It is important to keep safety and effectiveness in mind when deciding which training modalities may be the best to use and when to integrate them into a program.
- Because most novice exercisers lack resistance training experience, strength-training machines may offer a safer and effective option to free weights. Strength-training machines, however, are regarded as inferior to free weights for improving core stability and muscular coordination, as they offer artificial support instead of using one's core musculature.
- Free weights can be used by most populations, in a variety of fashions, for many goals, and in all phases of the OPT model. Although extremely versatile, free weights can be intimidating for some clients.
- Cable machines can provide greater ROM when compared to selectorized strength equipment. When using cable machines, it is important to match the cable's resistance to the muscle's natural line of pull.
- Elastic bands and tubing also allow clients to perform resisted exercises that mimic sport-specific movements, such as a golf swing or tennis forehand. Elastic resistance is portable and inexpensive but may not be ideal when trying to develop high levels of strength and muscular hypertrophy.

- Medicine balls can be used like other resistance implements to add load or instability to an exercise. Medicine balls can be used with a variety of populations as part of a program to increase muscular strength, endurance, and power, or in some cases, to help rehabilitate from injury.
- A kettlebell differs from a dumbbell, barbell, or medicine ball in that the center of mass is away from the handle, which may require more strength and coordination, as well as increased recruitment from stabilizers and prime movers simultaneously during particular movements. Many kettlebell exercises involve multiple joint motions and muscle groups.
- Suspended bodyweight training is an innovative approach to bodyweight fitness training in that it uses a system of ropes and webbing that allows the user to work against their own bodyweight while performing various exercises.
- Sandbags are designed to be carried, lifted, thrown, and pulled, and most come with several handles to easily change grips. Unlike barbells, dumbbells, and selectorized machines, the sand within the bag is constantly shifting, providing continuous instability.
- ViPR is an acronym for vitality, performance, and reconditioning. It is designed to be dragged, tossed, lifted, pulled, pressed, and carried. This design provides the fitness professional the ability to perform multidirectional, full-body exercises with external load resistance, known as loaded movement training.
- Battle ropes are typically made of heavy-duty nylon and come in a variety of lengths and thicknesses. Battle ropes are low-impact activities, which provide less impact on the joints.
- Balance modalities improve balance, ankle stability, and coordination but should not be used to perform maximal or near maximal lifts for safety reasons.
- Stability balls, also known as Swiss balls, are frequently used in a variety of training facilities with a wide range of populations. They are primarily used to increase the demand for stability in an exercise, but they can also be used to reinforce proper posture during squatting movements.
- The BOSU ball is an inflated rubber hemisphere attached to a solid plastic surface; it looks like a stability ball cut in half. Training with the BOSU ball offers the ability to increase the intensity of an exercise by decreasing the stability.
- The Terra-Core is comprised of an inflatable rubber bladder and hard-surfaced backing. Unlike stability balls, it is safe to perform several resistance training exercises, such as a dumbbell chest press, while lying supine on the Terra-Core.
- Fitness trackers are electronic wearable devices that enable a user to track their activity levels. They come in many forms, such as watches, bands, rings, heart rate monitors, and pedometers. Ease of use and intrinsic motivation are key factors for continued use of fitness trackers among those who purchase trackers.

Chapter 23. Chronic Health Conditions and Special Populations

- There is a significant need for increased awareness and access to general fitness training for youths year-round, not just during one or more sport seasons.
- Given the alarming increase in childhood obesity and diabetes, current youth fitness guidelines focus on promoting healthy lifestyles and health-related physical fitness. Current recommendations state that children and adolescents should get 60 minutes (1 hour) or more of moderate to vigorous physical activity daily.
- It is important to understand that there are fundamental physiologic differences between children and adults.
- Research has clearly demonstrated that resistance training is both safe and effective in children and adolescents.
- Despite the normal decline in physiologic functioning associated with aging, older adults—with and without other chronic health conditions—can and do respond to exercise much in the same manner as apparently healthy younger adults.
- By adhering to a systematic process, fitness professionals can make a dramatic impact on the overall health and well-being of older adults.
- Regular physical activity and exercise is one of the most important factors related to long-term successful weight loss.
- Exercise has been shown to have a substantial positive effect on the treatment and prevention of type 2 diabetes.
- Clients with stable coronary artery disease—especially those who have participated in a cardiac rehabilitation program—should know or be taught information on the importance and benefits of exercise, which include a lower risk of mortality, increased exercise tolerance, muscle strength, reduction in angina and heart failure symptoms, and improved psychological status and social adjustment.
- Exercise regimens that combine resistance training to increase BMD with flexibility, core, and balance training to enhance proprioception are important for clients with osteoporosis and osteopenia.
- It is important for fitness professionals to understand the difference between rheumatoid arthritis and osteoarthritis and be aware of the signs and symptoms of an acute rheumatoid arthritis exacerbation.
- Fitness professionals should also monitor the progress of clients with arthritis to assess the effects of the exercise program on joint pain.
- Exercise is an important intervention for clients recovering from cancer. It can improve exercise tolerance, reduce the cellular risks associated with cancer, and improve quality of life.

- There has been substantial research documenting the beneficial effects of exercise during pregnancy on the physiology and health of both the mother and developing fetus.
- Clients with lung disease experience fatigue at low levels of exercise and often experience dyspnea.
- The primary limiting factor for exercise in the client with PAD is leg pain.