Personal Training for the 21st Century

ACE
AMERICAN COUNCIL ON EXERCISE

An Introduction to the ACE Integrated Fitness Training™ Model

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WHAT IF . . .

. . . personal training could consistently provide positive and memorable experiences that would drive participation and retention?

. . . personal trainers could align their communication styles to each client's personality index to promote trust and facilitate effective dialogue?

. . . personal trainers could gain a better understanding of, and uniquely program for, each client's cognitive, emotional and physiological characteristics?

. . . personal trainers could effectively determine readiness to change behavior and then implement effective strategies to promote healthy behaviors and program adherence?

. . . there was a simple, yet systematic approach to programming that was relevant, appropriate, effective, and adaptable for any client?

. . . there was a logical and customized progression for all individuals for cardiorespiratory, functional movement, resistance, balance, flexibility and core training?

BY TODD GALATI, M.A.

These "what if" statements represent some of the key challenges ACE hears regularly from personal trainers, managers, directors, club owners and educators. Solutions are needed for each of these questions if the fitness industry is going to move ahead from the practices of yesterday into the next decade and beyond.

After years of reviewing industry research, consulting with numerous subject-matter experts in the fitness industry, and then trying to design solutions for each of these questions, the exercise scientists at the American Council on Exercise posed the following challenge to themselves: What if there was one blueprint for all of this?

To address such a large challenge, ACE adopted a "blue-sky" approach to planning by first formulating a vision of what a comprehensive plan for successful personal training would look like. This comprehensive blueprint would need to be applicable for novice and veteran personal trainers, personal-training managers and directors, club owners and educators, and it would need to apply to clients across the full spectrum of the health–fitness–performance continuum. Additionally, this blueprint would need to incorporate scientifically proven practices, while eliminating antiquated methods that create barriers to client enjoyment of, and adherence to, exercise.

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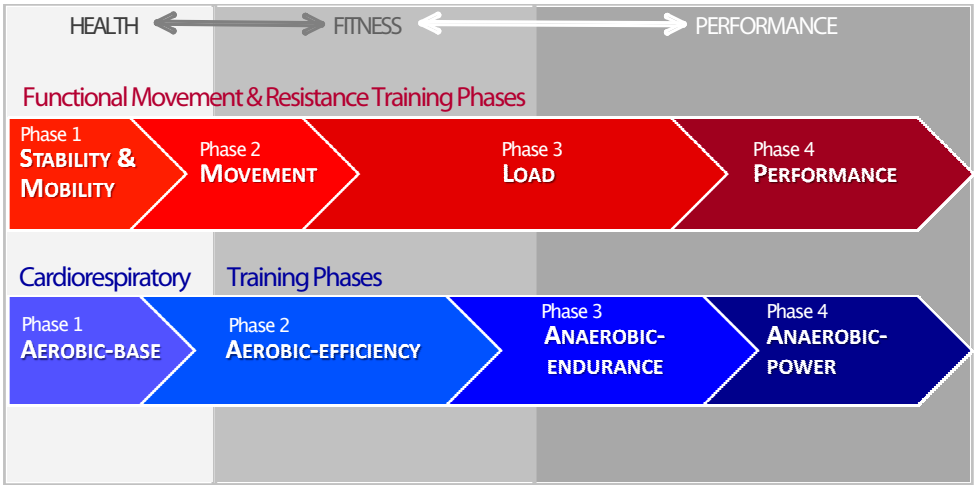
The Evolution of Personal Training

Personal training has gone through a significant evolution during the past 25 years, transforming from a relatively straightforward profession into a multifaceted field in allied healthcare. Today, personal trainers must meet the mounting challenges of an aging and increasingly overweight population with a long list of special needs that includes cardiovascular disease, hypertension, diabetes, metabolic syndrome and a variety of orthopedic conditions, including osteoporosis, osteoarthritis, low-back issues and post-orthopedic rehabilitation.

Advances in exercise science and medical research have led to updated exercise guidelines for both apparently healthy and special needs clientele. These guidelines provide broad parameters for programming, but lack the specific details necessary for unique programming based on each client's goals and current level of health and fitness. They also fail to address the diverse motivational needs of special population clientele who may have a history of exercise successes and failures or may be dealing with limited functional capacities.

Today, effective personal trainers must first build rapport with their clients, and then match the appropriate motivation and communication techniques with the right exercise program to help clients adopt healthful behaviors, build self-efficacy and safely reach their goals. This has evolved personal training from a science to an art form that incorporates the science of exercise with strong communication and teaching techniques that complement the psychological, emotional and physiological needs and concerns of their clients. This transition has new professionals, seasoned veterans, educators, and club owners and managers wondering how to pull it all together for themselves and their clients, employees and students.

Figure 1: Training Components and Phases of the ACE IFT Model



ACE Integrated Fitness Training™ Model

The American Council on Exercise developed the ACE Integrated Fitness Training™ (ACE IFT™) Model to provide personal trainers with a systematic and comprehensive approach to exercise programming that integrates assessments and programming to facilitate rapport, adherence and behavior change, while also improving posture, movement, flexibility, balance, core function, cardiorespiratory fitness, muscular endurance and muscular strength.

The ACE IFT Model organizes the latest exercise science research into a logical system that helps trainers determine appropriate assessments, exercises and progressions for clients based on their unique health, fitness, needs, goals and readiness to change behavior. The ACE IFT Model has two principal training components:

- Functional movement and resistance training
- Cardiorespiratory training

Each component is comprised of four phases (Figure 1) that provide trainers with a system for determining and implementing the most appropriate assessments, exercise programs, progressions and regressions for clients at all fitness levels. Rapport is the foundation for success during every phase, whether a trainer is working with a competitive athlete or a previously sedentary client just beginning an exercise program.

The four training phases span the full health–fitness–performance training continuum, which is based upon the premise that exercise programs should follow a logical progression that first improves health, then develops and advances fitness, and finally enhances performance. Each client will be at a unique point on the continuum and should be progressed according to his or her available time, capacity for recovery and outside stressors such as work, family and travel. Clients who have been sedentary for years should initially focus on becoming regular exercisers to improve health before progressing to work on improving fitness. This should seem logical, but what about the avid weight lifter or long-time runner? Should a client fitting one of these profiles automatically train all exercise parameters at intensities that fall into the fitness or performance domains? The ACE IFT Model provides the answers to these types of questions for clients at all points along the health–fitness–performance continuum.

Rapport

The greatest impact a personal trainer can have on a client's life is to help that person adopt new fitness-related behaviors and establish a positive relationship with exercise. For this reason, rapport is the foundation of the ACE IFT Model. By developing this critical component of the client–trainer relationship, personal trainers can promote open communication, develop trust and foster the client's desire to participate in an exercise program. Rapport should be developed early through open communication and initial positive experiences with exercise, and then enhanced through behavioral strategies that facilitate long-term adherence.

Exercise programming has traditionally focused on physiological changes, placing early emphasis on fitness assessments for program design and tracking progress. Some assessments are critical for ensuring client safety and designing appropriate exercise programs, but do personal trainers really need to conduct a full battery of physiological assessments with each client? The answer is no. While it is true that programming has traditionally depended on baseline values to assess progress, this practice can be counterproductive to client motivation and adherence.

Conducting a comprehensive set of physiological assessments can be detrimental to early program success by reinforcing a client's negative self-image and beliefs that he or she is out of shape or overweight. Do obese clients who want to lose significant weight really need to have their skinfolds measured to confirm what they already know? Does a client who cannot walk for more than 10 continuous minutes really need to perform a test of cardiorespiratory fitness? If the client is high risk, he or she should be referred for a medical examination and a graded exercise test prior to participating in an exercise program. But if the client is at moderate risk and just has poor fitness, walking for up to 10 continuous minutes is both a fitness assessment and a workout. This does not negate the effectiveness of fitness assessments. They are good tools for assessing progress, but personal trainers must always determine which fitness assessments to use with each client based on his or her current fitness, goals and desire for assessment.

Personal trainers should always collect health-history information to determine if the client has any contraindications or requires a physician's evaluation prior to exercise. The ACE IFT Model includes functional and physiological assessments that can be performed during specific phases to provide information for exercise programming in that phase. Some assessments, such as those that focus on functional movement, balance and range of

motion, may be conducted within the first few sessions with a new client, while other assessments should wait until the client has progressed from one phase to another. Ideally, trainers should utilize a sequential approach to conducting assessments that begins with reviewing the client's health history, discussing desires, preferences and goals, completing a needs assessment, and then determining relevant assessments and timelines for conducting them (Figure 2).

Always keep in mind that the most important initial adaptations come from helping a client to modify behavior to establish a habit of regular exercise. A personal trainer can have an immediate impact on a client's health by first creating positive exercise experiences that can lead to exercise adherence, and then gradually progressing the program to produce results.

At the first client–trainer meeting, it is important to encourage the client and create an environment where he or she can feel successful. It is also important for the trainer to be mindful that many adults have been inactive since childhood. After two to four weeks of regular physical activity, clients will generally experience more stable positive moods due to:

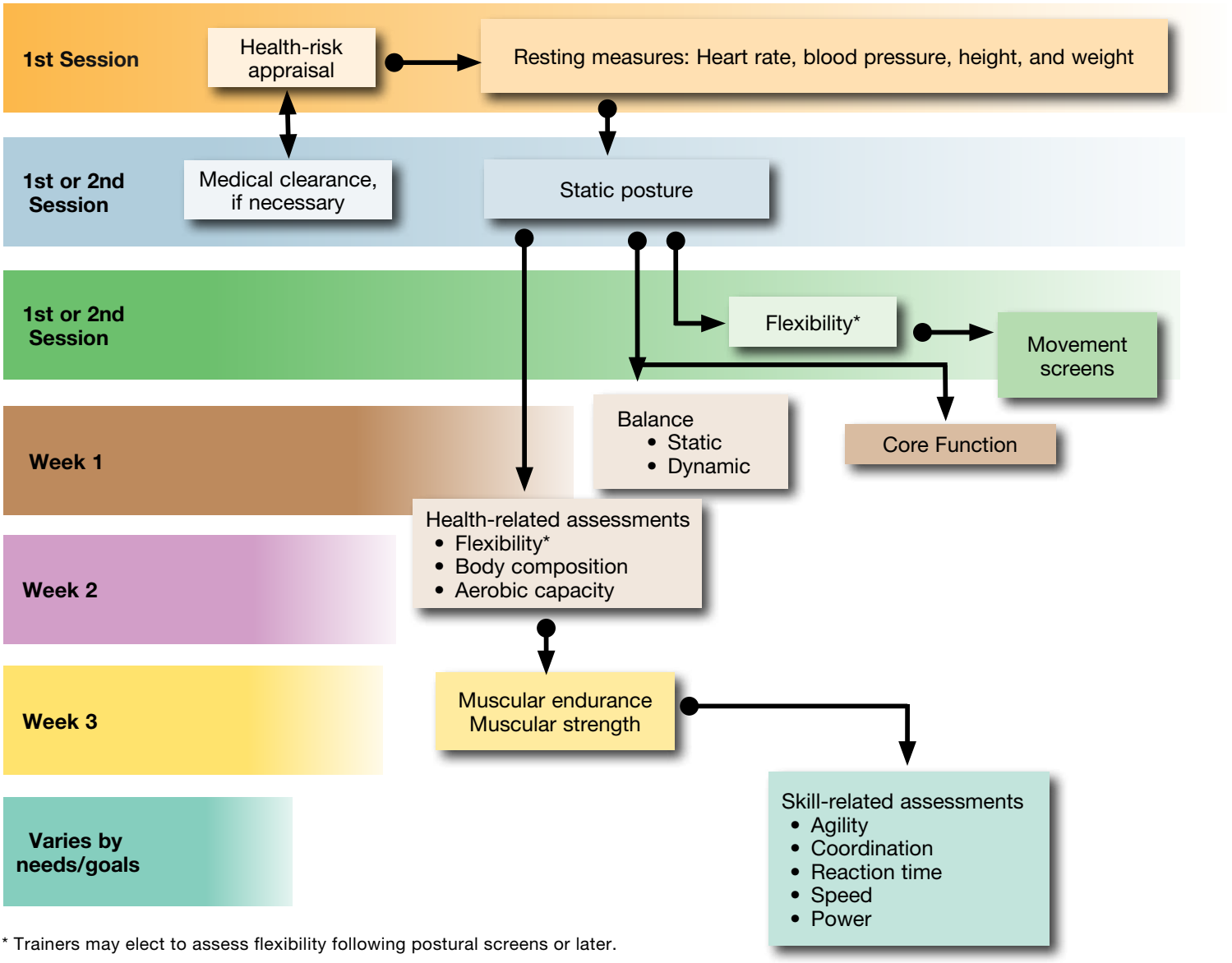
- Changes in hormone and neurotransmitter levels (e.g., endorphins, serotonin, norepinephrine)
- Increased self-efficacy with task and possibly short-term goal accomplishment
- Improved performance due to neuromuscular adaptations to exercise

These positive factors will enhance adherence behaviors, but the client must make it through two to four weeks of regular exercise to reap these benefits. To help a client transition to the action stage of behavior change, the trainer should make exercise fun and emphasize regular adherence first before switching the primary focus toward any other goals such as weight loss or body-composition changes. By providing regular positive experiences with exercise, personal trainers can help clients to have continued success.

Functional Movement and Resistance Training

Functional movement and resistance training are often treated as two separate types of training, even though resistance training is the application of an external load to movements. In the ACE IFT Model, they form one training component that progresses from training to improve postural stability and mobility to performance training (Table 1). Individuals who

Figure 2: Sample Assessments Sequencing for the General client



* Trainers may elect to assess flexibility following postural screens or later.

have weak core muscles or postural imbalances are at increased risk for injury when applying external loads to their movements. For that reason, phase 1 of this training component is focused on assessments and training for postural and joint stability and mobility. Once clients gain good postural integrity, they can progress to phase 2, where assessments and training are focused on good movement patterns. Once clients can perform proper movement sequences, they can progress to phase 3, where external loads are applied to movements. Only clients who have progressed to advanced training in phase 3 and have performance-oriented goals will move on to phase 4.

Many clients, regardless of their current exercise frequency and fitness level, will have muscle imbalances, postural issues and improper movement mechanics that should be addressed through early stability and mobility training and then progress to movement training. This will require some clients to regress from load training back to phase 1 training. The personal trainer can facilitate this by communicating the benefits of improved core function, postural and joint stability and mobility, and movement patterns on health, as well as performance once the client resumes load training.

TABLE 1
FUNCTIONAL MOVEMENT AND RESISTANCE TRAINING PHASE OVERVIEW

Phase 1—Stability & Mobility Training

- Improved posture through increased strength and endurance of postural muscles
- Improved joint stability and mobility
- Initial physiological adaptations to exercise

Clients with postural issues, muscle imbalances and/or core instability should train initially in this phase.

Phase 2—Movement Training

- Teaching fundamental movement pattern sequencing on five primary movements:
  1. Bend-and-lift movements (squatting)
  2. Single-leg movements (lunging)
  3. Pushing movements
  4. Pulling movements
  5. Rotational (twisting) movements
- Creating stable mobility and mobile stability
- Developing dynamic balance

Proper movement patterns should be established prior to loading the movements.

Phase 3—Load Training

- Application of external loads to movements through resistance training to meet client goals for:
  - ✓ Muscular endurance
  - ✓ Muscle hypertrophy
  - ✓ Strength
  - ✓ Maximal strength
  - ✓ Body composition changes
- Training focus on muscular force production during movement patterns rather than isolated muscle training
- Maintain phase 2 exercises as dynamic warm-up

Many fitness enthusiasts will train in this phase for years.

Phase 4—Performance Training

- Velocity of force production (power training)
- Activity/event specific training including plyometrics
- Speed – Agility – Quickness – Reactivity

Only clients with competitive or performance-oriented goals will train in this phase.

Cardiorespiratory Training

Cardiorespiratory-training programs have traditionally focused on steady-state training to improve cardiorespiratory fitness, with workload generally progressed through increased duration and/or intensity, and the use of loosely categorized intervals with a primary focus on reducing boredom, or training intervals at or near the lactate threshold to improve speed during endurance events. The ACE IFT Model provides a systematic approach to cardiorespiratory training that can take a client from being sedentary to training for a personal record in an event such as a half-marathon. While this will not be the goal of most clients, having an organized system that can allow for long-term progression like this is empowering for the personal trainer (Table 2).

This training component begins with the development of an initial aerobic base to improve health and then progresses to improving cardiorespiratory fitness through aerobic-efficiency training in phase 2, which is where many clients will train for years. Clients with competitive endurance goals will progress to anaerobic-endurance training in phase 3, and only those clients with specific needs for near-maximal speed during endurance events or competitive start-stop sports activities will train for anaerobic-power in phase 4.

Cardiorespiratory training in the ACE IFT Model uses client-specific intensity markers that include the talk test, heart rate at the first and second ventilator thresholds (VT1 and VT2), and ratings of perceived exertion. Traditional intensity markers such as percentages of maximal heart rate (%MHR), heart rate reserve (%HRR), or $\dot{V}O_2$ reserve ($\%\dot{V}O_2R$) are not recommended for use with the ACE IFT Model because of the inherent error of predicted MHR and predicted $\dot{V}O_2max$. Instead, training parameters

TABLE 2
CARDIORESPIRATORY TRAINING PHASE OVERVIEW

Phase 1—Aerobic-base Training

- Focus on positive exercise experiences and improved health
- No fitness assessments are required prior to exercise in this phase
- Focus on steady-state exercise in Zone 1; below talk test threshold or RPE of 3 to 4 (moderate to somewhat hard)

Progress to phase 2 once client can sustain stead-state exercise for 20-30 continuous minutes.

Phase 2—Aerobic-efficiency Training

- Increase duration of exercise in Zone 1
- Administer the submaximal talk test to determine HR at VT1
- Introduce aerobic intervals in Zone 2, progressing them towards but just below VT2

Many fitness enthusiasts will train in this phase for many years, and will be able to reach all of their non-competitive goals training in this phase.

Phase 3—Anaerobic-endurance Training

- Focus is on program design for clients who have endurance performance goals
- Administer the VT2 threshold test to determine HR at VT2.
- Training time distributed as follows to allow for adaptation to the total training load of the Zone 2 and Zone 3 intervals:
  - ✓ Zone 1: 70-80% of training time
  - ✓ Zone 2: < 10% of training time
  - ✓ Zone 3: 10-20% of training time

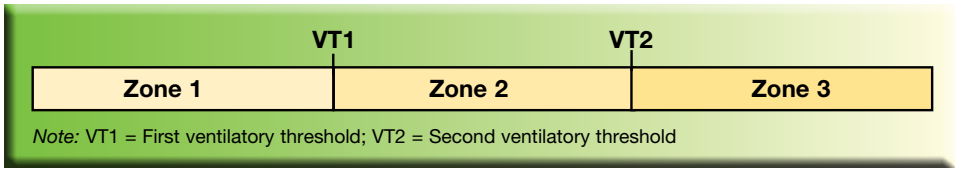
Only clients with event-specific goals or fitness enthusiasts performing > 7 hours of cardiorespiratory exercise per week will train in this phase.

Phase 4—Anaerobic-power Training

- Focus is on improving anaerobic power through enhanced phosphagen energy pathways and ability to buffer large accumulations of blood lactate
- Competitive goals focused on improving speed for short bursts during endurance or athletic competitions
- Programs will have a similar distribution of training time seen in phase 3, with short Zone 3 intervals at near-maximal efforts

Only clients competing in endurance or athletic competitions where short bursts at near-maximal efforts will train in this phase, and generally only during specific training cycles prior to competition.

Figure 3: Three-zone Training Model



Note: VT1 = First ventilatory threshold; VT2 = Second ventilatory threshold

are set around a three-zone model (Figure 3):

- Zone 1: HR < VT1.
- Zone 2: HR = VT1 to HR < VT2.
- Zone 3: HR > VT2.

During each cardiorespiratory training phase the modes of exercise performed should accommodate the level of exertion required, while also being appropriate for the client's preferences, health, fitness and contraindications.

ACE IFT Model for Special Population Clientele

Personal trainers in most settings will work with clients who have a variety of special needs. Once these clients have been cleared for exercise by their physicians, trainers can utilize the integrated training process of the ACE IFT Model by adjusting exercise selection, intensity, sets, repetitions and duration to fit the needs of each client based on his or her physician's recommendations and the guidelines available for his or her specific condition. Depending upon the condition, a special-needs client may progress normally or may stay in a training phase for a long time. The most important goal is to provide each client with initial positive experiences that promote adherence through easily achieved initial successes. Transitioning a special-population client into first the action and then the maintenance stages of change will have a significant impact on that client's health and quality of life.

Summary

The ACE Integrated Fitness Training Model provides a systematic approach for utilizing distinct training mesocycles (phases) and progressions with unique points of entry for all clientele. The ACE IFT Model also includes key behavioral and emotional strategies to enhance the overall exercise experience. This comprehensive system is ideal for novice trainers, yet accommodates practices of experienced trainers, managers and directors, and it provides a logical approach for educators teaching students the application of program design and progression. And, the ACE IFT Model can be used to enhance the business of personal training through a closed-end sales and marketing approach to selling personal training packages and promoting staff expertise in the various training phases.

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ACE Integrated Fitness Training™ (ACE IFT™) Model for Resistance and Movement: Phases 1 and 2

BY FABIO COMANA, M.A., M.S.

WHILE ALL CLIENTS SEEK GOALS THAT VARY ALONG THE HEALTH-FITNESS-PERFORMANCE CONTINUUM (FIGURE 4), THEY ALL FUNDAMENTALLY SHARE ONE TRAINING OBJECTIVE: TO IMPROVE THEIR EFFICIENCY OF MOVEMENT.

Although forward progress through this continuum is logical, it is the responsibility of the fitness professional to assess the appropriateness of progression and consider the need for initial regression that addresses the foundational elements of restoring good posture, improving stability and mobility throughout the kinetic chain, reestablishing core function, developing balance and promoting movement efficiency.

The ACE Integrated Fitness Training (ACE IFT) Model not only encompasses the current scope of practice for personal trainers, coaches and practitioners, but also includes a programming blueprint to address the need for stability and mobility, and for training movement. Additionally, the model addresses the notion of *dysfunctional fitness,* a concept gaining greater attention among fitness professionals. As technology continues to advance the complexity of exercise equipment, many exercises and drills have become equally technical, increasing the potential for poor technique, overuse and injury. As most deconditioned adults exhibit limited mobility and stability throughout the kinetic chain, they resort to compensated movement patterns when performing complex exercises or when using advanced equipment. This raises the concern whether exercise, without regard to the individual's levels of stability and mobility or their movement efficiency, is actually doing more harm than good.

The first two phases of the ACE IFT Model serve as a critical foundation to all training and is the basis from which load and performance training should begin. The goal of this article is to discuss key concepts of each phase and introduce a template developed within the ACE IFT model that progresses individuals in preparation for more traditional load and performance training. It should be noted that educating clients and athletes on the importance of this foundation can prove challenging. Fitness professionals can address this need by emphasizing both the short- and long-term benefits to fitness, performance and overall quality of life. While clients present with goals consistent with load training, they may require a few weeks to months of initial training emphasizing these prerequisites. This does not disqualify them from performing resistance training, but we must recognize this need and temporarily de-emphasize load or volume training with external resistance. Load or volume training without first addressing these prerequisites may exacerbate existing compensations and dysfunction.

- General Health
- Weight Management
- Disease Management
- Stress Management
- Functional Capacity

- Aerobic
- Muscular Endurance
- Muscular Strength
- Flexibility

- Speed
- Power
- Agility
- Reactivity
- Event-specific
- Quickness

Figure 4: The Health-Fitness-Performance (HFP) Continuum

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Before discussing programming components of each phase, it may be useful to first define the terms.

- Joint stability is the ability to maintain or control joint movement or position. This is achieved by the synergistic actions of the components of the joint (e.g., muscles, ligaments, joint capsule) and the neuromuscular system, but must never compromise joint mobility.
- Joint mobility is the range of uninhibited movement around a joint or body segment. This is also achieved by the synergistic actions of the joint components and neuromuscular system, and also must never compromise joint stability.

Movement generally begins from a position of good, static posture. While all joints demonstrate varying levels of stability and mobility, they generally favor one over the other depending on their function. For example, the hips are highly mobile, demonstrating significant movement in all three planes, whereas the lumbar spine is more stable, demonstrating limited ranges of movement. Likewise, the glenohumeral joint is highly mobile, whereas the scapulo-thoracic region is more stable, providing a solid platform from which upper-extremity pulling and pushing movements occur. If we examine the relationship of stability and mobility throughout the kinetic chain, we note an interesting relationship exists (Figure 5).

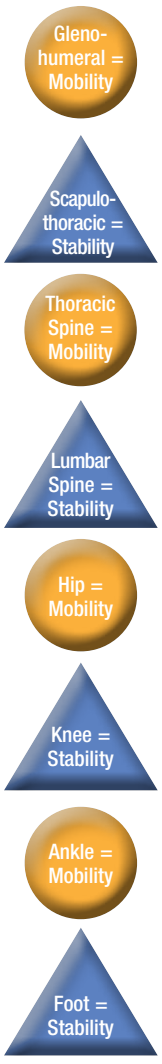

Figure 5: Mobility and Stability of the Kinetic Chain

Individuals who exhibit good posture with muscle balance generally demonstrate an appropriate relationship between stability and mobility throughout the kinetic chain. Concerns arise, however, with individuals who exhibit poor posture and muscle imbalances. What happens to joint movement along the kinetic chain when appropriate levels of mobility are lacking?

- Adjacent, more stable joints may need to compromise some degree of stability to facilitate the level of mobility needed at the moving joint. For example, if a client exhibits excessive kyphosis (loss of thoracic mobility) and attempts to extend the thoracic spine, the body may resort to increasing lumbar lordosis to compensate for the lack of thoracic mobility.
- A moving joint will seek to achieve the desired range of motion by incorporating movement into other planes. For example, if a client performs a hip-extension movement (sagittal plane) and lacks flexibility within the hip flexors, external rotation of the leg and hips into the transverse plane may occur, producing a compensated movement pattern.

Phase 1: Stability and Mobility

The primary objective of Phase 1 is to reestablish appropriate levels of stability and mobility within the kinetic chain, beginning with the most proximal region of the body and gradually progressing toward the distal segments. Figure 6 presents a template for this progression.

The lumbar spine is most proximal to the body's center of mass (COM) and the core. Programming should focus initially on promoting stability of the lumbar region through the actions and functions of the core. Given the impact of poor posture upon muscle hypertonicity (tight lumbar extensors), there may also be a need to promote muscle extensibility by stretching the lumbar extensors (e.g., using cat-camels). Once some stability in this region is achieved, the focus of the program should shift to addressing adjacent segments; specifically the hips and thoracic spine; then stability within the parascapular muscles of the scapula-thoracic region; and, finally, mobility throughout the distal segments. Attempting to improve a client's mobility within distal joints without first developing proximal stability will likely compromise stability within these segments. Without appropriate joint stability, muscles normally involved in mobilization of a joint may need to alter function and offer stability to the joint. For example, a lack of scapula-thoracic stability may force the deltoids, normally responsible for glenohumeral movement, to compromise their force-generating capacity and assist with scapular stability. For more in-depth information on this subject, refer to Chapter 9 of the *ACE Personal Trainer Manual* (4th edition).

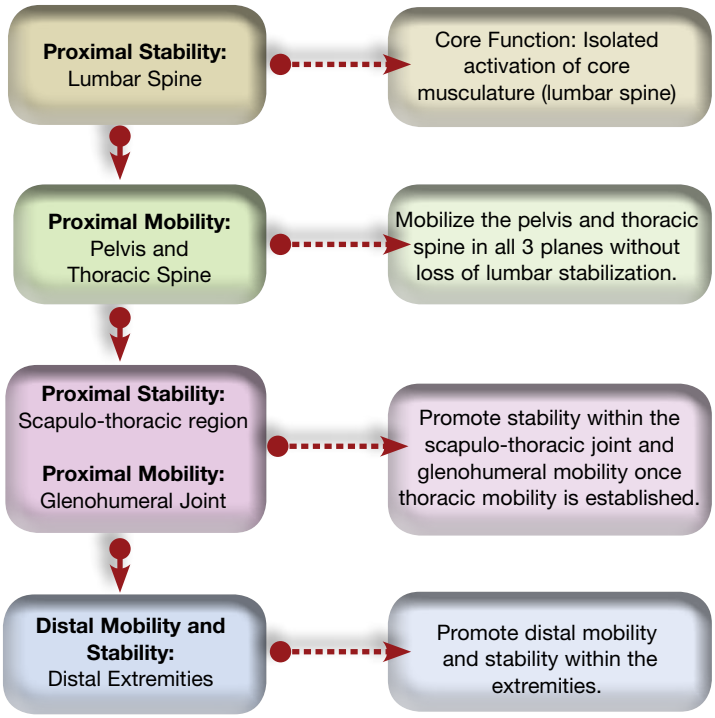

Figure 6: Programming Components of Phase 1: Stability and Mobility Training

Programming Guidelines for Phase 1

Consider the following basic guidelines when programming within Phase 1:

1. Promote conscious awareness of postural deviations.
   - ✔ Posture is controlled subconsciously by lower portions of the brain, and most individuals who exhibit poor posture are not consciously aware of their alignment.
   - ✔ Conscious awareness shifts control to higher regions of the brain and helps reeducate faulty neural information. This is a critical first step to restoring good posture.
2. Distinguish between correctible and non-correctible postural compensations.
   - ✔ Most compensations and muscle imbalance originate from correctible factors, including inactivity, repetitive motions, awkward positions, work environment, side dominance, improper exercise technique and poorly designed training programs. However, some can be attributed to non-correctible or potentially non-correctible factors, such as congenital conditions (e.g., scoliosis), pathologies (e.g., rheumatoid arthritis), structural deviations (e.g., tibial torsion,

femoral anteversion), or trauma (e.g., surgery, injury, amputations).

✔ Coach; don't manually move the joint, but rather ask the client to move his or her joint according to your cues.

3. Evaluate the client's intention to make lasting improvements.
   ✔ Working with your client for three hours a week to improve posture can be negated quickly if he or she does not make any real commitment to change during non-training hours.
4. Always respect scope of practice and the need for referral to qualified professionals.
   ✔ You are not qualified to diagnose injuries or medical conditions. If your client is experiencing musculoskeletal pain, refer him or her for medical evaluation.
5. The time required to successfully establish stability and mobility depends upon individual differences such as current conditioning level, past experiences, body type, abilities, attitudes, adherence, motivational levels, emotional make-up, learning style and maturation level.
6. A deconditioned individual generally lacks the ability to stabilize his or her own body.
   ✔ The initial emphasis in restoring good posture and this relationship of stability and mobility should focus upon muscle isolation in a supported environment (e.g., using the floor, walls, back rests) before introducing integrated (whole-body, unsupported) exercises.
   ✔ The use of supports also offers an additional benefit of kinesthetic and visual feedback critical to helping clients understand alignment of specific joints (e.g., when lying on the floor the individual can feel the contact points with the floor when joints are placed in a good postural position).
7. Restoring good posture essentially involves improving extensibility in the tightened, hypertonic muscles, while improving muscular endurance (targeting type 1 fibers) in the weakened postural (tonic) muscles. However, it is not as simple as just stretching tight muscles and strengthening weak muscles. Physiological and morphological changes will establish kinetic chain stability and mobility. These concepts are discussed in detail in the *ACE Personal Trainer Manual* (4th edition).
   ✔ The tightened muscles need to undergo a morphological change to add sarcomeres back in series within the myofibrils, which re-establishes the muscle's normal length-tension relationship.
   - Following current ACSM guidelines for flexibility is generally insufficient to bring about these changes.
   - Passive elongation for sustained time periods (as long as possible), coupled with conscious awareness of proper joint alignment, are keys to success.
   - This will reduce nerve tonicity (nerve tone) of the muscle and establish normal neural function (neural re-education).

   ✔ Weakened (lengthened muscles) must also undergo a morphological change to reestablish the muscle's normal length-tension relationship and promote a healthy force-coupling relationship at the joint.
   - Traditional strength training involving dynamic movements and full ranges of motion are not optimal for facilitating the initial adaptations needed for good posture.
   - Target type 1 fibers within the postural muscles by implementing sustained-duration isometrics or lower-intensity, higher-volume dynamic contractions.
   - Isometrics are favored as the muscle is strong in the lengthened position, but weak where it needs to maintain good posture. By contrast, dynamic movement may utilize momentum to power muscles through weaker positions (Table 3).

Phase Two: Movement

Engrams are presumed encodings that occur within neural tissue that provide a physical basis for the persistence of memory. Learned movement patterns are essentially

TABLE 3
RESTORATIVE EXERCISE PROGRAMMING GUIDELINES (F.I.R.S.T)

Training Variables	Stretching Tightened Muscles	Strengthening Weakened Muscles
Frequency:	Frequently as possible • Improvements are dose-related	Frequently as possible • Improvements are dose-related
Intensity:	Initially: Static stretching: • To point of tension • Control joint movements in bi-articulate muscles Later: Dynamic patterns: • Controlled tempos • Maintain full neuromuscular control of movement	Provide small overload in controlled positions. • Target type I fibers; only 30–70% of maximal voluntary contraction (MVC) are needed • Higher intensities generally evoke faulty recruitment patterns • Focus on strengthening with joints in good positions • Use body's resistance or fixed surfaces
Repetitions and Sets:	Static stretching: • 2–4 reps x 30–60 sec each Dynamic movements: • 1–2 sets x 5–10 repetitions	Isometric contractions: • 2–4 reps x 5–10 sec each • Emphasize uniplanar action Dynamic contractions: • 1–3 sets x 12–15 repetitions with slow, controlled tempos • Introduce tri-planar action
Timeframe	• Plan sessions between 30–45 minutes. • Plan, on average, 1–3 months of participation pending the degree of imbalance, volume of exercise performed or until noticeable body alignment and movement efficiency is restored.	

stored engrams that we call upon to perform our activities of daily living, yet we possess the capability to fine tune them as needed to meet the demands of the task performed. Consequently, the notion of training and coaching movement patterns rather than teaching exercises appears to provide a solid foundation to training. Human movement can essentially be broken down into five primary movements that encompass all activities of daily living (ADL):

- Single-leg movements (e.g., single-leg stance and lunging)
- Bend-and-lift movements (e.g., squatting)
- Pushing movements (primarily in the vertical/horizontal planes)
- Pulling movements (primarily in the vertical/horizontal planes)
- Rotational (spiral) movements

Movements can be as simple as a single primary movement or as complex as combining several into an integrated movement pattern. Consider, for example, a woman picking up her child and then turning to place the child in a highchair. She performs a bend-and-lift movement; a rotational movement; a single-leg movement to walk; a pushing movement extending her arms to place her child in the highchair; and a pulling movement to resist gravity while lowering her child into the highchair.

As we spend the majority of our day moving our own body, bodyweight training is the most appropriate modality to use during this stage. However, it is appropriate to include some light resistance to increase system overload once the client develops good form in performing the primary movement patterns. Segment learning of each movement pattern utilizing the part-to-whole approach and introduce progressions appropriately:

- While most ADL are performed with the lower extremity operating in a closed-chain environment (e.g., moving against the floor) and the upper-extremity operating in an open-chain environment (e.g., pushing and pulling on doors), the initial use of supports offers greater kinesthetic awareness to movement quality. Coupled with visual feedback, this helps cue the clients to improving their movement efficiency.
- Incorporate extremities and the head/torso as drivers to increase system overload, balance, and additional stability and mobility demands (e.g., driving both arms towards the floor during a bend-and-lift movement).
- Teach movement in all three planes, beginning with the sagittal plane, then the frontal plane and lastly the transverse plane.
- Introduce three-dimensional demands upon the body, both in the stable, closed-chain and freely moving, open-chain segments (e.g., performing a bend-and-lift movement in a staggered-stance position with the lead leg positioned in slight internal rotation while driving the upper extremity in the transverse plane).

During this phase, it is critical to coach movement effectively. We must always understand the objective behind every movement pattern or exercise we program, as well as the role of individual body segments within the kinetic chain required to perform that movement or pattern. The acronym M.O.V.E. can be used to teach movement patterns effectively (Figure 7).

For example, when performing a bird-dog movement, you should first identify what joint movements and planes of movements are desired (e.g., Which joints should remain stable and which are mobile? Is the movement in the sagittal or frontal plane?)

Once you have explained and demonstrated the movement, allow the client to practice and observe his or her performance. You must identify whether the desired movements occurred (e.g., Did the lumbar spine remain stable during hip extension? Was there rotation through the hips?). Next, and most importantly, you must validate why the compensations occurred (e.g., Was the increased lordosis during hip extension due to a lack of core stabilization, or a lack of hip flexibility, or both?). Finally, your ultimate responsibility is to educate the client to correct his or her form by identifying problematic areas and segment learning as needed.

Figure 7: The M.O.V.E Acronym for Coaching Movement

As with Phase 1, the timeframe needed to train these movements successfully depends on individual differences, including current conditioning level, past experiences, body type, abilities, attitudes, motivational levels, emotional make-up, learning style and maturation level.

Once your client demonstrates movement efficiency, he or she is ready to move into Phase 3—the Load Training phase—of the ACE IFT Model. However, many of the three-dimensional movement patterns with various progressions should remain part of the client's maintenance plan to continually reinforce good movement habits. Incorporate these movements into dynamic warm-ups, structure them as complementary drills (exercises) to the client's Phase 3 or 4 workouts or even program them as complete stand-alone sessions.

Phases 3 and 4 of the ACE IFT Model will be discussed in part three of this course.

ACE Integrated Fitness Training™ (ACE IFT™) Model for Functional Movement and Resistance Training: Phases 3 and 4

BY PETE MCCALL, M.S.

THE ACE INTEGRATED FITNESS TRAINING (ACE IFT) MODEL WAS DEVELOPED TO PROVIDE PERSONAL TRAINERS WITH A SYSTEMATIC AND COMPREHENSIVE APPROACH TO EXERCISE PROGRAMMING THAT INTEGRATES ASSESSMENTS AND PROGRAMMING TO FACILITATE RAPPORT, ADHERENCE AND BEHAVIOR CHANGE, WHILE ALSO IMPROVING POSTURE, MOVEMENT, FLEXIBILITY, BALANCE, CORE FUNCTION, CARDIORESPIRATORY FITNESS, MUSCULAR ENDURANCE AND MUSCULAR STRENGTH.

The first two articles in this course provided an overview of the ACE IFT Model and examined the key concepts of Phases 1 and 2: Stability and Mobility, and Movement Training. The second article also introduced a template provided within the ACE IFT Model that progresses individuals in preparation for more traditional load and performance training, which are the focus of Phases 3 and 4. The purpose of this article is to provide an overview of Phases 3 and 4, which address the application of external loads to movements to meet client goals related to muscular strength, endurance and hypertrophy, maximal strength and body-composition changes, and, if appropriate, competitive or performance-oriented goals.

Phase 3: Load Training

Phases 1 and 2 of the ACE IFT Model emphasize functional movement, specifically by addressing joint range-of-motion, muscular endurance, core stability and movement efficiency, and serve as a necessary foundation for more advanced training techniques. The purpose of the exercises in Phase 1 are to improve joint stability and mobility while enhancing the strength and endurance of the type I muscles responsible for core stability and good posture. Phase 2 is designed to teach a client how to move efficiently and effectively through the basic patterns of exercise. Once a client demonstrates that he or she can perform the basic movements of exercise while controlling his or her center of gravity over his or her base of support, it is time to progress the intensity of the training program by adding an external resistance, or load.

Clients seek the services of a personal trainer for a variety of reasons, including improved health and well-being, and it is not uncommon for new clients to cite "toning," "sculpting" or "improving muscle definition" as primary reasons for beginning a fitness program. While the exercises in the first two phases are important for restoring movement efficiency, which is critical for improving overall health and wellness, they do not produce enough overload to help clients achieve goals that focus on fitness-based objectives such as aesthetic appearance.

Certainly, the most effective way to achieve a sculpted or toned look is through resistance training using external loads to enhance muscular strength. In addition, resistance training is effective for helping with weight loss and enhancing overall quality of life. However, progressing to resistance training before addressing muscular imbalances may actually worsen any existing dysfunctions and could lead to long-term injuries for the client. Taking a client through the first two phases of the ACE IFT Model should restore muscle-activation patterns and address any length-tension relationships or muscle imbalances, as well as enhance technical skills related to coordination and movement (Figure 8). When a client demonstrates improved posture and movement efficiency, it is time to increase the intensity of the training program by adding resistance, or an external load to the exercises. This is the focus of Phase 3: Load Training.

Assessments for Phase 3 Load Training

There are two ways to assess a client's existing levels of muscular fitness. The first option is to test muscular endurance, which requires seeing how many repetitions a client can perform of a particular exercise before fatiguing. A second option is to test the client's strength in a specific lift to determine his or her one repetition maximum (1RM). This assessment information can then be used to determine the loads for the exercise program, as well as measure the progress of the client's program during the next testing session. Regular assessments are important in that they enable a client to see the results of their exercise efforts, which may also help facilitate long-term adherence. The *ACE Personal Trainer Manual,* 4th Edition, describes a variety of assessments that can be used to determine a client's existing level of muscular fitness.

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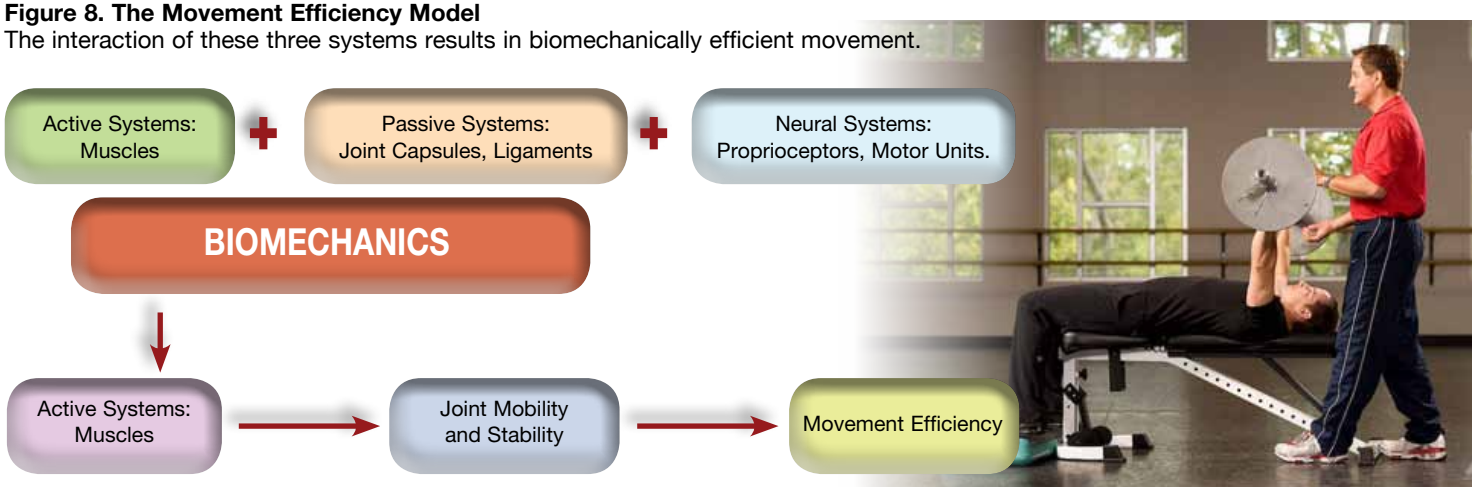
Figure 8. The Movement Efficiency Model
The interaction of these three systems results in biomechanically efficient movement.



Programming Guidelines for Phase 3 Load Training

Exercise program design in the Load phase of the ACE IFT Model adheres to the principles of resistance training: Specificity, Overload, Progression and Reversibility (Table 4), as well as the American College of Sports Medicine (ACSM) Guidelines for Resistance Training (Table 5).

Phase 3 of the ACE IFT Model is intended to achieve the standard outcomes of resistance training: muscular endurance, hypertrophy (strength-endurance), strength and maximum strength. If the client's goal is to develop lean muscle mass, for example, then the exercise program should be designed to progressively increase the training overload to stimulate growth. A well-designed Phase 3 resistance-training program applies the variables of exercise selection, intensity, tempo, repetitions, sets, rest interval and frequency to achieve a specific strength-based goal. Once a client reaches Phase 3, the bodyweight exercises used to promote core stability and movement efficiency in Phases 1 and 2 of the ACE IFT Model can now be used as a dynamic warm-up to prepare for the additional stresses of using an external load. The guidelines and principles establish the basic structure for developing an exercise program, but it is the application of the variables of program design that are responsible for the client's results.

Following is a brief review of the variables of exercise-program design that can be applied to create a progressive training overload:

- **exercise selection**—the actual movements and exercises performed
- **intensity**—the amount of resistance or load used in an exercise expressed as a percentage of one-repetition maximum (1RM)
- **repetitions**—the complete range of motion (ROM) of the lengthening and shortening phase of the muscle action, expressed as the number of times the complete cycle is performed
- **sets**—the total amount of repetitions completed at one time
- **tempo**—the velocity at which the weight is moved
- **rest interval**—the time period between exercises that allows the muscles to recover and refuel to be able to perform more work. The actual length of the rest interval is determined by the load and the training outcome. The greater the load, the longer the rest period needed to restore the muscle's energy pathways.

The combined total of the intensity (weight used), number of repetitions and sets completed is known as the **volume** of the workout. The number of workouts per training period can be classified by days, weeks, months or even years and is defined as the **frequency** of the exercise program.

Clients new to resistance training should aim for the low end of the ACSM guidelines and strive to complete two resistance-training

Table 4. The Principles for Resistance-training Exercise Program Design

Principle	Description
Specificity	The type of physiological demand placed on the body will dictate the specific adaptation that will occur.
Overload	An above-normal stress or load applied to a muscle or muscle group to elicit an enhanced training response.
Progression	To continue seeing gains and improvements from an exercise program, the intensity of the exercises must gradually become increasingly more challenging.
Reversibility	Once initial neuromuscular adaptations have occurred, without regular strength training muscles may atrophy and become weaker.

Table 5. The ACSM Guidelines for Resistance Training (2010)

Frequency	Intensity	Repetitions	Sets	Type
2–3 days/week with at least 48 hours rest for the same muscle groups	Moderate to hard; the last repetition should be difficult	8–12 (healthy adults) 10–15 (older adults)	2–4, with a rest interval of 2–3 minutes between sets	Multi-joint exercises using more than one muscle group. (May also include single-joint exercises.)

sessions per week. As a client progresses and become stronger, frequency can be adjusted (Table 6), but should still allow appropriate rest time between workouts. It is your responsibility to closely monitor your client's progress during Phase 3 and identify when it is time to adjust the intensity and volume of the program.

Phase 3 exercise selection can incorporate any type of resistance-training equipment including traditional strength-training equipment such as selectorized machines, medicine balls, cable machines, plate-loaded machines, barbells and dumbbells, as well as nontraditional equipment such as kettlebells, sandbags, stones or water-filled implements. Because of the sheer volume of possible resistance-training exercises, it is necessary to have a system for organizing the exercises in a logical sequence to provide the greatest results. Methods of organizing and sequencing exercises include grouping exercises based on body part (e.g., chest, arms or back), movements (e.g., push, pull or rotation), or by the relevance to an activity or sport. Regardless of which implements or method of organizing the exercises you use, it is important to pay attention to the client during every single lift and apply the M.O.V.E. acronym (see sidebar) to ensure that the client is using good form and muscular force to move the load (as opposed

M.O.V.E.

The M.O.V.E. acronym is recommended to provide specific feedback to clients about their form and movement when performing an exercise.

MOVEMENT
Identify the desired movements at the specific joint(s).
Example: sagittal plane extension of the hips.

OBSERVE
Ask your client to perform the movement.

VALIDATE
Analyze their ability to maintain proper alignment between segments within the kinetic chain.
Example: Mobility and stability at specific joints, without compromise.

EDUCATE
Provide various forms of feedback to correct, reinforce, and help self-correct.
Example: kinesthetic, visual and verbal cues, and feedback.

Table 6. General Training Frequency Guidelines

Training Status	Frequency
Beginner—not currently exercising or just beginning an exercise program, possesses only minimal exercise skill.	2–3 training sessions per week
Intermediate—possesses basic exercise skill	3–4 training sessions per week
Advanced—possesses advanced exercise skill	4–5 training sessions per week

Phase 4: Performance Training

Many clients with the aforementioned fitness goals of improving lean body mass, muscular definition or muscular strength will never need to progress past Phase 3. With the ACE IFT Model, it is possible to design programs that cycle between the different phases of strength training—endurance, hypertrophy and strength—to help clients avoid plateaus and efficiently achieve results (Table 4). However, for clients who are interested in training for athletic events—whether they are competing at the elite professional level or just want to be an injury-free weekend warrior—it will be necessary to progress to Phase 4 in the ACE IFT Model: Performance.

Table 7. Recommended Phase 3 Training Variables Based on Training Goals

Training Goal	Sets	Repetitions	Rest Interval
General muscular strength	1–2	8–15	30–90 seconds
Muscular endurance	2–3	>12	<30 seconds
Muscular hypertrophy	3–6	6–12	30–90 seconds
Muscular strength	2–6	<6	2–5 minutes

Performance training is also appropriate for clients who enjoy non-competitive recreational activities such as playing tennis, golf or pickup basketball with friends, or who are preparing for an adventure-style vacation like a ski trip, cycling across Europe or hiking Machu Picchu in Peru. For clients who have progressed through the three previous stages, have no movement restrictions or muscle imbalances, and who are interested in pursuing dynamic, challenging workouts, progressing to the Performance phase may be appropriate. Additionally, the safe application of power training in Phase 4 is an important component for older adults who seek to maintain their functional independence as they age.

While the purpose of the Load phase is to help a client increase his or her muscle force production, the intent of the Performance phase is to improve the velocity of muscle-force production by increasing the velocity of the stretch-shorten cycle (SSC—see box below) and minimizing the time it takes to convert from muscle lengthening to muscle shortening. This is called the amortization phase. Reducing the time of the amortization phase of the SSC greatly enhances a muscle's ability to generate power. It is helpful to think of the SSC of a muscle as the spring in a pinball machine—if the spring is pulled back and held in a shortened position, it won't produce the same amount of explosive force as when the spring is rapidly pulled and immediately released.

Stretch-Shorten Cycle Explained

A standard or traditional tempo of exercise is a steady cadence, usually one to three seconds on each of the eccentric muscle–lengthening and concentric muscle–shortening phases of muscle action. The muscle action continuum of transitioning from lengthening to shortening is known as the stretch-shorten cycle (SSC). The eccentric phase of the SSC stores mechanical energy as the muscle is lengthened while the concentric phase releases the energy as the muscle returns to resting length. While a steady tempo of one to three seconds in each phase is an effective overload for increasing muscular strength, muscular power is generated by rapid, explosive action of the SSC.

Many common machine-based exercises place the emphasis of the muscle action on the concentric phase, which is when the muscle has to generate the force to overcome external resistance. However, the greatest strength and performance increases come from minimizing the amortization phase of the SSC. Exercise selection in Phase 4 focuses on explosive exercises such as plyometric jumps to develop lower-body power, medicine-ball throws to improve upper-body power, or Olympic-style lifts to enhance total-body power output. The purpose of using plyometric or explosive exercises is to train the muscle to rapidly lengthen under a load so it can rapidly shorten to produce a high-resultant force.

Assessments for Phase 4 Performance Training

If a client meets all of the prerequisites for performance training and expresses an interest in increasing the intensity of his or her training program with power-based exercises, the next step is to assess the client's current level of muscular power to determine the purpose and goals of the exercise program. It is essential to assess the client's current level of power using tests like the vertical jump, horizontal jump or seated medicine ball chest-pass because the outcome will determine the client's current muscular power output. This information can then be used to demonstrate progress as the client follows the Phase 4 program. Specific assessments and tests are described in Chapter 8 of the *ACE Personal Trainer Manual,* 4th Edition.

Programming Guidelines for Phase 4 Performance Training

For healthy adults with no muscle imbalances and good movement efficiency, the first three phases of the ACE IFT Model can be used to prepare a client for the high-stress, high calorie–expending exercises required to enhance muscle-power output. Training clients to increase their net power output will condition them to be able to do more work in less time, which can make their workouts more effective and efficient.

The same variables of program design that are applied to develop more strength in Phase 3 are used in Phase 4 programming; the major differences are in the intensity of the exercises and the total volume of work performed. Because Phase 4 exercises involve very high-intensity efforts, the number of repetitions is reduced and the rest intervals are increased to allow for appropriate rest and replenishment of energy stores between sets (Table 8).

When programming plyometric exercises in Phase 4, it is extremely important to start the client with low-intensity plyometric exercises to allow the musculoskeletal system to adapt to the faster SSC velocities before progressing to the higher-intensity exercises with more dynamic jumps or heavier loads (Table 9).

Table 8. Recommended Phase 4 Training Variables for Explosive Lifts

Power Exercise	Sets	Repetitions	Rest Interval
Single-effort lifts	3–5	1–2	2–5 minutes
Multiple-effort lifts	3–5	3–5	2–5 minutes

Table 9. Lower-body Plyometric Exercises

Type of Jump	Description	Intensity
Jumps in place	Jumps require taking off and landing with both feet simultaneously.	Low
Single linear jumps or hops	These exercises emphasize the vertical and horizontal components of jumping and are performed at maximal effort with no rest between actions.	Low-to-moderate
Multiple linear jumps or hops	These exercises move the client in a single linear direction, emphasize the vertical and horizontal components of jumping or hopping, and are performed repeatedly with no rest between actions.	Moderate
Multidirectional jumps or hops	These exercises move the client in a variety of directions, emphasize the vertical and horizontal components of jumping, and are performed repeatedly with no rest between actions.	Moderate-to-high
Hops and bounds	Hops involve taking off and landing with the same foot, while bounds involve the process of alternating feet during the take-off and landing (e.g., taking off with the right foot and landing with the left foot). Hops and bounds emphasize horizontal speed and are performed repeatedly with no rest between actions.	High
Depth jumps or hops	These exercises involve jumping or hopping off of a box, landing on the floor and immediately jumping, or hopping vertically, horizontally or onto another box.	Very high

Precautionary Guidelines for Plyometric Exercises

Given the ballistic and high-impact nature of plyometric exercises, appropriate strength, flexibility and postural mechanics are necessary to avoid injury. The following recommendations are provided to reduce the potential for injury and increase the likelihood of client's achieving their desired performance-based goals:

- Introduce clients to high-intensity, lower-body plyometric drills only after they have demonstrated the ability to successfully squat 1.5 times their body weight or complete five squat repetitions with 60 percent of their bodyweight in five seconds.
- Plyometric drills should be performed at the beginning of a training session after the completion of a dynamic warm-up (while clients are not fatigued) to reduce the risk of injury.
- Clients should not jump until they first learn how to land safely. Ensure that clients are capable of landing correctly by initially teaching small, low-intensity jumps and using appropriate landing techniques. (Refer to Chapter 10 of the *ACE Personal Trainer Manual,* 4th Edition.)
- Start with a low volume of low-intensity jumps and increase the volume of the plyometric exercises before increasing intensity (Table 10).

Table 10. Plyometric Volume Guidelines (given in number of foot contacts per training session)

Skill Level	Low-intensity Drills	Moderate-intensity Drills	High-intensity Drills
Beginner (no training experience)	80–100	60 (100–120 total*)	40 (100–120 total*)
Intermediate (some training experience)	100–150	80–100 (150–200*)	60–80 (150–200 total*)
Advanced (vast training experience)	140–200	100–120 (180–220 total*)	80–100 (180–220 total*)

*Includes some low-intensity drills as movement preparation for the more advanced drills.

Summary

The purpose of the Functional Movement and Resistance Training (FMRT) component of the ACE IFT Model is to develop a systematic approach for designing an exercise program that can progress clients from the initial phases of stability and mobility training to the high-intensity exercises required to enhance muscle force production and power output. The first two phases of the FMRT focus on addressing postural imbalances and muscle motor control to help clients develop the necessary postural stability and proper movement sequences to allow for safe external loading for full-body movements. Clients with specific training goals, such as changes in body composition to increase lean muscle; improved muscular strength, or muscular endurance; or a desire to develop a more "toned" look, will want to progress to Phase 3 once they have adapted to the lower-intensity exercises and demonstrated success at adhering to a program. It is during the Load training phase that you will apply the current understanding of strength training to create and progress exercise programs to meet the many different needs of your clients. Phase 4 training is for clients with specific performance goals or who just want to challenge themselves with high-intensity power-based workouts. The client's progress will dictate the exact application of the program-design variables and the length of time in each training phase.

To help facilitate client progress during all phases, reassess your clients' fitness levels, goals and exercise programs on a regular basis and make appropriate adjustments as needed. This is important to facilitate continued goal achievement and new goal setting, which can help your clients avoid burnout or injury. It also provides a good mix of challenge and fun to keep motivation high. Finally, as clients improve their movement skill, strength and power output, they could incorporate group exercise and be encouraged to try strength training, boot camp or sports-conditioning classes to add variety to their routines.

ACE IFT Model for Cardiorespiratory Training: Phases 1–4

BY TODD GALATI, M.A.

THE PREVIOUS THREE ARTICLES IN THIS FOUR-PART COURSE PROVIDED AN OVERVIEW OF THE ACE INTEGRATED FITNESS TRAINING™ (ACE IFT™) MODEL. THESE ARTICLES DESCRIBED HOW RAPPORT IS THE FOUNDATION OF THE MODEL, AND INTRODUCED THE FUNCTIONAL MOVEMENT AND RESISTANCE-TRAINING PHASES OF THE ACE IFT MODEL AS A LOGICAL SYSTEM OF MOVEMENT-BASED EXERCISE PROGRAMS AND MODIFICATIONS THAT CAN BE USED WITH ANY CLIENT TO TRAIN FOR STABILITY AND MOBILITY TO IMPROVE POSTURAL IMBALANCES ALL THE WAY THROUGH TO TRAINING FOR SPEED-AGILITY-QUICKNESS AND POWER FOR IMPROVED ATHLETIC PERFORMANCE. THE FOLLOWING ARTICLE INTRODUCES A NEW SYSTEMATIC APPROACH TO CARDIORESPIRATORY TRAINING THAT CAN BE USED TO HELP ANY CLIENT REACH HIS OR HER UNIQUE GOALS FOR HEALTH, FITNESS OR PERFORMANCE IN ENDURANCE COMPETITIONS.

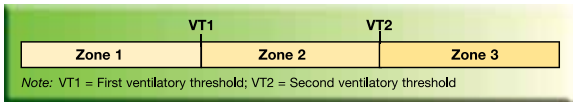
The ACE IFT Model has four cardiorespiratory training phases:

- Phase 1: Aerobic-base training
- Phase 2: Aerobic-efficiency training
- Phase 3: Anaerobic-endurance training
- Phase 4: Anaerobic-power training

Each phase has a primary training focus designed to facilitate specific physiological adaptations to exercise. Not every client starts in phase 1, as each client has a unique entry point into the cardiorespiratory training phases based upon his or her current health, fitness and goals. By utilizing the assessment and programming tools in each phase, you can develop individualized cardiorespiratory programs that can progress clients from being sedentary to training for performance in endurance events. While most clients will not go through this full progression, it is empowering to have the tools to provide these long-term training solutions.

Programming in each phase is based on a three-zone training model (Figure 9). The exercise intensities in each zone are based on client-specific intensity markers that include heart rate (HR) at the first and second ventilatory thresholds (VT1 and VT2), the talk test, and ratings of perceived exertion (RPE). Traditional intensity markers such as percentages of maximal HR (%MHR), HR reserve (%HRR), or $\dot{V}O_2$ reserve (%$\dot{V}O_2$R) are not the recommended methods for monitoring cardiorespiratory exercise intensity in the ACE IFT Model, because they require actual measurement of MHR or $\dot{V}O_2$max to provide accurate individualized data for programming. Most personal trainers do not have the equipment to assess $\dot{V}O_2$max, and there is little or no reason to find a client's actual MHR unless $\dot{V}O_2$max is also being assessed. As such, personal trainers using these traditional intensity markers must estimate MHR and $\dot{V}O_2$max using equations with large standard deviations. Exercise guidelines based upon predicted MHR or $\dot{V}O_2$max can help clients reach their goals, but they have a lot of room for error and do not account for each client's unique metabolic response to exercise.

Figure 9
Three-zone Training Model



To use the three-zone training model in the four cardiorespiratory training phases of the ACE IFT Model, you must first have working knowledge of the ventilatory response to exercise. During exercise, higher levels of intensity cause an increase in respiration to allow larger volumes of air to move into and out of the lungs to facilitate increased delivery of O_2 and removal of CO_2. The volume of air moving into and out of the lungs in one minute is called minute ventilation VE, which increases linearly with the exception of two distinct deflection points at VT1 and VT2 (Figure 10).

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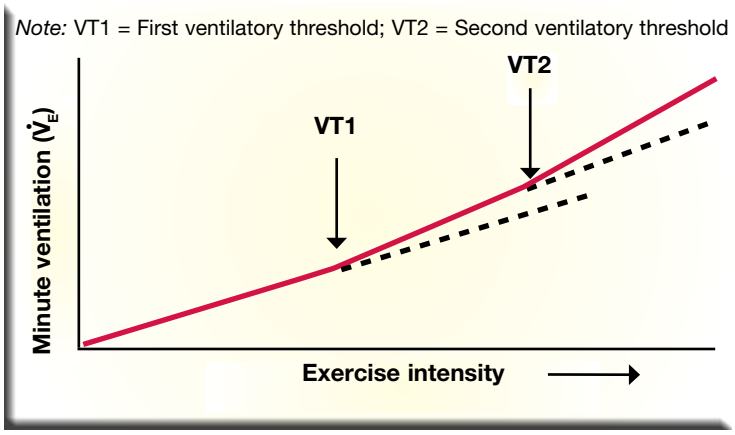

Figure 10
Ventilatory response to increasing exercise intensity

Below VT1, fats are the primary fuel source, only small amounts of lactic acid are being produced, and the increasing cardiorespiratory challenge comes from a need to increase inspiration, not expiration. The body responds by increasing the amount of air inspired with each breath (tidal volume). When exercising below VT1, talking should not be challenging or uncomfortable.

At the point of VT1, the major fuel source switches from fats to carbohydrates and lactic acid begins to accumulate in the blood. The bicarbonate buffering system works to neutralize the increased lactate. This leads to increased cellular production of CO2, resulting in increased ventilation accomplished by an increase in breathing frequency. This creates the first deflection point in VE at VT1 (Figure 10). Once a client reaches VT1, he or she can still speak, but it will become somewhat uncomfortable. As exercise intensity increases above VT1, clients will still be able to speak, but it will become more uncomfortable as intensity approaches VT2.

When the buffering mechanism can no longer keep up with the extra lactate production, the pH of the blood begins to drop. This results in another increase in respiratory rate, causing the second non-linear increase in VE known as VT2. This point is generally associated with the onset of blood lactate accumulation (OBLA), designated by a blood lactate concentration of approximately 4.0 mmol/L. If exercise continues at or above VT2, blood lactate levels will rise quickly. When exercising at or above VT2, speech is not possible other than single words. This intensity at VT2 is what most fitness professionals and athletes refer to as the anaerobic or lactate threshold. Exercise intensities just below VT2 represent the highest intensity an individual can sustain for approximately 20 to 30 minutes. When an individual increases the workload performed at VT2, he or she will have improved performance.

The three-zone training model is built around these two key metabolic markers as follows:

- Zone 1: HR < VT1
- Zone 2: HR = VT1 to < VT2
- Zone 3: HR > VT2

During exercise in zone 1, talking is relatively easy and exercise can be sustained for long durations. In zone 2, clients will not be sure if they can talk comfortably and exercise can be sustained for moderate durations, depending on a client's current fitness and level of fatigue at the start of exercise. In zone 3, speech is limited to single words and exercise can only be sustained for short intervals.

www.youtube.com/v/e8vRWNb0suE
For more information about VT1, VT2 and the ability to talk in each of these three training zones, click the link above to view a video demonstration.

Assessments for VT1 and VT2

The first and second ventilatory thresholds can be accurately assessed using metabolic analyzers; however, these systems are not readily available to most personal trainers. Fortunately, field tests can be used to determine reliable heart rate values at VT1 and VT2.

The field test for VT1 is based on research that has found the talk test to be a very good marker of VT1. Below VT1, clients can speak comfortably. Once they reach VT1, they will still be able to speak, but it will no longer be comfortable. The submaximal talk test for VT1 can be conducted with clients to determine their HR at VT1 (Table 10). This value is important for programming in cardiorespiratory phases 2–4.

Table 10: Submaximal Talk Test for VT1 (general protocol *)	
Objective	To measure HR response at VT1 by incrementally increasing workload in small increments to identify the HR where the ability to talk continuously becomes compromised
Equipment	• Treadmill, cycle ergometer, elliptical trainer, or arm ergometer • Stopwatch/watch • HR monitor with chest strap (preferred) • Phrase or paragraph to be read by client, something familiar such as the pledge of allegiance, alphabet, etc. (have printed copy if needed for reading)
Pre-assessment	• This assessment is recommended in ACE IFT™ cardiorespiratory training phases 2 through 4 • Explain protocol and obtain consent to perform assessment • Should have pre-determined intensity jumps that will elicit a 5 bpm increase in HR • Recital of phrase will be easy below VT1, but will become more difficult at VT1 as the ability to string 5 to 10 words together becomes challenging. • Use caution with reading on a treadmill given the potential risk of falling • VT1 should be reached in 8 to 16 minutes • Goal is to record HR at VT1 • HR varies between treadmills, bikes, etc., so utilize your client's preferred mode of exercise • This assessment should be performed prior to any other fatiguing exercise on the test day
Step 1	3–5 minute warm-up with HR<120 bpm (RPE of 2 to 3)
Step 2	Begin first stage of test measuring steady-state HR (aim for HR of approximately 120 bpm, or RPE = 3 to 4 on 0–10 scale). Stages should be 60 to 120 seconds long.
Step 3	Recite/read text out loud continually during last 20 to 30 seconds of each stage
Step 4	Upon recital completion, ask if this task felt "easy," "uncomfortable-to-challenging" or "difficult" ("uncomfortable-to-challenging" = VT1)
Step 5	If talk-threshold has not been reached, progress to the next stage by increasing intensity by a work rate that elicits a HR increase of 5 bpm and repeat stage length and phrase recital
Step 6	Continue until "talk threshold" is reached (HR at VT1). Use a HR monitor for easier measurement. (Ideally, average HR at VT1 from 2 separate tests should be assessed.)
Step 7	3–5 minute cool-down at same intensity as warm-up once VT1 is reached and HR is recorded

* For a detailed explanation of this protocol, refer to the *ACE Personal Trainer Manual* (4th ed.), pg. 202–204.

The talk test can also be used as a fairly accurate marker of VT1 in clients who have not yet performed the submaximal talk test for VT1. This is especially important for clients in phase 1, where exercise should be kept below the talk-test threshold.

The field test for VT2 is based on the premise that exercise intensities just below VT2 are the highest sustainable intensities and are excellent markers of performance. Clients can sustain exercise at or just below VT2 long enough to collect repeated heart rates to get an average HR calculation at VT2. The VT2 threshold test can be conducted with clients to determine exercise HR at VT2 (Table 11). This value is important only for clients training in phases 3 and 4.

Table 11: VT Threshold Test (general protocol *)	
Objective	To measure HR response at VT2 using a single-stage, sustainable, high-intensity 15- to 20-minute bout of exercise
Equipment	• Treadmill, cycle ergometer or arm ergometer • Stopwatch/watch • HR monitor with chest strap (preferred)
Pre-assessment	• This assessment is recommended only for clients who are deemed low-to-moderate risk and are successfully training in ACE IFT™ cardiorespiratory training phase 3 or phase 4 • Explain protocol and obtain consent to perform assessment • Clients should be experienced with selected modality to effectively pace themselves at their maximal sustainable intensity for the duration of the assessment • Should have pre-determined intensity that is the highest level that the client can maintain for 15 to 20 continuous minutes, as the highest sustainable intensity an individual can perform will be at or close to VT2 • Goal is to record HR at the end of each of the last 5 minutes of the assessment • This assessment should be performed prior to any other fatiguing exercise on the test day
Step 1	3–5 minute warm-up with HR<120 bpm (RPE of 2 to 3)
Step 2	Begin the test by increasing intensity to the pre-determined level that is the highest level that the individual can maintain for 15 to 20 continuous minutes
Step 3	Allow the individual to make changes to the exercise intensity as needed during the first few minutes of the exercise bout
Step 4	Record the HR response at the end of each minute during the final 5 minutes of the exercise bout (at the end of minutes 11 through 15)
Step 5	Once HR responses for each of the final 5 minutes have been recorded, have client cool down for 3–5 minutes at same intensity as warm-up
Step 6	Calculate the average HR collected over the last 5 minutes of the bout to accommodate for any cardiovascular drift associated with fatigue, thermoregulation and changing blood volume
Step 7	Multiply the average HR during the last 5 minutes by 0.95 to correct for increased intensity during a 15-minute test vs. 30-minute test—this is the HR at VT2 estimate *Example:* Avg. HR (final 5 min) = 168bpm HR at VT2 estimate = 168 x 0.95 = 160 bpm

* For a detailed explanation of this protocol, refer to the *ACE Personal Trainer Manual* (4th ed.), pg. 202–204.

Ratings of perceived exertion (RPE) correlate fairly well with this three-zone model:

- "moderate" to "somewhat hard" (RPE = 3–4, 0-to-10 scale) below VT1
- "hard" (RPE = 5–6, 0-to-10 scale) between VT1 and VT2
- "very hard" to "extremely hard" (RPE = 7–10, 0-to-10 scale) above VT2.

As such, RPE can be used by clients to track training intensities.

ACE IFT Model Cardiorespiratory Training Phases

Phase 1: Aerobic-base Training

Clients that cannot perform 30 minutes of continuous moderate-intensity exercise should begin cardiorespiratory training in this phase. This is a common starting point for many clients, especially those that are sedentary or have special needs. The most important goal in this phase is to help clients to have early positive exercise experiences that drive program adherence. Regular exercise participation will help clients see initial physiological adaptations to exercise, achieve early goals, enhance self-efficacy, and see improvements in mood, energy and stress. Many clients will progress to phase 2, while clients with limited functional capacities may continue to train in phase 1 for years.

The principal training focus in phase 1 is on helping clients that are sedentary or have little cardiorespiratory fitness to engage in regular exercise, initially to improve health and then to build fitness. Exercise in this phase should be performed in zone 1 (RPE = 3–4, 0-to-10 scale). If a client is not able to speak comfortably during exercise, he or she has gone over the talk-test threshold and exercise intensity should be decreased. Exercising in zone 1 has a high benefit-to-risk ratio for beginning exercisers. To help enhance exercise enjoyment, use different exercise modes and vary exercise intensities between RPE of 3 and 4.

Cardiorespiratory fitness assessments are not necessary in phase 1, as all exercise is performed below the talk-test threshold. In addition, poor performance on fitness tests can deflate the enthusiasm that a sedentary client has for starting an exercise program.

Progressions in phase 1 should focus on increasing exercise duration and frequency to facilitate health improvements and caloric expenditure, and should not exceed a 10 percent increase from one week to the next. Once clients are performing 30 minutes of continuous exercise just below the talk-test threshold, they are ready to move on to phase 2.

Phase 2: Aerobic-efficiency Training

Clients that can perform 30 minutes or more of continuous moderate-intensity exercise and are not currently training for performance in

endurance events should train in phase 2. This is the phase where most fitness enthusiasts will train for extended periods, as many fitness and weight-loss goals can be achieved in this phase, including completing a one-time event such as a half marathon.

A submaximal talk test should be conducted at the beginning of phase 2 to determine the client's HR at VT1. This HR will be used as the marker to differentiate between exercise in zones 1 and 2. This assessment should be performed periodically to determine if HR at VT1 increases with fitness improvements. The VT2 threshold test is not necessary in this phase.

The principal training focus in this phase is on improving aerobic efficiency. This is first accomplished through increasing exercise session time and frequency. The main limitation will be the client's available time to exercise. Training should then progress with the introduction and progression of zone 2 intervals.

In phase 2, the warm-up, cool-down, recovery intervals and steady-state exercise should be performed in zone 1 to continue building the client's aerobic base and to allow for adequate recovery following zone 2 intervals. Low zone 2 (RPE of 5) intervals should be introduced at a HR that is just above VT1 (approximately 1 to 10 bpm). These intervals will help increase the workload performed at VT1, resulting in greater caloric expenditure and fat utilization just below VT1. Begin with relatively brief (up to 60 seconds) work intervals with a work-to-recovery ratio of 1:3 (e.g., 60-second work interval with a 180-second recovery interval). Progress these intervals to a ratio of 1:2 and then 1:1. Interval duration can also be increased, with slow progression of interval length, frequency and recovery that is no more than 10 percent per week.

As the client's fitness increases, steady-state exercise bouts with efforts just above VT1 can be introduced. Intervals can be progressed to the upper end of zone 2 (RPE of 6), starting with a work-to-recovery ratio of 1:3, progressing to longer intervals and then moving toward a 1:1 ratio. A sample phase 2 cardiorespiratory-training program is shown in Table 12.

Table 12: Sample Phase 2 Cardiorespiratory-training Progression

Training Parameter	Week 1	Week 2	Week 3	Week 4	Week 5
Frequency	3 times/ week	3–4 times/ week	3–4 times/ week	4 times/ week	4–5 times/ week
Duration (10% weekly increase)	"X" minutes	10% increase	10% increase	10% increase	10% increase
Intensity	Below VT1 HR	Below and above VT1 HR	Below and above VT1 HR	Below and above VT1 HR	Above VT1 HR
Zone	1	1 and 2	1 and 2	1 and 2	1 and 2
Training Format	Steady state	Aerobic intervals	Aerobic intervals	Aerobic intervals	Aerobic intervals
Work-to-Recovery Intervals (active recovery)	None	1:2 2–3 minute intervals	1:2 3–4 minute intervals	1:1½ 3–4 minute intervals	1:1 4–5 minute intervals

Well-trained fitness enthusiasts can progress to where they are performing as much as 50 percent of their cardiorespiratory training time in zone 2. Once a client reaches seven or more hours of cardiorespiratory training per week or develops endurance-performance goals, he or she should progress to phase 3.

Phase 3: Anaerobic-endurance Training

Clients that are highly trained fitness enthusiasts performing seven hours or more of cardiorespiratory exercise per week should progress to phase 3. This phase is appropriate for clients that have endurance-performance goals requiring adequate training volume, intensity and recovery to peak for performance. Clients do not need to be elite athletes to train in zone 3, but they do need to be motivated by goals that go beyond just finishing an event.

At the beginning of phase 3, the submaximal talk test and the VT2 threshold test should be given to determine the client's HR at VT1 and VT2. These heart rates will be used as markers to differentiate between training zones 1, 2 and 3. For example, a client with HR at VT1 = 150 bpm and HR at VT2 = 172 bpm would have the following HR training zones:

- Zone 1: HR < 150 bpm
- Zone 2: HR = 150 to 171 bpm
- Zone 3: HR > 172 bpm

These assessments should be performed periodically, to determine if HR at VT1 or VT2 change with improved fitness. For multi-sport athletes, conduct these assessments for all primary exercise modalities where the assessment can be performed (excluding the pool) as HR at VT1 and VT2 can vary among training modes.

Exercise programming in phase 3 is focused on helping clients improve anaerobic endurance so they can perform more physical work at or near VT2 for an extended period, which will result in improved speed, power and performance. Training time should be distributed as follows:

- Zone 1 = 70–80% of training time
- Zone 2 < 10% of training time
- Zone 3 = 10–20% of training time

This is the training distribution used by elite athletes in a variety of endurance sports including Nordic skiers, cyclists and runners. The large percentage of training time in zone 1 allows endurance athletes to perform large training volumes without overtraining. Training in zone 1 includes warm-ups, cool-downs, long-distance workouts, recovery workouts, and recovery intervals following zone 2 and zone 3 intervals.

The volume of training time is higher in zone 3 than zone 2 because work in zone 3 has been found to result in the greatest improvements in aerobic capacity. The least amount of work is performed in zone 2 as this intensity has been found to be hard enough to make a person fatigued, but not hard enough to really provoke the optimal adaptations seen with zone 3 training.

The frequency and focus of zones 2 and 3 are based on the client's event goals, strengths and weaknesses, and capacity for recovery. Highly fit clients may perform two to four interval workouts per week, while clients new to this type of training may perform only one zone 3 interval workout per week. Zone 2 intervals will generally be of longer duration, but lower intensity than zone 3 intervals, while zone 3 intervals will have longer recovery intervals following work intervals to allow for recovery from these high-intensity intervals. The total volume of training (duration, intervals, etc.) should be progressed no more than 10 percent per week. Table 13 illustrates a phase 3 mesocycle for marathon training. Only clients with endurance-performance goals that involve repeated sprinting or near-sprinting efforts during endurance events should progress to phase 4 training.

Table 13: Sample Phase 3 Cardiorespiratory-training Program: Four-week Mesocycle for Marathon Training				
Training Parameter	**Week 1— Increase Intensity**	**Week 2— Increase Intensity**	**Week 3— Increase Intensity**	**Week 4— Recovery Week**
Training Volume	Total training time = 9 hours	Total training time = 9.5 hours	Total training time = 10 hours	Total training time = 6.5 to 7.5 hours
Zone 1 (~80% of volume) 3 workouts per week plus warm-up, cool-down, and rest intervals during zone 2 and 3 workouts	1 time/week Long run = 2 hours 30 min 1 time/week 90-min run (RPE = 4) 1 time/week 60-min run (RPE = 3–4)	1 time/week Long run = 2 hours 45 min 1 time/week 90-min run (RPE = 4) 1 time/week 60-min run (RPE = 3–4)	1 time/week Long run = 3 hours 1 time/week 90-min run (RPE = 4) 1 time/week 60-min run (RPE = 3–4)	1 time/week Long run = 2 hours 1 time/week 60-min run (RPE = 4) 1 time/week 45-min run (RPE = 3)
Zone 2 (~10% of volume) 1 workout per week	3 x 5-min intervals 1:1½ work:rest ratio 60-min workout with long warm-up and cool-down	4 x 5-min intervals 1:1½ work:rest ratio 70-min workout with long warm-up and cool-down	5 x 5-min intervals 1:1½ work:rest ratio 75-min workout with long warm-up and cool-down	2 x 8-min intervals 1:2 work:rest ratio 60-min workout with long warm-up and cool-down
Zone 3 (~10% of volume) 1 workout per week	2 sets: 3 x 60-second intervals 1:3 work:rest ratio 10 min between sets 60-min workout with long warm-up and cool-down	3 sets: 3 x 45-second intervals 1:3 work:rest ratio 10 min between sets 70-min workout with long warm-up and cool-down	3 sets: 3 x 60-second intervals 1:3 work:rest ratio 10 min between sets 75-min workout with long warm-up and cool-down	2 sets: 3 x 30-second intervals 1:3 work:rest ratio 10 min between sets 45-min workout with long warm-up and cool-down
Strength Training	Circuit training 2 days/week 1 hour/session	Circuit training 2 days/week 1 hour/session	Circuit training 2 days/week 1 hour/session	Circuit training 1–2 days/week 1 hour/session

Phase 4: Anaerobic-power Training

The principal focus of phase 4 training is on helping clients with very specific goals related to high-speed performance during endurance events to develop anaerobic-power. Athletes that might perform phase 4 training include soccer athletes, cross-country runners and cross-country skiers. The underlying physiologic principle of this type of training is that if there is substantial and sustained depletion of the phosphagen stores and accumulation of lactate, the body will adapt with a larger phosphagen pool and potentially larger buffer reserves to increase the workload performed at VT2.

As in phase 3, assessments for phase 4 include the submaximal talk test and the VT2 threshold test to determine HR at VT1 and VT2. These heart rates are then used to establish training zones with total training time similar to phase 3: 70 percent to 80 percent of the training time in zone 1, 10 percent to 20 percent in zone 3, and less that 10 percent in zone 2. The big difference between phase 4 and phase 3 training is that the zone 3 intervals in phase 4 are performed at or near maximal intensity. As such, they are of very short duration (e.g., 10 seconds) and have much longer recovery periods (e.g., work-to-rest ratio = 1:10 or 1:20).

Most clients will never train in phases 3 or 4. This is due in part to the focus of the phases on training for performance in endurance

events, and because zone 3 intervals are very uncomfortable, especially in phase 4 training. The training intensity in phase 4 is so great that even elite athletes will spend only a fraction of their annual training plan focused in this phase.

Recovery and Regeneration

Training should be periodized with a regular cycle of hard and easy days within a week, and a regular cycle of hard and easy weeks within a month or mesocycle. This will allow for adaptation to the demands imposed during harder training sessions and weeks. The more challenging the training program, the more important recovery becomes. It is essential to help clients understand that to achieve their goals on hard training days, they must recover on their recovery days. Always remember that your clients are not only recovering from their training program, but also from the other stressors that impact their lives, such as work, travel, family and a lack of sleep.

Learn More

For full details on the ACE IFT Model, reference the *ACE Personal Trainer Manual,* 4th Edition Set. In addition, gain a general overview of the model and earn 0.1 CECs by taking ACE's free, highly-rated online recorded webinar.

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