## Resistance training

Creating a well-designed, strategic, safe, and effective training program can be a complicated process that is often required for Certified Personal Trainers before they are able to assist their clients in meeting their needs and goals. Careful consideration must be taken to adequately meet the many facets of exercise principles, including any manipulation of training variables throughout the planned program. By adhering to certain fundamental principles, the fitness professional needs to ensure that workout programs produce the desired outcomes. A variety of essential training principles should guide the development of effective training programs, especially resistance training. Programs that fail to address these fundamental principles may be at risk for lower exercise adherence and increased risk of injury.

Fitness professionals must understand the fundamental principles, scientific nature, and application of resistance training to be an effective guide toward their client’s results. It is with these principles and application that designing safe, customized, and individualized training will govern appropriate and obtainable workouts. This chapter explores many critical resistance training concepts involved in designing and implementing strength training programs for all abled populations. The primary focus of this chapter includes principles of adaptation, progressive overload, principles of specificity, characteristics of strength development, and various types of training systems, implementation, and exercise progressions.

**Principle of adaptation**

One of the more unique features and traits of the human body is its ability to adapt under various conditions, including stress, environmental changes, and functional capacities. Resistance training also elicits physical adaptations. Regardless of the primary goal of the client, whether it is related to aesthetics or sports performance, resistance training has been shown to exhibit significant favourable outcomes.

| **Physical and Performance Benefits** | |
| --- | --- |
| Improved cardiovascular efficiency  Improved endocrine (hormone) and cholesterol adaptations  Increased muscular hypertrophy (larger muscles)  Increased bone density  Increased metabolism  Decreased body fat | Increased neuromuscular control (coordination)  Increased connective tissue (tendons, ligaments) strength  Increased muscular endurance  Increased muscular strength  Increased power |

**General Adaptation Syndrome**

The general adaptation syndrome (GAS) is the central theory governing overall adaptation to training responses. GAS was first proposed in 1936 by Hans Selye, a Canadian physician. It is used to describe the process of how an organism adapts when it is exposed to an acute, or even damaging stimulus.

According to this early model, damaging agents included excessive muscular exercise, cold shock, or sublethal drug doses. However, within the context of resistance exercise, the stress placed on the body is the weight used during resistance training. This can be considered a good form of stress called *eustress*, which helps the body adapt over time and become better accustomed to resistance exercise. For adaptation to occur, over time the body must be repeatedly confronted with a stressor, or stimulus, creating the desired outcome for the response. The GAS model outlines three stages of response to stress:

1. Alarm reaction
2. Resistance development
3. Exhaustion.

Alarm reaction stage

The first stage is known as the alarm reaction stage, which is the initial reaction to a stressor. These reactions can include fatigue, joint stiffness, or delayed-onset muscle soreness (DOMS). The alarm reaction stage typically occurs 6 to 48 hours after initial injury to the neuromuscular system. Over the course of 24 to 72 hours, when a person begins a new training routine or unaccustomed exercise, muscles may exhibit classic DOMS. During this period of DOMS, any attempt at replicating or advancing the soreness-inducing exercise will be limited by the factors contributing to the soreness. It is noteworthy to mention that research indicates soreness as poorly correlated with the magnitude of muscle damage. Specifically, it may provide a general indication that muscle damage has occurred; however, it cannot be used as a sole determinate of the extent of muscle damage. It is important for fitness professionals to note that all types of muscle contractions and various exercise programs induce aspects of muscle damage, particularly in untrained individuals, especially when developing resistance training programs for new or beginning clients. Therefore, it is important to minimize DOMS by introducing resistance exercises in a gradual and systematic fashion.

The alarm reaction stage stimulates several physiological processes within the body, including an increase in oxygen and blood supply, neural recruitment to working muscles, bone formation, increased joint load and tolerance, and connective tissue strengthening. It is believed that if small doses of damaging stimuli were to persist, the injured organism would develop a large resistance to the stimulus, and the body’s appearance and function would return to homeostasis. As such, fitness professionals should apply the principle of progressive overload to assist the body in overcoming unaccustomed stressors.

Resistance development stage

During the resistance development stage, numerous physiological changes occur that ultimately lead to training adaptations that promote increases in performance. After repeated training sessions, the human body will increase its capability to efficiently recruit muscle fibres and distribute oxygen and blood to the proper areas in the body. As previously mentioned, applying the principle of progressive overload, the body will increase its ability to meet the demands being placed on it as a response to an additional stimulus.

It is imperative that fitness professionals understand this adaptation response. However, it must be emphasized that increasing load (i.e., the amount of weight lifted) is only one example to increase the intensity of an exercise program; many additional methods are used to increase intensity, as discussed later in this chapter.

In the previous example of unaccustomed exercise, once DOMS has decreased from the initial training session, subsequent soreness is reduced, thereby enhancing repair and regeneration of muscle tissue, resulting in the advancement of performance. Performance will continue to improve until some new performance plateau is reached and will be maintained if training is maintained.

Exhaustion stage

Prolonged stress or intolerable amounts of stress can lead to exhaustion or distress. This can result in several negative consequences such as the following:

* Stress fractures
* Muscle strains and ligament sprains
* Joint pain
* Emotional fatigue.

Although many of these types of injuries can develop independently, they can also lead to a combination of accumulated injury.

|  |  |
| --- | --- |
| **Stage** | **Reaction** |
| Alarm reaction | An initial reaction to stressor, such as fatigue, joint stiffness, or DOMS |
| Resistance development | Increased functional capacity to adapt to a stressor, such as increasing recruitment of muscle fibres |
| Exhaustion | A prolonged intolerable stressor that produces fatigue and leads to injury or a breakdown in the system |

Resistance training, in addition to other forms of exercise, must be cycled through different stages that increase stress placed on the body but also allow for sufficient repair and regeneration to avoid the exhaustion stage. Periodization is described as macromanagement, or planned manipulation of training variables in an organized fashion to improve performance over time. In other words, periodization is a training program that is divided into smaller, progressive stages (i.e., training cycles). There is large variability between the lengths of each training cycle because clients have unique physical abilities, goals, and training schedules.

STRETCH YOUR KNOWLEDGE

*Overtraining* syndrome is a condition in which an athlete or fitness client experiences fatigue, declining performance, and burnout. This is a chronic condition and occurs primarily because of overly aggressive training schedules; more particularly, it is a sequence of training bouts that is abruptly increased, exists for an extended period, or entails high-volume or high-intensity exercise with inadequate recovery and regeneration.

*Overreaching* is more of a temporary condition when compared to overtraining syndrome. Like overtraining syndrome, overreaching also involves decrements in performance, often as a result of fatigue. If overreaching is not identified, it can lead to overtraining syndrome. While these terms may sound the same, the subtle difference has to do with the amount of time for performance restoration, not the type of duration of training stress.

**The Principle of Specificity: the SAID Principle**

The principle of specificity, often referred to as the SAID (specific adaptation to imposed demands) principle, describes the body’s responses and adaptations to exercise and training. The body’s adaptations are specific to the type of exercise and muscle group(s) involved. For example, if someone repeatedly lifts heavy weights, that person will produce higher levels of maximal strength. Conversely, if a person repeatedly lifts lighter weights for many repetitions, that person will develop higher levels of muscular endurance. Some types of specificity include the following:

* Specificity of energy systems (anaerobic and aerobic)
* Specificity of mode of training
* Specificity of muscle groups and movement patterns
* Posture specificity.

This principle infers that one should aim to keep all training as specific as possible. The fitness professional can use this principle and apply it to training certain muscle groups, specific energy systems, functional movement patterns, velocity of movement, or even particular muscle actions (e.g., eccentric, concentric, isometric). One of the biggest and most effective ways to apply specificity of training is to identify specific movement patterns. Those sports that require high velocity of movement should emphasize exercise movements that integrate these patterns, such as plyometrics or power-based resistance exercises. Overall, the more similarity that exists from the training program to movement patterns, the greater can be the effect and transfer to sport-related activities.

An exception to this rule occurs when specific movement patterns elevate risk of injury or exacerbate dysfunctional movements. When these situations arise, exercises should be kept as specific as possible while mitigating the risk of injury. For example, an athlete may require high levels of power, but perhaps this same athlete lacks eccentric control and displays poor landing mechanics when performing jump-landing tasks. As such, the fitness professional must train the athlete in a systematic fashion, first emphasizing eccentric control and proper landing mechanics before progressing toward explosive movement patterns that are necessary for their sport.

TRAINING TIP

Remember that type I muscle fibres function differently than type II muscle fibers. Type I (e.g., slow-twitch) muscle fibres are important for muscles that need to produce long-term contractions necessary for joint stabilization, endurance, and postural control. Type II (fast-twitch) muscle fibres are larger in size, quick to produce maximal tension, and fatigue more quickly than type I fibres. These fibres are important for muscles producing movements requiring force and power, such as performing a sprint. To train with higher intensities, proper postural stabilization is required, and therefore, tissues need to be trained differently to prepare them for higher levels of training. This emphasizes the need for exercise programs to be both systematic and progressive based on the ability level of the client, in addition to following the principle of specificity.

**Mechanical, neuromuscular, and metabolic specificity**

The previous section briefly discussed common types of specificity. This section aims to provide more detail concerning mechanical, neuromuscular, and metabolic specificity and how these specificities relate to an exercise training program.

The degree of adaptation applied during training is directly related to the mechanical, neuromuscular, and metabolic specificity of the training program. To effectively achieve program goals for clients, fitness professionals need to consistently evaluate and manipulate exercise routines to meet training goals.

* Mechanical specificity refers to the weight and movements placed on the body. For example, the development of muscular endurance of the legs requires light weights and high repetitions when performing leg-related exercises. To develop maximal strength in the chest, the fitness professional must include the use of heavy weights during chest-related exercises.
* Neuromuscular specificity refers to the speed of contraction and exercise selection. To develop higher levels of stability while pushing, chest exercises will need to be performed with controlled, unstable exercises and at slower speeds. To develop higher levels of strength, exercises should be performed in more stable environments with heavier loads to place more of an emphasis on strengthening the prime movers. Low-weight, high-velocity movements can develop higher levels of power.
* Metabolic specificity refers to the energy demand placed on the body. To develop aerobic endurance, resistance training will require prolonged bouts of exercise, with minimal rest periods between sets. Endurance training primarily uses aerobic pathways to supply energy for the body. To develop maximal strength or power, resistance training programs require longer rest periods to replenish adenosine triphosphate (ATP), so the intensity of each exercise can remain high. Energy will be supplied primarily via the anaerobic pathways.

It is important for fitness professionals to remember that a client’s training program should be designed to meet the specific demands of their daily life, health, and wellness goals. The following example applies the concept of specificity to a client whose goal is body fat reduction.

1. Mechanically, the body burns more calories when movements are performed while standing, versus a seated or lying position, and using moderate weights. An example would be performing standing cable rows versus seated machine rows.
2. From a neuromuscular standpoint, the body burns more calories when more muscles are in use for longer periods in controlled, unstable environments. An example would be performing a standing dumbbell shoulder press versus a seated machine shoulder press.
3. Metabolically, the body burns more calories when rest periods are short to minimize full recuperation. An example would be to have clients perform resistance training exercises in a circuit fashion with little to no rest between sets.

When applying the principles of specificity to a training program for weight loss, the client should perform most exercises while standing and using moderate weights. The client should also recruit and use as many muscles as possible during each exercise and carefully monitor rest periods for greater caloric expenditure.

**Progressive adaptations from resistance training**

The concept of adaptation makes it clear that some type of change will occur based on the stresses placed on the body. Resistance training programs are designed to produce changes that result in various adaptations. Whether the goal is to increase muscular endurance, strength, hypertrophy, or power or to reduce body fat and improve overall health, the use of resistance training is an important component of any fitness program. This will help ensure optimal health and longevity for the client. As clients develop greater strength and endurance, they can train for longer periods before reaching the exhaustion stage (e.g., GAS), which leads to greater degrees of change and adaptation realized over time. The main adaptations that occur from resistance training include stabilization, muscular endurance, hypertrophy, strength, and power.

**Stabilization**

Stabilization is the body’s ability to provide optimal dynamic joint support to maintain correct posture during all movements. In other words, stabilization is getting the right muscles to fire, with the right amount of force, in the proper plane of motion, and at the right time to support our joints and spine. This requires high levels of muscular endurance for optimal recruitment of prime movers to increase concentric force production and reduce eccentric force. Repeatedly training with controlled, unstable exercises increases the body’s ability to stabilize and balance itself. Conversely, if training is not performed with controlled unstable exercises, clients may not gain the same level of stability, and their joint stability may even worsen. Research shows that improper stabilization can negatively affect a muscle’s force production. Stability is an important training adaptation because it increases the ability of the body to stabilize the core and joints during movement, thus allowing the arms and legs to work more efficiently

TRAINING TIP

Stabilization-focused resistance exercises are unstable in nature and typically require a standing, single-leg stance, or use of a balance modality. In other words, the client must support their spine and posture with their core and joint stabilizers versus relying on artificial support, such as a bench or machine. It is important to note that the amount of instability should be client specific based on their physical capabilities. This cannot be overemphasized: stabilization-focused exercises should only introduce an amount of instability that can be safely controlled by the client. The client must be able to perform the exercises while maintaining ideal posture.

Additionally, stabilization-focused resistance exercises are not ideal for developing muscular hypertrophy or maximal strength because heavier loads are required, which necessitate a stable environment due to safety concerns (Behm et al., 2010). But stabilization-focused resistance exercises lay a solid foundation of core and joint stability, prior to client attempts at advanced forms of strength training, and play an integral role in a periodized training plan.

**Muscular endurance**

Muscular endurance is the ability to produce and maintain force production for prolonged periods of time. Developing and improving muscular endurance is an integral component of all fitness programs; it helps increase core and joint stabilization, which is the foundation on which hypertrophy, strength, and power are built. Training for muscular endurance of the core focuses on the recruitment of muscles responsible for postural stability—namely, type I muscle fibres.

Research has shown that resistance training protocols using high repetitions are the most effective means of improving muscular endurance. In addition, a periodization training program can enhance local muscular endurance as well, and after an initial training effect in previously untrained individuals, multiple sets of periodized training may prove superior to single-set training for improving muscle endurance. A relationship exists between increases in strength and local muscular endurance, indicating that strength training alone may improve endurance to a certain extent. However, specificity of training produces the greatest improvements. Training to increase muscular endurance implies that the individual performs many repetitions, which increases a muscle’s time under tension, and/or minimizes rest periods between sets.

**Muscular hypertrophy**

Muscular hypertrophy is the enlargement of skeletal muscle fibres in response to being recruited to develop increased levels of tension, as seen in resistance training. Muscle hypertrophy is characterized by an increase in the cross-sectional area of individual muscle fibres resulting from an increase in myofibril proteins, along with muscle fibre anatomy and function. Although the visible signs of hypertrophy may not be apparent for 4 to 8 weeks in an untrained client, the process begins in the early stages of training, regardless of the intensity of training used.

Resistance training protocols that use a variety of repetition ranges, with progressive overload, lead to muscular hypertrophy. Structured progressive resistance training programs that use multiple sets lead to increased muscular hypertrophy in both younger and older men and women alike. 24 weeks of training for 3 days per week, with three sets of 8 to 12 repetitions per exercise, improved muscle hypertrophy and body composition. Thus, progressive resistance training programs using a variety of repetition protocols, with progressively higher loads and sets, will result in increased hypertrophy in adults.

**Strength**

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. Whether the external force demands the neuromuscular system to produce stability, endurance, maximal strength, or power, internal tension within the muscles is what leads to force production. The degree of internal tension produced is the result of strength adaptations. The specific form of strength or internal tension, which is produced from training, is based on the type and intensity of training used by the client; this refers back to the principle of specificity.

It can be argued that resistance training programs have traditionally focused on developing maximal strength in individual muscles, emphasizing one plane of motion, typically the sagittal plane. Because all muscles function eccentrically, isometrically, and concentrically in all three planes of motion (sagittal, frontal, and transverse) and at different speeds, training programs should be designed using a progressive approach. This approach emphasizes appropriate exercise selection, multiple planes of motion, all muscle actions, and repetition tempos.

Because muscle operates under the control of the central nervous system, strength needs to be considered, not as a function of muscle but as a result of activating the neuromuscular (muscular + nervous) system. Strength gains can occur rapidly in beginning clients and can increase with a structured, progressive resistance training program. One factor in increased strength is an increase in the number of motor units recruited, especially early in a training program. Resistance training increases the neural demand and recruitment of more muscle fibres until a recruitment plateau is reached, after which further increases in strength are a result of muscle fibre hypertrophy.

Strength cannot be thought of in isolation. Strength is built on the foundation of stabilization requiring muscles, tendons, and ligaments to be prepared for the load that will be required to increase strength beyond the initial stages of training. Whereas stabilization-focused resistance training is designed with the characteristics of type I slow-twitch muscle fibres in mind (slow-contracting, low-tension output, and resistant to fatigue), strength-focused resistance training is designed to match the characteristics of type II muscle fibres (quick-contracting, high-tension output, prone to fatigue). Thus, resistance training variables (sets, reps, intensities) are manipulated to take advantage of the specific characteristics of each fibre type. The majority of strength increases will occur during the first 12 weeks of resistance training from increased neural recruitment and muscle hypertrophy. Intermediate and advanced lifters will find it necessary to carry out a more demanding program in terms of training volume and intensity by following a sound periodized schedule.

**Power**

Power is the ability of the neuromuscular system to produce the greatest possible force in the shortest possible time. This is represented by the simple equation of force multiplied by velocity (force × velocity). Power adaptations build on stabilization and strength adaptations and then apply them at more realistic speeds and forces seen in everyday life and sporting activities. The focus of power-resistance training lies in getting the neuromuscular system to generate force as quickly as possible (rate of force production).

An increase in either force or velocity will produce an increase in power. Training for power can be achieved by increasing the weight (force), as seen in the strength adaptations, or increasing the speed with which weight is moved (velocity). Power training allows for increased rate of force production by increasing the number of motor units activated, the synchronization between them, and the speed at which they are activated. The GAS and principle of specificity both dictate that to maximize training for this type of adaptation, both heavy and light loads must be moved as fast as possible, yet in a safe fashion. Thus, using both training methods in a superset fashion can create the necessary adaptations to enhance the body’s ability to recruit a large number of motor units and increase the rate (speed) of activation.

GETTING TECHNICAL

As mentioned previously, power can be defined as force × velocity. However, another equation exists for power and is often used by sport scientists and engineers.

Power is defined as the rate at which work is performed. It is calculated by dividing the amount of work performed by the length of time to perform that work.

Work ÷ Time

Power can be measured in many forms (such as horsepower), but in the context of human performance, the most common method of measurement is watts.

**Acute variables**

Acute variables, also known as exercise training variables, provide the foundation of any exercise program. They determine the amount of stress placed on the body and, ultimately, the physical adaptations that occur. The information presented in this section further details all acute variables and guides the fitness professional in the development of a resistance training program. Acute variables include repetitions, sets, training intensity, repetition tempo, rest intervals, training volume, training frequency, training duration, exercise selection, and exercise order.

HELPFUL HINT

Acute variables include the following:

* Repetitions
* Sets
* Training intensity
* Repetition tempo
* Rest intervals
* Training volume
* Training frequency
* Training duration
* Exercise selection
* Exercise order

For continued adaptations and improvement, the fitness professional must consider a periodized training approach and proper manipulation of acute variables to reduce potential injury or overtraining while facilitating sustained progress. Resistance training programs are often designed through the lens of many disciplines: bodybuilding, powerlifting, Olympic weightlifting, strength and conditioning, and physical therapy. Moreover, resistance training programs vary considerably by professionals in these categories. While the overall breadth and depth of training experiences will largely dictate how well a program is developed and executed, it is not the sole determinate of client success. Designing a safe and effective resistance training program requires a variety of skills, including knowledge gained through continued education, personal interest in exercise, effective communication, buy-in and relationship building, and working with a variety of clientele.

It is imperative for the Certified Personal Trainer to develop the correct application and combination of exercise training knowledge, experience, and skills to be competent at designing resistance training programs for a variety of clients. At a minimum, fitness professionals should be able to answer the following questions with confidence for all their clients:

1. Which exercises are most appropriate for my client?
2. Which exercises are contraindicated for my client (i.e., should not be used)?
3. Which exercise intensities are appropriate for my client?
4. How many exercises are appropriate for my client?
5. How many sets and repetitions should my client perform?
6. How many days per week should my client train?

Without possessing the appropriate knowledge and education to answer these questions, the fitness professional may design inappropriate, ineffective, or even unsafe programs for their clients.

### Acute variables of training

Acute variables are the most fundamental components of designing a training program, including resistance exercise. They determine the specific demands placed on the body over the course of exercise training. When applied during an exercise program, the acute variables dictate these demands and the adaptations achieved. Properly manipulating acute variables fosters structured and systematic program planning to elicit optimal performance. To ensure proper development and progression of a resistance training program, fitness professionals must understand the acute training variables.

**Repetitions**

Repetition refers to the number of times an exercise is completed, for example, performing 15 repetitions of a biceps curl involves curling the weight upward for a total of 15 times. Repetitions are inversely related to the load lifted. For example, the heavier the load, the lower number of repetitions can be achieved. Repetitions can be categorized as low (1 to 5), moderate (6 to 12), and high (12+).

**Sets**

A set describes a group of repetitions that are performed consecutively. The quantities of the other acute variables (i.e., repetitions and training intensity), as well as the fitness level of the client, determine the number of sets that an individual will perform.

There is an inverse relationship between sets, repetitions, and intensity. The individual usually performs fewer sets when performing higher repetitions at a lower intensity (lighter weight) and more sets when performing lower repetitions at a higher intensity (heavier weight).

**Training intensity**

Training intensity (i.e., load), as it relates to resistance training, has been shown to substantially influence muscle hypertrophy and is often argued as the single most important exercise variable for stimulating muscle mass. Although intensity can be described as simply the degree of effort involved with training, it is commonly expressed as a percentage of one repetition maximum (1RM) and equates to the number of repetitions that can be performed with a given weight.

A client’s physical capabilities, fitness level, nutritional status, and goals determine the quantity of repetitions, sets, and training intensity.

| **Training Adaptation** | **Suggested Acute Variables\*** |
| --- | --- |
| Stabilization and muscular endurance | Moderate to high repetitions: ~12–20 or higher  Low to moderate sets: ~1–3 sets  Low to moderate training intensities: ~50–70% 1RM |
| Muscular hypertrophy† | Low to moderate repetitions: ~6–12 or higher  Moderate to high sets: ~3–6 sets  Moderate to high training intensities: ~75–85% 1RM |
| Maximal strength | Low repetitions: ~1–5  High sets: ~4–6 sets  High training intensities: ~85–100% 1RM |
| Power | Low to moderate repetitions: ~1–10  Moderate to high sets: ~3–6  Low training intensities: ~10% of bodyweight (when using a medicine ball) or ~30–45% (when using weights) |

\*The acute variables listed in this table are not absolutes. A client’s training program, goals, and fitness level dictate appropriate acute variable selection.

† Muscle hypertrophy adaptations can be attained with various repetition, set, and intensity schemes depending on the total volume of training and the client’s fitness level (Borde et al., 2015; Lasevicius et al., 2018).

HELPFUL HINT

Intensities (amount of weight) are generally expressed as a percentage of a one-repetition maximum (1RM), but 1RM testing can be challenging to do accurately. However, most repetition ranges for the fitness adaptation are inversely related to %1RM intensities.

For example, for stabilization and muscle endurance (50-70% 1RM intensity), if you can complete 20 reps, with the final rep being challenging, you can assume you are near 50% of your 1RM at that weight. On the other hand, if form begins to break down at 12 reps, then you can assume the weight is at or near 70% of your 1RM for that exercise.

So to keep things simple, you may often see intensity expressed as something like "12 RM" to reflect the rep range that equates to the desired intensity. To begin, find a weight you can comfortably do the lift at for 12 repetitions, then progress accordingly from there.

**Repetition tempo**

Repetition tempo relates to the rate at which each repetition is performed. Studies have analysed the effects of movement tempo on adaptive processes in terms of strength, muscle power, or muscle hypertrophy. Each of the forms of resistance training has been shown to lead to hypertrophy or an increase in muscle strength. A slower movement cadence is often used to stimulate muscle hypertrophy since faster uncontrolled speeds are typically employed to develop strength and power. Slower tempos are also used for the development of stabilization and muscular endurance.

The following practical example will help the fitness professional understand how to read and interpret repetition tempo. A repetition tempo uses a four-number system. Each number corresponds to the length of time (in seconds) to perform a specific muscle action (eccentric, isometric, concentric). The numbers are also listed in the following named order regardless of the way in which the exercise is performed: eccentric/isometric/concentric/isometric. For example, a push-up using a 4-2-1-1 tempo involves the following:

1. Lowering the body toward the floor for 4 seconds (eccentric action)
2. Pausing the body with the chest slightly above the floor for 2 seconds (isometric contraction)
3. Pushing upwards and returning to the top position in 1 second (concentric contraction)
4. Pausing at the top position for 1 second before repeating the next repetition (isometric contraction)

A barbell biceps curl using a 3-0-1-2 tempo involves the following:

1. Curling up the barbell for 1 second (concentric contraction)
2. Pausing at the top for 2 seconds (isometric contraction)
3. Lowering the barbell for 3 seconds (eccentric action)
4. Pausing at the bottom position for 0 seconds before repeating the next repetition (isometric contraction)

HELPFUL HINT

Repetition tempos use the same four-numbered sequence no matter if the exercise first starts with an eccentric movement, like a squat or bench press, or a concentric movement, like a biceps curl or shoulder press.

**Rest interval**

A certain amount of rest is needed throughout a resistance training session to optimize recovery between sets. The rest interval is the time taken to recuperate between sets or exercises and has a dramatic effect on the outcome of the training program. Each performed exercise requires energy. The primary type of energy used during training, whether it is anaerobic or aerobic, depends on the quantity, intensity of the exercise, and the fitness level of the client.

Muscular endurance is best described as the ability to maintain repeated muscular contractions for a given period. As mentioned previously, muscular endurance is best achieved when combining relatively low to moderate loads (light to medium weight) with a moderate to high number of repetitions (e.g., 12 to 20). The general rest recommendation for muscular endurance is approximately 30 to 60 seconds between sets. But depending on the client’s physical fitness level, rest periods can be adjusted. It is important to point out that it is sometimes difficult to maintain a given intensity when performing this type of training. In such a case, the load should be reduced to allow the appropriate repetition range to be performed for muscular endurance adaptations to occur.

Muscle hypertrophy occurs when the size or quantity of muscle cells increases. The general recommendation for hypertrophy training is to have moderate to high loads with wide ranging rest periods between sets—approximately 0 to 180 seconds (Grgic et. al., 2017). Due to the interaction of load and rest interval length, individuals may find it challenging to maintain a given intensity while performing a series of hypertrophy sets. If this occurs, it is suggested that the fitness professional should reduce the load to allow a specific amount of repetitions to be performed.

Maximal strength adaptations are best achieved with relatively long rest periods, depending on the client’s level of fitness and intensity of the exercises. Research provides insight that 3- to 5-minute rest period lengths are perhaps more effective and safer, especially when using multijoint movements.

Power adaptations also require relatively long rest periods. When training for power performance, the rest interval between sets should correspond with the time needed for ATP replenishment. According to research, this rest period is approximately 4 minutes long. Using this research as a general guideline, because everyone is different, resting for 3 to 5 minutes between sets seems logical and can allow for the preservation of force and power production over multiple sets and reps. By following these guidelines for power development, individuals may minimize the effects of fatigue.

**Training volume**

Although volume is not a part of the five components of fitness, it heavily interacts with many other variables of training and thus deserves to be addressed. Training volume is the sum of the repetitions performed in a given set during each training session multiplied by the resistance used. A set can be defined as the number of repetitions performed repeatedly without rest, whereas exercise volume is the product of total repetitions, sets, and load performed in a training session. It is often seen simply as a formula: reps × sets × weight. It has been reported that higher-volume, multiple-set protocols have consistently proven their superiority over single-set protocols with respect to increased muscle hypertrophy and strength.

STRETCH YOUR KNOWLEDGE

The five components of fitness include the following:

1. Cardiovascular endurance
2. Muscular strength
3. Muscular endurance
4. Flexibility
5. Body composition

One key characteristic of training volume is that volume and intensity must be strategically and systematically increased throughout all training programs to avoid training plateaus and necessitate continued progress. Training volume can be changed by altering the number of exercises performed, repetitions performed, or sets performed for each training session. Another key aspect of training volume is that volume and intensity have an inverse relationship. As intensity increases, volume usually decreases. As volume increases, intensity is often reduced. This is frequently observed in variations and models of periodization.

**Training frequency**

Training frequency usually describes the total number of weekly training sessions. Frequency is directly related to duration and intensity of training and can vary depending on the client’s goals, preferences, and time limitations. There are numerous factors influencing training frequency. These may include the type of exercise performed, total involvement of muscle groups, the client’s training status, and overall structure of the program, with specific focus on intensity and volume. In addition, the general lifestyle and social habits of the client will also be an influential factor in frequency and its implementation in the program. Fitness professionals may accidentally implement a wide variety of training without considering the way each factor stresses the client’s workload. Therefore, consideration of the workload must take precedence. A general recommendation is to allow at least 1 day of rest between resistance training sessions that stress identical muscle groups. Specific recommendations are dependent on the client’s overall training status: beginner, intermediate, or advanced.

| **Resistance Training Status** | **Recommended Frequency (Sessions per Week)** |
| --- | --- |
| Beginning or novice | 2–3 |
| Intermediate | 3 if using total body training sessions  4 if using a split regimen (i.e., training different muscle groups each session) |
| Advanced | 4–6; these individuals may perform many sessions in a single day |

**Training duration**

Training duration describes the length of a training session. It is important for the fitness professional to understand that duration and intensity have an inverse relationship. Specifically, as the intensity of an exercise session increases, the duration session will decrease. Like many facets of training, there are other factors involved with duration, such as client health status, training level, and program goals. Volume and specific types of training are also key factors. In most fitness-related scenarios, exercise sessions typically last between 30 and 90 minutes.

**Exercise selection**

Exercise selection is of considerable importance when designing resistance training programs. Exercise selection is often influenced by these factors: specificity of training, availability of equipment, training history, dedication to training, and time availability. For example, performing multijoint exercises takes considerably more effort than performing single-joint exercises (e.g., leg extension or bicep curls). When employing exercise selection, the first factor to consider is establishing the correct exercise technique. Regarding novice clients with unaccustomed training technique or faulty movement patterns, the fitness professional is mandated to provide excellent technique demonstration and explanation and even allow an adequate adjustment period for proper technique sequencing. This is often a good opportunity for the Certified Personal Trainer to modify an exercise or teach a movement pattern, to help build a solid foundation of exercise technique prior to forthcoming programs. After careful review of these factors, the fitness professional can offer exercise selections that maximize training adaptations that address the client’s specific training goals and reduce the likelihood of injury.

It is a well-accepted practice of performing large-muscle-mass exercises prior to small-muscle mass exercises during resistance training. The justification behind this training recommendation is twofold. First, muscle force production for the entire training session becomes significantly greater when multijoint or compound exercises are performed before small-muscle groups. Second, when single-joint exercises are performed first, the force production for larger muscle mass exercises is reduced.

In addition, multijoint exercises require greater stabilization of the body compared to single-joint exercises. In contrast, single-joint exercises allow for a greater focus on individual muscles. The use of single-joint exercises can be used to selectively target any underdeveloped musculature and can enhance muscular symmetry. Ordering resistance exercises in this specific way may result in greater strength improvements.

**Exercise order**

The arrangement of exercise order both describes the way in which exercises are performed during the workout and is influenced by factors including the potential goals of the client, the fatigue response of the exercise, and the specific types of exercise, such as multijoint or single-joint. The main method of exercise order is to first arrange them in order of priority. Specifically, the client will first perform the exercises that emphasize their specific goals in the workout and then implement the less specific goals toward the end of the training session. Reducing the element of fatigue is the primary justification for placing the priority exercise first. The other method of exercise order is according to the type of exercise: multijoint or single-joint. Multijoint, also known as compound exercises, involves engagement of large muscle mass that involves two or more primary joints. Single-joint, also known as an assistance exercise, typically recruits smaller muscle mass and the use of single-joint exercises (e.g., bicep curls or triceps extensions). The fitness professional should have the ability to choose from a multitude of exercises, for both multijoint and single-joint exercises.

This exact organization of exercise order allows the client to perform compound exercises under low fatigue while also maximizing excellent technique. Therefore, the fitness professional should be able to optimize the training loads and tolerance levels for all clients by arranging them in an ideal way to best reduce fatigue.

**Resistance training systems**

Originally, most resistance training programs were designed by powerlifters, Olympic weightlifters, and bodybuilders. Many of these styles of resistance training programs remain popular today because of good marketing or “gym science,” not because they have been proven to be scientifically superior to other forms of training programs that bring about increases in stabilization, strength, and power. Research has shown that following a systematic, integrated training program and manipulating key training variables can help clients achieve optimal gains in muscular endurance, strength, hypertrophy, and performance.

| **Type** | **Definition** |
| --- | --- |
| Warm-up set | 1–2 sets at a low intensity to psychologically and physiologically prepare for the resistance training exercise |
| Single set | Performing one set of each exercise |
| Multiple set | Performing a multiple number of sets for each exercise |
| Pyramid | Increasing (or decreasing) weight with each set |
| Superset | Performing two exercises in rapid succession with minimal rest |
| Complex training | Performing a multijoint or compound exercise, with a heavy load, immediately followed by an explosive movement (e.g., a barbell squat then a vertical jump) |
| Drop set | Performing a set to failure, then removing a small percentage of the load and continuing with the set |
| Giant set | Performing four or more exercises in rotation with as little rest as possible between sets |
| Rest pause | Incorporating a slight pause between repetitions within a series of sets |
| Circuit training | Performing a series of exercises, one after the other, with minimal rest |
| Peripheral heart action | A variation of circuit training that alternates upper and lower body exercises throughout the set |
| Split routine | A resistance training routine that trains different body parts on separate days |
| Vertical loading | A form of training in which strength training exercises are performed in rapid succession, starting with the upper body and working down to the lower body (i.e., total-body → chest → back → shoulders → biceps → triceps → legs) |
| Horizontal loading | Performing all sets of an exercise (or body part) before moving on to the next exercise (or body part) |

Warm-up set

The fitness professional should regularly perform preparatory movements with their clients, prior to undergoing vigorous exercise, which includes resistance training. Warm-up sets require performing one to two sets at a low intensity prior to increasing the load. The purpose of a warm-up set is to psychologically and physiologically prepare the individual for the work to be performed. For example, a client may perform one or two sets of a bench press exercise using light weights prior to increasing the load and finishing the remainder of their set; typically, 10 to 15 repetitions are enough for a warm-up set. It is important that the load selected during a warm-up set does not cause undue fatigue and compromise a client’s performance for their remaining sets.

The Single-Set System

As the name suggests, the single-set system uses one set per exercise. It is usually recommended that single-set workouts be performed two times per week to promote sufficient development and maintenance of muscle mass. Although multiple-set training is promoted as being more beneficial for strength and hypertrophy gains in advanced clients, the single-set system can be beneficial, especially for beginning-level clients.

Fitness professionals are encouraged to explore the benefits and options of single-set workouts to further customize individual program design options. Single-set training systems are often negatively perceived for not providing enough stimuli for adaptation. However, when reviewing the physiology of the human body and how it operates, this notion may not be true. In fact, many beginning clients could follow a single-set program to allow for proper adaptive responses of the connective tissue and nervous system before engaging in more rigorous training systems. By encouraging clients to avoid lifting more than they can handle, injury can be avoided.

The Multiple-Set System

The multiple-set system, on the other hand, consists of performing multiple numbers of sets for each exercise. The resistance (load), sets, and repetitions performed are selected according to the goals and needs of the client. While multiple-set training can be appropriate for both novice and advanced clients, it has been shown to be superior to single-set training for more advanced clients. The increased volume (sets, reps, and intensity) is necessary for further improvement but must be administered appropriately to avoid overtraining.

The Pyramid System

The pyramid system involves a progressive or regressive step approach that either increases weight with each set or decreases weight with each set. In the light to heavy system, the individual typically performs 10 to 12 repetitions with a light load and increases the load for each following set, until the individual can perform 1 or 2 repetitions, usually in four to six sets. This system can also be used for workouts that involve only two to four sets or higher repetition schemes of 12 to 20 repetitions. The heavy to light system works in the opposite direction, in which the individual warms up and then begins with a heavy load for 1 to 2 repetitions, then decreases the load and increases the repetitions for four to six sets.

The Superset System

The superset system uses two exercises performed in rapid succession, one after another. There are multiple variations of the superset system.

The first variation includes performing two exercises for the same muscle group back to back. For example, an individual may perform the bench press exercise, immediately followed by push-ups, to fatigue the chest musculature. Completing two exercises in this manner will improve muscular endurance and hypertrophy because the volume of work performed is relatively high. This style of superset can use two, three (termed a *triset*), or more (termed a *giant set*) exercises for the target muscle group. The greater the number of exercises used, the greater the degree of fatigue experienced and demands on muscular endurance.

The second variation consists of performing two exercises back to back that involve opposing muscle groups, such as the chest and back or quadriceps and hamstring complex. Performing supersets in this manner allows a significant load to be placed on the target muscle during each set. This is possible because while the agonist (prime mover) is working, the antagonist is recovering, and vice versa.

Supersetting typically involves sets of 8 to 12 repetitions with no rest between sets or exercises; however, any number of repetitions can be used. The superset system is popular among bodybuilders and athletes and may be beneficial for muscular endurance, muscular hypertrophy, or power, depending on the exercises used.

Complex training

Complex training is an effective, time-efficient training method for enhancing strength and power, which alternates heavy resistance exercise with an explosive power exercise that is biomechanically similar in movement. This provides the fitness professional an opportunity to train both sides of the force-velocity equation in one session. Specifically, the fitness professional can train their client on both the force end with heavy loads (e.g., squats) coupled with a higher-velocity movement (e.g., squat jumps). The premise behind complex training is that the client or athlete can perform the power or plyometric exercise more explosively due to the previous heavy-load exercise.

The explanation for this phenomenon is known as post-activation potentiation (PAP) and is the primary method on which complex training is based. Post-activation potentiation refers to the condition by which acute muscle-force generation is increased as a result of the inner contractions of the muscle. In other words, a person displays an increase in muscular force that is caused by the excitation of the nervous system, which was created by the heavy loads.

Complex training is volume dependent, meaning that it is necessary to complete sufficient sets to stimulate the neuromuscular system (e.g., three to five sets or more). Due to the high-stress nature of complex training, the neuromuscular system needs about 72 hours for complete recovery. Considering this, Certified Personal Trainers should consider limiting the implementation of complex training to two to four sessions per week, depending on their client’s training split.

Drop sets

A drop set is a resistance training system that is popular among bodybuilders and strength athletes. It is a system that enables an individual to continue a set past the point at which it would usually terminate. Drop sets involve performing a set to failure, then removing a small percentage of the load (typically 5–20%) and continuing with the set, completing a small number of repetitions (usually 2–4). This procedure can be repeated several times (typically 2–3 drops per set). A set to failure followed by three successive load decrements performed with no rest would be referred to as a triple drop. Drop sets are considered an advanced form of resistance training suitable for experienced lifters.

Giant set

Giant sets, while very similar to supersets, are comprised of four or more exercises completed in succession. When performing giant sets, it is best for the Certified Personal Trainer to focus on one muscle group at a time, with three or more exercises corresponding to 8 to 12 repetitions. The rest interval is fairly short with approximately 5 to 15 seconds between exercises and several minutes (e.g., 2–5) between giant sets. It is important to note that the fitness professional might not be working the muscle in the exact same manner, variation, or angle; therefore, it is best to choose a weight that is challenging while allowing the individual to complete the necessary repetitions. For example, a chest giant set might consist of 10 repetitions of flat dumbbell chest presses, 10 repetitions of incline dumbbell presses, 10 repetitions of decline bench presses, and 10 repetitions of dumbbell pec flys. The Certified Personal Trainer should customize the giant set to their client’s goals and ability level. Giant sets have been shown to improve the weight lifted during one-rep maximum, peak, and shuttle-run performances, as well as improve lean muscle mass.

Rest-pause set

Rest-pause training is a popular style that typically employs moderate to heavy loading with a short rest interval, allowing clients to develop as much of a stimulus as possible in minimal time. Rest-pause is a productive method of training to increase time under tension and metabolic stress, especially in recreationally trained persons (Prestes et al., 2019). To perform a rest-pause set, the fitness professional would instruct their client to engage in the following sequence:

1. Perform a set for a specific amount of repetitions.
2. Set the weight down and take several deep breaths, then complete the subsequent repetitions to muscular failure.
3. Complete the second step as many times as possible.

The amount of rest and load used during each set is dependent on the client’s goals and fitness level. Heavier loads and slightly longer rest periods are recommended for clients seeking maximal strength, whereas moderate loads and shorter rest periods are ideal for clients seeking muscular endurance or body composition changes.

The circuit-training system

The circuit-training system consists of a series of exercises that an individual performs one after the other, with minimal rest between each exercise. The typical training variables for a circuit-training program include a low to moderate number of sets (1–3), with moderate to high repetitions (8–20) and minimal rest periods between exercises; however, these variables can be manipulated to enhance the desired effect. Circuit training is a great training system for individuals with limited time and for those who want to alter body composition.

The peripheral heart action system

The peripheral heart action system is another variation of circuit training that alternates upper body and lower body exercises throughout the circuit. This system of training distributes blood flow between the upper and lower extremities, potentially improving circulation. The number of exercises per sequence varies with the program’s goal. The individual typically performs 8 to 20 repetitions per exercise, depending on their desired adaptation and fitness level. This system is very beneficial for incorporating an integrated, multidimensional program and for altering body composition and improving health outcomes.

| **Resistance Training Exercises** |
| --- |
| Dumbbell chest press |
| Dumbbell squat |
| Seated machine row |
| Dumbbell Romanian deadlift |
| Standing dumbbell shoulder press |

The Split-Routine System

A split-routine system involves breaking up the body into parts to be trained on separate days. Many bodybuilders and mass-dominant and strength athletes (American football, shot put, etc.) use the split-routine system. Bodybuilders typically perform numerous exercises on the same day for the same body part to bring about optimal muscular hypertrophy. By breaking up the body into parts that can be trained on different days, more work can be performed for the allotted time per workout, which can increase muscular hypertrophy Any variation of these outlined routines can be used, but the important issue in some of these routines is recovery time. When training each body part more than once per week, fitness professionals should account for volume and intensity.

| **Routine** | **Day(s) Performed** | **Body Parts Trained** |
| --- | --- | --- |
| 2-day | Monday | Upper body |
|  | Thursday | Lower body |
| 3-day | Monday | Chest, shoulders, triceps |
|  | Wednesday | Legs |
|  | Friday | Back, biceps |
| 4-day | Monday | Chest, triceps |
|  | Tuesday | Back, biceps |
|  | Thursday | Legs |
|  | Friday | Shoulders |
| 5-day | Monday | Chest |
|  | Tuesday | Legs |
|  | Wednesday | Back |
|  | Thursday | Shoulders |
|  | Friday | Arms |
| 6-day | Monday and Friday | Chest, shoulders, triceps |
|  | Tuesday and Saturday | Legs |
|  | Wednesday and Sunday | Back, biceps |

**Vertical Loading and Horizontal Loading**

Vertical loading is a resistance training system that moves a workout vertically down the workout template by alternating body parts trained from set to set (Table 20-8). It is a form of training in which strength-training exercises are performed in rapid succession, starting with the upper body and working down to the lower body:

1. Total-body
2. Chest
3. Back
4. Shoulders
5. Biceps Triceps
6. Legs

In a vertically loaded workout, the client would perform the first exercise (total-body) for the required repetitions and then move on to the chest exercise for the next set of repetitions. After the chest exercise, the client would move on to the back exercise and so forth, until all exercises have been completed. Once completed, the client would return to the first total-body exercise and run through the exercises again for the desired amount of sets. This can also be done in a circuit style, by minimizing the rest periods between exercises.

This vertical loading system of training can be very beneficial for allowing maximal recovery to each body part while minimizing the amount of time wasted on rest. For example, if it takes 1 minute to perform each exercise, by the time the client returns to the chest exercise, 7 to 10 minutes could have passed, which should be sufficient time to allow for adequate recovery. Even though 7 to 10 minutes have passed, the client has been constantly moving and has performed one set of every exercise in their workout.

Horizontal loading refers to performing all sets of an exercise or body part before moving on to the next exercise or body part. For example, if performing three sets of a chest exercise and three sets of a back exercise, the client would perform all three sets of the chest exercise before moving to the back exercise. The progression of exercises is therefore said to be horizontal across the template. This is the method most commonly used in health club environments and is appropriate for hypertrophy, maximal strength, and power training.

The drawback to the horizontal loading system is the amount of time typically spent resting, which can often be more time than the actual workout itself. Horizontal loading can be a metabolic progression if rest periods are monitored and limited to 30 to 90 seconds between sets. If the same muscle groups are forced to work with minimal recovery, it can lead to faster development of metabolic and hypertrophy-related adaptations in the muscle.

**Safety**

The most important objective and goal for the Certified Personal Trainer is to commit to doing no harm to their clients. Like all athletic activities, the susceptibility to injury is always present. However, the fitness professional should use all measures of risk management to keep injury risk to a minimum while maximizing client results. When the Certified Personal Trainer increases knowledge through science and application, awareness is enhanced and the risk of client injury due to poor judgment and negligence is decreased.

Maintaining a safe environment

The fitness professional’s scope of practice involves the responsibility of interviewing potential clients to gather relevant information regarding their personal health history, lifestyle, and willingness and ability to exercise. Much of their centred care is concentrated on instructing, demonstrating, teaching, evaluating, and providing extensive education to their clients. The Certified Personal Trainer must effectively create and endorse the use of safe and efficient exercise programming through appropriate client consultation, screening, and comprehensive evaluation. Certified Personal Trainers should also be able to respond appropriately in emergency situations if and when they arise.

Proper equipment setup

Equipment should be grouped and placed according to specific categories, including free weights, resistance training machines, plyometrics, and warm-up areas. Proper setup ensures adequate flow throughout the gym and weight room, reducing congestion and maximizing the use of space. Fitness professionals should be cognizant of the specific equipment used during their sessions and return all equipment to its original place. This helps maintain the condition of equipment and potentially reduces the risk of injury because unkempt or untidy equipment can become a tripping hazard. Fitness professionals should never use damaged equipment in the facility, such as frayed cables and missing or unstable pieces. All equipment should be repaired or replaced if broken. Current and existing equipment should be regularly cleaned and upgraded over time.

Spotting techniques

The Certified Personal Trainer must teach and model proper technique during exercise, perform proper spotting, and monitor all exercise movements until safe execution has been mastered. It is critical for fitness professionals to exhibit large degrees of confidence and experience with respect to spotting technique to provide maximum safety and high-quality coaching for every session. Compound exercises, such as a barbell back squat, bench press, or dumbbell shoulder press, require a spotter to reduce injury risk, especially when using heavier loads. Research has indicated that a decrease in injuries occurs through proper spotting techniques.

The following checklist should be used by the fitness professional during spotting activities:

1. The spotter should regulate the number of total repetitions performed by the client prior to the beginning of each set.
2. The spotter should stand and maintain a stable, wide-stance body position to increase maximal safety of the corresponding exercise.
3. An experienced spotter delivers adequate and ample support for the client to successfully execute the lift, especially when lifting through the sticking point.
4. The Certified Personal Trainer is encouraged to spot at the client’s wrists instead of the elbows when using dumbbells (i.e., in a dumbbell shoulder press). Spotting at the wrist provides better support for the lifter and eliminates the elbows collapsing inward.
5. During the barbell squat exercise, the spotter should be positioned behind the lifter and place their upper arms underneath the lifter’s armpits. This provides maximum spotting security between the spotter and the lifter.
6. The Certified Personal Trainer is encouraged to use an additional spotter for exercises when the load surpasses what a single spotter can successfully manage on their own. For example, two spotters will stand on opposite sides of the barbell during a heavy barbell back squat exercise. When and if needed, the spotters will assist the client in accomplishing the movements by lifting the ends of the barbell until they are able to complete the exercise.
7. It is not recommended for fitness professionals to spot machine-based or cable-based exercises by placing their hands underneath the weight stack. This increases risk of injury to the spotter and the lifter.

Monitoring exercise

Fitness professionals should closely monitor their clients during an exercise session, including monitoring exercise intensity and exercise technique. Monitoring exercise intensity can be performed in many fashions, such as tracking heart rate or ratings of perceived exertion, which is a subjective ratings scale from 1 to 10 in which clients subjectively rate their level of effort during exercise based on physical markers, such as breathlessness, fatigue, sweat rate, and muscle soreness. A lower score indicates light effort, whereas scores closer to 10 indicate intense effort.

| **Rating** | **Perceived Exertion Level** |
| --- | --- |
| 0 | No exertion, at rest |
| 1 | Very light |
| 2–3 | Light |
| 4–5 | Moderate, somewhat hard |
| 6–7 | High, vigorous |
| 8–9 | Very hard |
| 10 | Maximum effort, highest possible |

**Five kinetic chain checkpoints**

In addition to tracking exercise intensity, fitness professionals must be proficient at teaching and correcting proper exercise technique. In other words, fitness professionals must be diligent and meticulous when monitoring their client’s movements and provide the appropriate corrections and cueing to ensure that their clients perform exercises correctly. This minimizes injury risk and maximizes muscle recruitment. As with all exercises, quality should always come before quantity or weight progression, and the five kinetic chain checkpoints should always be monitored (Figure 20-8).

1. Feet: Approximately shoulder-width apart and pointing straight ahead (unless the exercise requires a different foot position)
2. Knees: In line with the second and third toes (avoid allowing knees to cave inward)
3. Hips: Level and in a neutral position
4. Shoulders: In a neutral position (avoid protracting or elevating the shoulders, unless the exercise requires these positions)
5. Head: Cervical spine in a neutral position

**Proper breathing technique**

Although breathing is regulated and coordinated by the autonomic nervous system, proper breathing is not automatic. Breathing influences muscular function and posture because the habitual use of breathing muscles during respiration affects the ways in which these muscles are used.

Especially during resistance training, fitness professionals need to teach their clients proper breathing techniques to maximize performance and minimize injury risk. During the concentric phase of an exercise, the client should breathe out (exhalation), preferably through the mouth, whereas during the eccentric portion of the lift, the client should breathe in (inhalation).

When discussing breathing technique, the Valsalva manoeuvre can be a useful strategy, particularly when performing maximal or near-maximal lifts to ensure spinal stability. This process involves expiring against a closed glottis, creating additional intra-abdominal pressure and spinal stability. In turn, this reduces the associative compressive forces on the spinal discs during lifting. Keeping the spine stable requires individuals to brace the trunk, using many abdominal muscles, including the transverse abdominis, rectus abdominis, the external and internal obliques, and the diaphragm, thus generating large amounts of intra-abdominal pressure, which is critically important when lifting heavy loads.

However, the Valsalva manoeuvre is also potentially dangerous because it can cause light-headedness and dizziness, impede the return of venous blood to the heart, and raise an individual’s heart rate and blood pressure. Using the Valsalva manoeuvre is generally not recommended for clients presenting with hypertension and other forms of heart disease. Considering that a large majority of fitness clients are seeking weight loss and improved health measures as opposed to maximal strength, the use of the Valsalva manoeuvre in many cases is not necessary, unless the client is physically healthy and seeking maximal performance measures in strength.

**Guidelines for resistance training**

Resistance exercises are an integral component of any exercise training program because they help ensure optimal joint stability, muscular endurance, strength, power, and coordinated movement. Moreover, resistance exercises can be an effective mode meant for increasing lean muscle mass, reducing body fat, enhancing athletic performance, and improving numerous health markers. Programming resistance training exercises must be systematic and progressive. As such, fitness professionals should follow specific program guidelines, including proper exercise selection criteria and milestones for progression.

| **Resistance Training Variables** | |
| --- | --- |
| Progressive   * Easy to hard * Simple to complex * Static to dynamic * Slow to fast * Stabilization → strength → power | Volume   * Sets   + Low   + Moderate   + High * Repetitions   + Low   + Moderate   + High |
| Range of motion   * Full * Partial * End range * Mixed ranges | Planes of motion   * Sagittal * Frontal * Transverse * Multiplanar |
| Speed of motion   * Slow * Medium * Fast * Explosive | Resistance   * Body weight * Light * Medium * Heavy |

**Resistance training progressions**

When introducing resistance exercises into an exercise program, the exercises should initially focus on optimizing ideal movement patterns. These patterns include (but are not limited to) squatting, pushing, pulling, vertical pressing, and hip hinging. Clients should become familiar with these basic movement patterns before a fitness professional introduces intricate or advanced forms of exercise. In addition, a focus on acquiring basic exercise skills, such as the proper use of exercise machines, free weights, and other types of exercise equipment, is paramount. This is especially important to minimize injury risk for new or deconditioned clients.

Once a client displays adequate movement competency, resistance exercises can progress. We recommend progressing resistance training in a systematic fashion, using these three steps: (1) stabilization-focused exercises, (2) strength-focused exercises, and (3) power-focused exercises. The sequence is critically important.

Stabilization-focused exercises

First, clients should focus on the adaptations of stability and muscular endurance. This provides an adequate foundation of core and joint stability and prepares connective tissue (tendons, ligaments) for higher demands of training. In addition, the client will obtain greater levels of muscular endurance and strengthen type 1 muscle fibers necessary for maintaining ideal posture and spine stability, especially during more advanced forms of exercises that use heavier loads. This form of resistance training should provide greater demands on core stability and proprioception by progressing from bilateral to unilateral movements, using slow repetition tempos and high repetition schemes. For example, the standing cable row can be progressed from two-arm movements to alternating-arm movements to one-arm movements, providing greater variety in one exercise.

Exercises can also be progressed in this category by decreasing one’s base of support. For example, the same cable row sequence (two-arm, alternating-arm, one-arm) can be advanced to a single-leg stance to further challenge the client’s posture, balance, and joint stability.

Lastly, stabilization-focused resistance exercises can be progressed to increase stabilization demands of the upper extremities by using unique loading patterns and specialized equipment. For example, the kettlebell bottoms-up exercise is a unique loading pattern that challenges both core and shoulder stability, whereas the Earthquake Bar is a unique tool that simultaneously challenges upper-extremity stability and strength.

CRITICAL

Stabilization-focused resistance exercises should use a slow repetition tempo, a high amount of repetitions (typically 12–20), and a few sets (1–3). This form of training enhances muscular endurance, posture, and joint stability.

However, exercises must be tailored to the client’s own ability level. For example, a highly skilled athlete may be able to perform advanced forms of stability training, such as performing lifts on a single leg, or use unique loading schemes seen with implements like an Earthquake Bar or kettlebell.

Conversely, an older adult unaccustomed to exercise will likely need to start with less advanced forms of stability training. In this instance, the use of elastic bands in a seated position may be the most unstable position that this client can safely handle. Over time, with practice and improved conditioning, the older adult can graduate toward more advanced forms of stability training.

Strength-focused exercises

After clients have obtained sufficient movement competency, stability, and muscular endurance, it is safe to progress toward strength-focused resistance exercises. These exercises focus on the adaptations of strength and muscular hypertrophy and typically require heavier loads than stabilization-focused resistance exercises. The goal is to increase the amount of stress placed on the body for increased muscle size and strength. This period of training is a necessary progression from stabilization for anyone who desires to increase muscle size, muscle strength, and bone mineral density. Common exercises in this category include squats, Romanian deadlifts, bench presses, and other common weightlifting exercises.

Power-focused exercises

The last progression focuses on the adaptation of muscular power. Power-focused resistance exercises are designed to increase the rate of force production (or speed of muscle contraction). This form of training uses the adaptations of stabilization and strength acquired previously and applies them with more realistic speeds and forces that the body will encounter in everyday life and in sports.

Power training is not a common or usual practice in the fitness environment, but it has a very viable and purposeful place in a properly planned training program. Examples of power-focused resistance exercise can include (but are not limited to) explosive movements, such as medicine ball throws and explosive plyometrics.

**Resistance training exercises**

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Total-Body Exercise Descriptions

Ball Squat, Curl to Press

When performing any form of a ball squat, try to use the ball to guide one through the squatting motion (sitting in a chair) versus relying on the ball for support (leaning back on the ball).

Multiplanar Step-Up, Balance, Curl to Overhead Press

When pressing overhead, make sure the low-back does not arch. This may indicate overactivity of the latissimus dorsi and underactivity of the abdominals.

Single-Leg Squat, Curl to Overhead Press

When performing any version of a single-leg squat, only squat to the depth that can be safely controlled while maintaining ideal posture.

Single-Leg Squat to Row

This total-body exercise targets many muscles of the posterior chain, including the gluteus maximus and shoulder retractors, such as the posterior deltoids and rhomboids.

Multiplanar Lunge to Two-Arm Dumbbell Press

When performing any squatting or lunging motion, keep the foot straight and align the knees with the second and third toes. This ensures proper joint mechanics and optimal force generation, increasing the benefit of the exercise while decreasing its risk.

Squat, Curl to Two-Arm Press

Choose a load that enables the client to perform the biceps curl and overhead press with ideal form. The upper body will likely fatigue before the lower body when performing this exercise.

Deadlift, Shrug to Calf Raise

This exercise can typically be done using heavy loads; it is a complementary exercise for those who perform Olympic weightlifting.

Two-Arm Push Press

This is a power-focused resistance exercise. Clients are encouraged to first establish proper movement patterns, stability, and strength before attempting this exercise.

Barbell Clean

This is a simplified illustration of performing the barbell clean. This is an advanced power exercise that requires proper instruction before attempting.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Chest / Pushing Exercise Descriptions

Push-Up

A common compensation that occurs when performing a push-up is arching of the low-back as the hips fall toward the ground. This is an indicator that the individual possesses underactive abdominals and the exercise must be regressed.

Push-Up: Hands on Ball

If using a stability ball is too advanced, regress the exercise to a traditional floor push-up.

Standing Cable Chest Press

The shoulder shrug is a common compensation that occurs when performing a standing cable chest press. This can indicate overactive upper trapezius muscles, which would require additional stretching.

Flat Dumbbell Chest Press

When performing chest presses, the range of motion at the shoulder joint, which is indicated by how far the elbows go down, will be determined by the load one is lifting (control) and tissue extensibility. The key is only to go as far as one can control without compensating.

Barbell Bench Press

During this exercise, the feet should remain in contact with the floor, whereas the buttocks, shoulders, and head must remain in contact with the bench. The use of weight plates underneath the feet is acceptable if the client cannot reach the floor, due to height limitations.

Medicine Ball Chest Pass

If the ability to perform power exercises with a medicine ball is not an option, because of equipment or facility limitations, this exercise can also be done using tubing or a cable apparatus. Make sure to adjust the weight or resistance accordingly, so the client can still perform the movement quickly and under control without compensation.

Medicine Ball Rotation Chest Pass

A client can either throw the ball to their Certified Personal Trainer or toward a wall. If throwing toward a wall, instruct the client to be prepared to catch the ball on the rebound.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Back/Pulling Exercise Descriptions

Ball Cobra

Externally rotate the arms during this exercise so the thumbs are pointing up toward the sky.

Ball Dumbbell Row

Performing exercises in a prone position can be uncomfortable. When working with overweight individuals, it may be more appropriate to perform this exercise using a machine or from a standing, hip-hinged position.

Standing Cable Row

When performing rows, initiate the movement by retracting and depressing the shoulder blades (scapulae). Do not allow the shoulders to elevate.

Seated Cable Row

To increase the effectiveness of the exercise and decrease the risk of injury, keep the torso stationary throughout the execution of the exercise. Flexing and extending the torso while performing the row creates momentum, which decreases the effectiveness of the exercise and may place stress on the low-back.

Seated Lat Pulldown

Performing lat pulldowns with a bar behind the neck is not advised, because this places stress on the shoulder joints and cervical spine. If performing the lat pulldown exercise with a bar, the bar should pass in front of the face, to approximately shoulder height.

Medicine Ball Pullover Throw

To decrease stress to the shoulder and low-back, it will be important for the client to have optimal extensibility through the latissimus dorsi musculature before performing this exercise.

Soccer Throw

Use a medicine ball that is no more than 10% body weight. The goal is to throw the ball as hard as possible to maximize power production.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Shoulder / Vertical Pressing Exercise Descriptions

Tubing External Rotation

This exercise helps strengthen muscles of the rotator cuff, such as the infraspinatus and teres minor. These two muscles externally rotate the shoulder.

Tubing Internal Rotation

This exercise helps strengthen the subscapularis, one of the four rotator cuff muscles. This muscle internally rotates the shoulder.

Single-Leg Dumbbell Scaption

Performing shoulder exercises in the scapular plane, with arms out at a 45-degree angle, decreases the risk of the supraspinatus muscle becoming impinged within the shoulder. If standing on one leg is too difficult, regress this exercise to a bilateral stance.

Ball Combo I

This exercise consists of three parts. First, the client will perform a Y (scaption) position, then a T (shoulder abduction) position, and lastly an A (cobra) position.

Ball Combo II

Like ball combo I, this exercise also consists of three parts: a dumbbell row, shoulder external rotation, and a prone shoulder press.

Standing Dumbbell Shoulder Press

Proper core activation is important during all overhead pressing exercises, so as to minimize injury to the low-back area.

Standing Dumbbell Lateral Raise

This exercise helps strengthen the middle deltoid. Remember, the deltoids consist of three segments: anterior deltoid, middle deltoid, and posterior deltoid.

Seated Dumbbell Shoulder Press

When performing overhead presses, make sure the cervical spine stays neutral, so the head is drawn back. Do not allow the head to migrate forward, because this places excessive stress on the posterior neck muscles and cervical spine.

Seated Shoulder Press Machine

Ensure that the client is properly positioned on the machine with their feet flat on the floor.

Front Medicine Ball Oblique Throw

If a partner is unavailable, this exercise can be performed by tossing the medicine ball against a wall.

Overhead Medicine Ball Throw

This exercise is best performed outside to avoid hitting overhead lights or the ceiling.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Biceps Exercise Descriptions

Single-Leg Dumbbell Curl

Keeping the scapulae retracted during the exercise ensures proper scapular stability, placing more of an emphasis on the bicep’s musculature.

Standing Dumbbell Curl

This exercise is performed in the same manner as the single-leg dumbbell curl. Instruct your clients to avoid using momentum to curl the weight upwards.

Standing Barbell Curl

To decrease stress on the elbow, do not grip too close or too wide on the bar. To determine grip width, clients should extend their elbows so their hands fall naturally to their sides, palms facing forward. This is the position where they should be when they grip the bar.

Standing Hammer Curl

Palms should face each other throughout the duration of the movement. This exercise also strengthens forearm muscles in addition to the biceps brachii.

Seated Two-Arm Dumbbell Biceps Curl

This exercise can also be performed with either alternating arms or one arm at a time.

Biceps Curl Machine

When performing biceps curls, it is important to keep an upright posture. Do not allow your client’s torso to excessively flex or extend to cheat the movement.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Triceps Exercise Descriptions

Supine Ball Dumbbell Triceps Extensions (Dumbbell Skull Crushers)

When performing stability ball exercises in a supine position, the head should comfortably rest on the ball. This will decrease stress to the cervical spine.

Prone Ball Dumbbell Triceps Extensions

To ensure optimal alignment, make sure the ankles, knees, hips, shoulders, and ears are all in alignment and maintained throughout the exercise.

Cable Pushdown

Using a rope when performing cable pushdowns will allow the elbows to track through their natural path of motion versus having the hands closely fixed on a bar. This may help decrease the risk of elbow pain.

Supine Bench Barbell Triceps Extensions (Barbell Skull Crushers)

As with barbell curls, keeping the hands too close on the bar can increase stress on the elbow. Placing hands closer to shoulder-width apart can decrease stress on the elbow.

Close Grip Bench Press

The proper hand position should be slightly inside shoulder-width apart during this exercise. Moving the hands inward places more emphasis on the triceps musculature, but the anterior shoulders and chest are still involved with this exercise.

The following is a list of common stabilization-focused, strength-focused, and power-focused resistance training exercises. However, this is not an exhaustive list.

Leg Exercise Descriptions

Ball Squat

Ball squats are a great way to teach individuals how to squat properly. The goal is to have them eventually progress to squats without the stability ball.

Single-Leg Squat

This is an advanced stabilization-focused leg exercise. The client should only squat as low as they can safely control.

Single-Leg Romanian Deadlift

This exercise strengthens many muscles of the posterior chain including the hamstrings, gluteal complex, and lumbar erector spinae (low-back muscles).

Calf Raise

This exercise helps strengthen the gastrocnemius, soleus, and other plantar flexor muscles of the lower leg.

Multiplanar Step-Up

Lunges are excellent lower extremity strengthening exercises; however, many individuals lack the flexibility and stabilization requirements to execute the exercise properly. Step-ups are a great way to regress the lunge until your client develops proper flexibility and stabilization capabilities to perform the lunge correctly.

Multiplanar Lunge

Lunges can be performed in all directions, including front lunges, lateral lunges, and turning lunges. Reverse lunges are also an option.

Dumbbell Squat

Make sure the feet are positioned shoulderwidth apart, the toes are pointed straight, and the knees are aligned with the second and third toes. Avoiding knee valgus (knees caving inward) is important to minimize unwanted stress to the knee ligaments.

Leg Press (Hip Sled)

Make sure the feet are positioned on the platform shoulder-width apart, the toes are pointed straight, and the knees are aligned with the second and third toes. This will decrease stress to the knees, hips, and low-back.

Barbell Squat

“How far down should your client squat?” The answer is, “Only as far as can be controlled without compensating.” As your client develops more flexibility and stabilization strength, the range of motion can be increased, assuming no compensations occur.

Deadlift

Monitor all five kinetic chain checkpoints throughout the duration of the exercise, especially your client’s spine position. The spine should remain neutral rather than rounded and hunched over.

Squat Jump

Landing with the knees caved inward is dangerous and can lead to pain and injury. Make sure your clients display optimal landing mechanics, with their feet pointed straight ahead and knees tracking over the second and third toes.

Tuck Jump

When performing jumping exercises, make sure your clients land just behind the ball of their foot, rather than on the ball of the foot or on the heel. This will ensure proper force distribution through the foot and lower extremities, thus improving force production capabilities

**Program design**

Creating and modifying exercise programs for clients can be a complicated process because there are many variables to consider, including the client’s goals, their tolerance for exercise, and their unique physical abilities and medical history. Moreover, fitness professionals have a multitude of different exercise formats to choose from, which can potentially cause confusion and frustration during the program design process. Keeping these concerns in mind, arguably the most important factor when creating an exercise program is to ensure it is adopted and adhered to by the client. Whether programs are developed for beginning exercisers, avid fitness enthusiasts, or experienced athletes, exercise programs need individuality and uniqueness to make them impactful and meaningful for clients. This increases commitment and helps affirm a client’s success toward reaching their health, wellness, and fitness goals.

In addition, it is vitally important for fitness professionals to design and implement exercise programs that are individualized for each client based on their needs, goals, and abilities. Exercise programs based on a client’s assessment results, attitudes, and fitness level help guarantee continued success and long-term adherence to the exercise program.

To assist in this process, fitness professionals must be able to answer specific questions that are related to the appropriateness of exercise programming:

1. What are my client’s needs, goals, and abilities?
2. Does my client have any concerns or contraindications for exercise due to previous injuries or medical conditions?
3. What are the results from my client’s fitness assessment? Does my client exhibit muscle imbalances, poor posture, or limited mobility?
4. Which forms of exercise does my client like and dislike? Am I integrating liked exercises for my client to foster a positive environment?
5. What exercise variables, such as sets, repetitions, or rest periods, should I use that best match my client’s abilities, goals, and phase of training?
6. What exercise modalities, such as free weights, elastic bands, or machines, are appropriate for my client based on my client’s goals and fitness level?
7. What is the appropriate frequency (days per week) and duration (time per session) of exercise sessions that should be used?

If the fitness professional can answer these questions consistently, it is likely the client is in good hands to reach their fitness goals in a safe and effective manner. If not, the fitness professional is possibly creating an inappropriate exercise program, which may cause injury or undue fatigue that could lead to overtraining or burnout (Walters et al., 2018). Conversely, by following specified protocols, risk factors can be mitigated, and the client can exercise in a safe and positive environment that is set up for success.

Fitness programming takes practice, but, as with anything, the more experience obtained working with a wide range of exercisers, the less challenging it becomes. The goal is to create unique exercise programs that are systematic and progressive so that consistent overload can occur and fitness goals can be met.

Additionally, it is recommended that the fitness professional adopt an integrated approach to program design that includes multiple forms of training, such as flexibility; cardiorespiratory; core; balance; plyometric; speed, agility, and quickness (SAQ); and resistance training. Using an integrated approach to program design can increase consistency and progression and minimize the risk of injury.

In some instances, clients and fitness professionals may be tempted to use an overly simplistic approach to program design. For example, exercise programs may overemphasize particular factors, such as expending maximal calories for fat-loss goals or the development of speed and power to improve athletic performance. However, a well-rounded exercise program must be progressive and systematic and consider many variables, such as teaching proper movement patterns, improving mobility and stability of the kinetic chain, enhancing muscular and aerobic endurance, and reducing the likelihood of injury. In other words, exercise programming involves more than what we see at the surface, such as reducing body fat, gaining muscle mass, or increasing strength and power. This is known as the “iceberg effect”.

### Program design

Program design is an organizational structure of exercises with appropriate volume and intensity to attain a specific fitness or performance goal. In other words, the fitness professional provides a road map and vital step-by-step processes, modifications, and parameters to follow based on client capabilities, limitations, and goals. To be successful in program design, the fitness professional must have a clear understanding of training plans and periodization.

**Training plans**

To accomplish objectives, training programs should be organized into a plan that involves using long-term and short-term goals. A training plan is a specific outline that a fitness professional uses to help meet the client’s goal.

It 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. Training plans are unique to each client, and fitness professionals are discouraged from using cookie-cutter exercise programs or plans. Understanding the importance of designing safe and effective programs using acute variable manipulation is essential information for all fitness professionals to possess.

**Periodization fundamentals**

Fitness and sport-performance programming are based on the concept of periodization. Periodization (or planned fitness training) is a systematic approach to program design that exploits the general adaptation syndrome and principle of specificity to vary the amount and type of stress placed on the body to produce adaptation and prevent injury. Periodization varies the focus of a training program at regularly planned periods of time to encourage optimal adaptation. Periodization involves two primary objectives:

1. Dividing the training program into distinct periods (or phases) of training: annual training plan (macrocycle), monthly training plan (mesocycle), and weekly or daily training plan (microcycle)
2. Training different forms of strength in each period (or phase) to control training volume and to prevent injury

Annual plan (macrocycle)

An annual training plan, or macrocycle, shows how the training program will progress for the long term, from month to month, to meet the desired goal. It outlines specified training schedules, projected fitness evaluation sessions, and planned recovery periods. In other words, macrocycles provide a bird’s-eye view of the entire year’s training regimen. This gives the client a clear representation of how the fitness professional plans to get the client to their goal.

In the realm of sports conditioning, macrocycles are typically divided into preparatory, competitive, and transition periods (i.e., preseason, in-season, or off-season) that are spread out over a year’s time.

Monthly plan (mesocycle)

A monthly training plan, or mesocycle, divides a training plan into specified monthly cycles. The monthly plan details the specific days of each workout and the style of training used. This enables clients to see their training schedule on a smaller scale, and it provides more detail than the annual plan (macrocycle).

While typically 4 weeks long, it is important to note that mesocycles do not have to be 1 month in duration in all instances. For example, a bodybuilder may follow a 3-week fat-loss mesocycle in preparation for a contest, whereas a baseball pitcher may use a 6-week off-season mesocycle program to build arm strength and increase throwing velocity.

Weekly plan (microcycle)

A weekly plan, or microcycle, details the specific workouts for the week. Many clients appreciate this plan the most, but without first developing the annual or monthly training plans, weekly plans can lack purpose, focus, and direction. Microcycles are usually 7 days, but, depending on the client’s schedule, a microcycle could expand to 10 days, if desired.

In most cases, three to six microcycles form a mesocycle, depending on the client’s training schedule and goals.

A more in-depth discussion regarding the integration of the OPT model into macrocycles, mesocycles, and microcycles will be provided later in this chapter.

**Linear and Undulating Periodization**

Periodization has been shown to be an effective method of program design for many fitness-related goals, and yet, to date, it is not a common practice among all fitness professionals. Periodization provides for the repeated use of different forms of training, at specific times, to elicit different adaptations in the body, such as muscular endurance, strength, and power. Periodization also aims to properly manage training more effectively, create a peak period for competition, and reduce the risk of injury and overtraining

GETTING TECHNICAL

Periodization’s origins stem from athletics because athletes compete during specific times of the year. As such, strength and sport coaches use periodization to ensure athletes reach peak performance according to the athlete’s competition schedule.

Periodization can be divided into three distinct phases that lead up to competition: preparatory, competitive, and transition. The preparatory phase aims to gradually increase volume and intensity of training to peak levels prior to the competitive season. The competitive phase is the competition (in-season) period, and the aim is to keep athletes in top condition while minimizing overtraining and burnout. The transition phase (off-season) is the point where a competitive phase ends, and the athlete begins to incorporate active rest and tapers down the intensity of workouts (Lyakh et al., 2016).

Linear periodization

Linear periodization is a traditional method of program design that aims to gradually increase the intensity of the training load while simultaneously decreasing volume over a set period of time. Linear periodization is consistent in its approach and often uses predetermined timelines or protocols for exercise progression. For example, one approach uses light loads for the first 4 weeks to develop muscular endurance and joint stability prior to performing 4 weeks with moderate loads and, finally, performing 4 weeks using heavy loads to develop muscular hypertrophy and maximal strength, respectively.

The fitness professional can use this method with new or experienced exercisers because it is simple and easy to follow. With this approach, the load and intensities used within the program increase in a systematic fashion.

| **Timeframe** | **Intensity: 1-Repetition Maximum (1RM)** |
| --- | --- |
| Weeks 1 to 4: Stability and muscular endurance | Light to moderate loads: 60–70% of 1RM |
| Weeks 5 to 8: Hypertrophy and strength | Moderate to heavy loads: 70–85% of 1RM |
| Weeks 9 to 12: Maximal strength | Heavy to maximal loads: 85–100% 1RM |

It is important to recognize that linear periodization schemes can modify more than load/intensity and can also manipulate exercise selection, rest periods, and volume (sets + reps) to progress exercise programs. This is an important consideration for those with goals other than strength and hypertrophy, such as those seeking weight loss or endurance athletes seeking improvements in aerobic capacity.

Undulating periodization

Undulating periodization, or nonlinear periodization, uses changes in volume, intensity, and exercise selection to provide loading differences on a daily or weekly basis. This form of periodization is mentally beneficial because the workouts do not become stale or boring. Fitness professionals can also be a little more creative in their approach because multiple training protocols can be used all in the same week. For example, a fitness professional can assign a muscular endurance–focused workout on Monday, a power-focused workout on Wednesday, and a hypertrophy-focused workout on Friday. Using this method, multiple styles of training are performed within the same week. Because of these daily changes, the stress on the body is constantly varied, which limits the client’s ability to plateau in their performance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** |
| Muscular endurance–focused workout |  | Power-focused workout |  | Hypertrophy-focused workout |