Principles of Training

Key Points

• Adenosine Tri-Phosphate (ATP) is called the "energy currency of the body" because it is the primary intermediate carrier of energy in metabolic reactions.

• The body has three energy systems used in physical activity, phosphocreatine (explosive burst of high energy), anaerobic glycolysis (rapid periods of moderate to high energy), and aerobic (prolonged periods of sustained energy).

• Progressive overload is the process of providing the body with a stimulus (exercise) to improve.

• Overload includes combination of the three variables of frequency of exercise, intensity of exercise, and duration of exercise.

• There is a point of diminishing return. After a person exercises about five hours per week the health benefit of exercise does not increase to the same degree that it did during the first five hours of exercise per week.

• Specificity refers to the principle that only those specific body systems overloaded by the exercise will have the stimulus to improve.

• Individuality refers to our own unique nature, with some people having more of a talent for some activities than others.

• Consistency refers to the need to apply exercise overload on a regular and frequent basis if one is to see any long-term effects.

• Recovery from exercise is a key training principle. The body must be provided with the rest time, sleep, and nutritional building blocks it requires if it is to improve.

• Reversibility refers to the principle that, just as body systems can be developed through exercise, those same body systems will deteriorate through a lack of exercise.
Reading Comprehension – Chapter 2

Read the commentary by George Sheehan on page 21. What benefits would the "physician," "psychologist," "sociologist," "educator," and "philosopher" ascribe to Sheehan's running? How does he view the benefits of exercise?

Define the following terms:
- cardiorespiratory endurance
- muscular strength
- flexibility
- fat-free mass
- progressive overload
- overtraining
- metabolism
- muscular endurance
- body composition
- specificity
- reversibility
- exercise stress test

What are the guidelines for training discussed on pages 29-30?

Supplemental Knowledge

For most people, exercise is simply an enjoyable activity in which they engage in order to improve their physical, mental, emotional, etc., well-being. For a certain group of people, however, exercise is also a path of scientific discovery. One of the most popular methods of the scientific exploration of the body during exercise is to examine metabolism, or the vital processes by which food nutrients are converted into energy and used by the body to power various systems. There are several means by which the body transfers energy, but the molecule adenosine triphosphate or ATP is called the "energy currency of the body" because it is the most common intermediate carrier of energy in metabolic reactions.

Using ATP "energy currency" as a metaphor, the body uses three primary energy systems to power exercise. The phosphocreatine system provides explosive bursts of high energy, such as those used in the shot put or the standing broad jump. Comparatively, this energy may be thought of as "pocket money," because these small stores of energy are situated directly in the individual muscle cells and are immediately available for use. The anaerobic glycolysis system provides the body with periods of moderate to high energy that may last from a few seconds to perhaps two minutes long. In this system lactic acid is produced as a metabolic intermediate, and the lactic acid conversion may be compared to using a metabolic "credit card" -- with a pre-set
spending limit and a pretty high rate of interest. Anaerobic glycolysis also takes place primarily in the muscle cells, but there is some interaction with the bloodstream and the amount of available energy is considerably larger than the phosphocreatine system. The final energy pathway, the aerobic system, combines oxygen with carbon-based molecules (food) to provide prolonged periods of sustained energy. In our financial comparison, this is the equivalent of going out and getting a job. Since this system requires both oxygen and nutrients, there is extensive interaction with the respiratory system and the circulatory system. All of this interaction takes time and limits the amount of energy that can be produced during any given minute.

It is important to keep in mind that all three energy systems are operating all the time. No system "turns on" or "shuts down." The phosphocreatine system is operating during a marathon run, and the aerobic system is functional during a pole vault. The concept is that one system will be dominant at one time or another, depending upon the energy needs of the activity.

In order to stimulate the body to improve (or even to keep from regressing), we must provide the body with more work than it can comfortably perform. This training principle is called "progressive overload," meaning we must regularly overload the body systems if they are to become stronger. This principle gives the lie to all those television commercials that promise exercise improvement without any work. The nature of exercise is work. Overload includes the combination of the three variables of frequency of exercise (number of exercise days per week), intensity of exercise (difficulty of the exercise), and duration of exercise (the length of time for each exercise session).

Intensity and duration have an inverse relationship, the less you exercise the greater the intensity needed to maintain the same benefit, but a certain minimum frequency must be maintained to keep the body from reversibility (discussed below). In addition, there is a point of diminishing return. A person engaging in about five hours per week of moderate- to high-intensity aerobic exercise is obtaining close to the maximum health benefit from that exercise. Make no mistake, benefit will continue to accrue, but not to the same degree that it did during the first five hours of exercise per week. Now, no world-class runner is going to win the Olympic Marathon training five hours per week, but remember I said "health benefit." If one is interested in a performance benefit – in addition to health – more exercise may well be required.

The training principle of specificity illustrates the need to overload those particular body systems that we want to improve. Strength training does not significantly increase cardiorespiratory endurance, and vice versa. Regrettably, we all tend to spend our time pursuing things we are already good at, so the natural endurance athlete may neglect flexibility or muscular strength, and the naturally gifted power athlete may neglect endurance and body composition. Other activities, however enjoyable, do not significantly overload any health-related body system such that they can be classified as a health-related activity. As we will discuss later, some of our nation's most favorite athletic pursuits – basketball, football, volleyball, baseball, gymnastics, or dance – do not provide significant cardiorespiratory exercise. They are definitely worth pursuing for enjoyment's sake, but we may need to engage in other forms of activity in order to build or maintain a health benefit.

People have different gifts, of course, and there is such a thing as competitive adaptations. As an extreme example, a professional-level football linebacker will seldom
become a world-class marathon runner. The physical and athletic characteristics that provide success in one arena actually detract from success in the other. Most of us don't have to worry about choosing between a career in the NFL or a gold medal in the Olympic Marathon, but each of us has a certain genetic package that makes it harder or easier for us in certain areas. This is the training principle of *individuality*, which requires us to "listen to our body" and know if we are pushing too hard in one area and not enough in another. Some people lose weight easier than others, some people are naturally more flexible, and some people have greater natural strength. If we lack a certain natural talent in one area it does not mean we should give up and go watch television, but it does mean we may have to work harder in that area and we may have to re-define our expectations.

The training principle of *consistency* refers to the need to apply exercise overload on a regular and frequent basis if one is to see any long-term effects. We could go to the Student Recreation Center one day and engage in a near-perfect workout, but that one workout isn't going to do us much long-term good. At the same time, *recovery* from exercise is also a key training principle. The body must be provided with the rest time, sleep, and nutritional building blocks it requires if it is to improve. I always ask my class the following trick question: "Does lifting weights make you stronger?" The technical answer to this question is "no;" lifting weights actually "breaks down" the muscles and makes you weaker. In other words, lifting the weight merely provides the body with the stimulus to become stronger – the body still needs enough time (including sleep time) and nutrients (proper food) to react to the stimulus.

One final training principle is that of *reversibility*, meaning that just as body systems can be developed through exercise, those same body systems will deteriorate through a lack of exercise. No one can get in such great shape that they cannot lose those same abilities if the body is neglected. And the body seems to lose ability much faster than it gains. On a more positive note, it takes a lot less exercise to *maintain* a fitness level than it takes to achieve one.

It's possible that some members of a *Lifetime Health and Fitness* class may have experienced the childhood humiliation of being chosen last for round after round of grade school reindeer games. Indeed, much of the problem we face as *Lifetime Health and Fitness* instructors is the degree to which so many students have been socially conditioned away from activity throughout their young lives, believing in their hearts that physical activity can only bring them more humiliation.

In elementary school, middle school, and even to some extent in high school, social credit is given to those who are good at various "ball" sports – sports that require a high degree of eye-hand coordination, explosive speed, kinesthetic awareness, and other marks of athletic talent. You will notice, however, that health-related fitness goals are dependent upon things that have little relevance to ball handling.

If you weren't particularly "athletic" in grade school – or if you were – keep in mind that as you advance into the adult world, the rules of the game have changed: Adult society is primarily interested in health-related fitness, and this type of activity does not emphasize the same things that make a great ballplayer. Cardiorespiratory endurance can be developed without ever touching a ball, as can muscular strength/ endurance, flexibility, and a healthy body composition. If you were the BFOC – Big Fawn on Campus – in your childhood reindeer games, the next few years of living in an adult body
may require a little bit of a reality-check as to what is now required. On the other hand, if
you grew up thinking "I'm no good at sports," what a marvelous opportunity these new
rules may provide you.