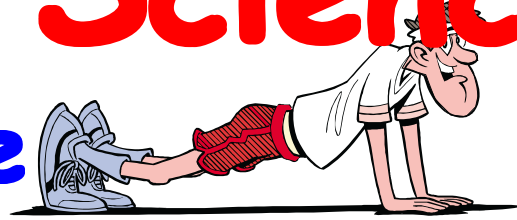


Exercise Science

Made Simple



by Brian D. Johnston



You are unique!

For some people, exercise seems like a very complex subject. But like any complex subject, it can be made simple... at least exercise theory is fairly simple, whereas what you do with that knowledge (how you decide to apply exercise) can be quite varied and different from how other people apply exercise. This is true because of your "individuality" and what works for someone else may not work for you or, at least, not to the same extent.

We begin our journey with a brief look at philosophy. This step is necessary since the principles of exercise are part of a larger picture, and this larger picture is governed by certain Laws that guide everything and every subject. The first law is the **Law of Identity**. This means that everything in the Universe (all that which exists) has an identity. For example, you are who you are, and the things in your home are what they are. This should seem common sense.



The Universe



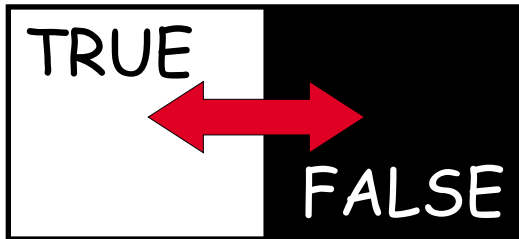
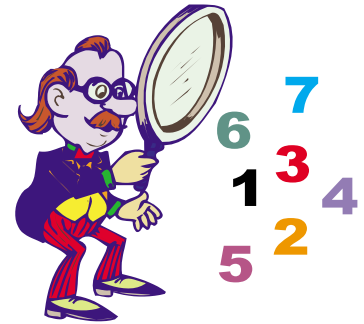
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Exercise



Exercise is no different in that it is something specific and the "nature" of exercise and the rules you must follow in order to make exercise productive are established and very clear. We'll be speaking about these principles shortly.

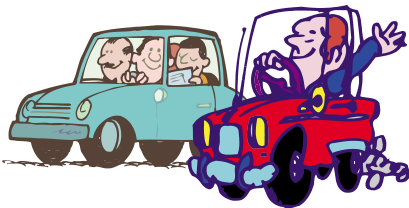
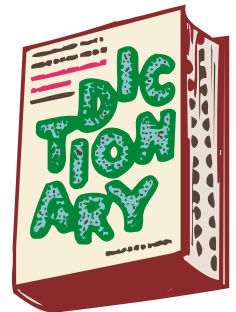
An important logical point to remember is that there must be a limited number of rules to know about exercise, or any other science. If the rules we had to follow were infinite, then there would be no way we could learn and apply any science. However, although the number of rules are limited, the combinations that can come about from these rules (how we apply exercise) can be almost limitless.



The second logical law that you should be aware of is the **Law of Non-Contradiction**. This means that there cannot be any contradiction in what a thing is or what a statement says. A statement cannot both be true and false, and you cannot be someone else other than yourself. Although you can "pretend to be " or "act" like someone else, you cannot escape your identity... of who you are.

How the Laws of Identity and Non-Contradiction fit into exercise science and its *theory* (a description of rules or a set of principles to follow) will become clear as we proceed. For now, what you need to remember are two things:

1. To identify something mentally we need to define that "something." A **definition** is a description of the *essential characteristics* of a thing that exists. You could say that a definition describes what we perceive through our senses, i.e., sight, hearing, touch, taste, and smell.



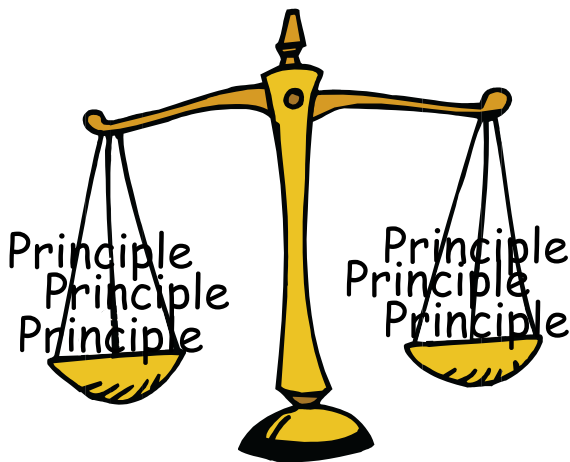
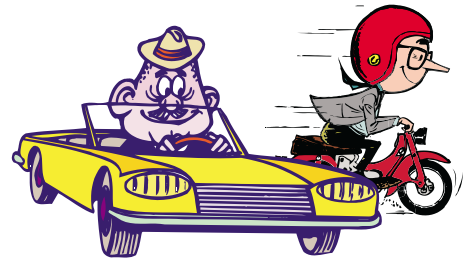
For example, to describe or define an automobile you would say it is a *self-propelled passenger vehicle with wheels designed for operation on roadways*. You would not describe the color, since it could be any colour, and the same is true of how many passengers the car holds, how fast it could move, its length, weight, model and manufacturer, etc... these things vary from one automobile to the next, but the essential characteristics described in the definition above hold true in all cases.

Exercise science is similar, in that there are certain definitions to describe its principles or rules that you need to follow.

The definition of a "thing" is how we describe and communicate identity.

2. A thing can only be what it is and nothing else (at the same time). Neither can you say "I can lift 100 pounds" and "I cannot lift 100 pounds." Either you can or you cannot.

An automobile cannot be a scooter at the same time. A person can take an automobile apart and create a new thing, such as a scooter from the parts, but it no longer is an automobile.



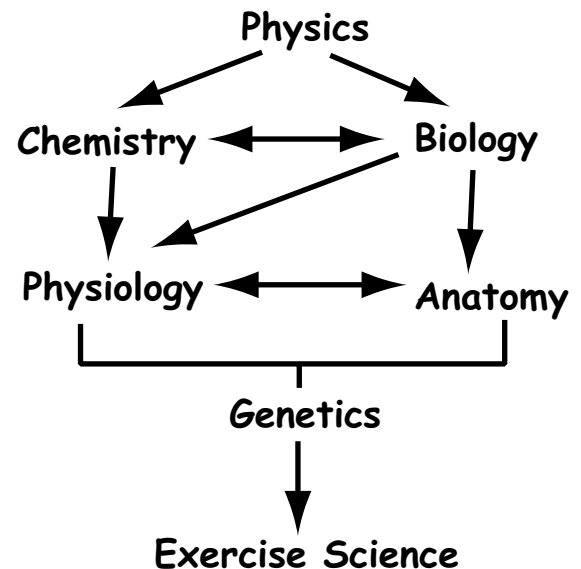
Once you understand the "nature" or identity of exercise principles, and what they mean, you will discover that you cannot contradict the nature of those principles. This means that the rules you must follow need to coordinate to create a balanced "synergy" so that you do not do too much exercise nor too little exercise, but the right amount and type of exercise.

Next, all the sciences connect in some manner. Different sciences include physics, chemistry, biology, anatomy, and genetics. All these studies influence or make up exercise.

For example, when we talk about developing our muscles, we refer to *anatomy*, which is the biological science dealing with the structure of organisms, including our bodies.

And how our bodies respond to exercise, such as the building of muscle and strength, speaks of *physiology*, or the science of the functions of living organisms and the chemical and physical processes involved.

How well you respond to exercise depends on the quality of the exercise program and your genetics.

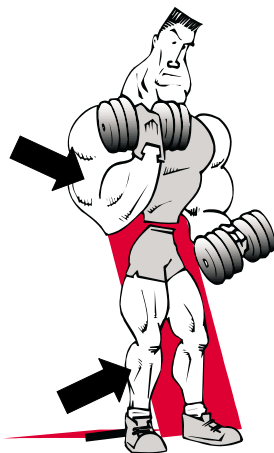
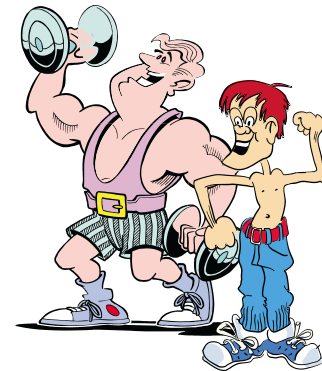


Exercise Does Not Exist Within a Vacuum!



Genetics is an important consideration. We all come in different shapes and sizes. Some people are thin, whereas others carry more body fat. Some people are short, whereas others are tall.

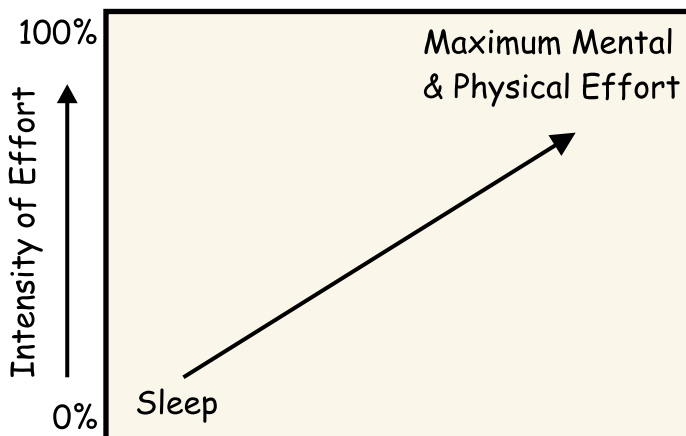
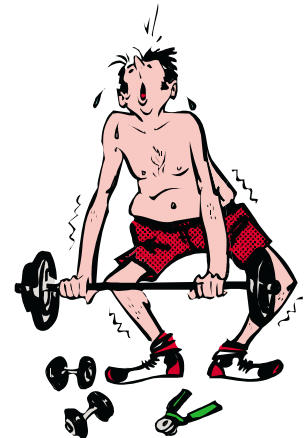
Some people respond very well to exercise, such as building a lot of muscle or they are able to run marathons, whereas other people have to work very hard to make only slight changes.



Sometimes a person can have some muscle groups that respond very well to exercise, whereas other muscle groups do not seem to develop very much at all, like large arms and small calves. Chances are you will notice this too.

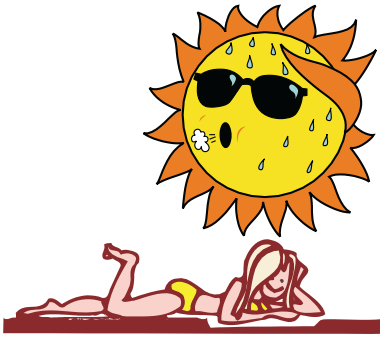
The first principle of exercise is **Intensity**, which is the possible percentage of momentary effort exerted.

To break this down, if you try as hard as possible to lift a weight, mentally and physically, you demonstrate 100% of your ability. Now, the only times this occurs would be if you were to lift a maximum weight in an exercise, or if it happens to be the last repetition possible, such as lifting a weight ten times and an eleventh repetition is impossible.



At any other time (or moment) you exert a percentage of what is possible but not 100%.

A key to productive exercise is that the harder or more intense you exercise, the better your chances of developing muscle and strength because the exercise "stimulus" was so strong.



This can be compared to getting a suntan when it is cloudy and the temperature is cool as opposed to when the sky is clear and the temperature is hot. The stimulus to produce tanned skin, which is a response of our bodies to the stress of the Sun's light rays, obviously is greater when it is hot and the sky is clear.

Just remember, you do not have to lift heavy weights to exercise intensely. Rather, it is the quality of effort that makes the difference, such as moving slowly and continuing the set until the repetitions become difficult or challenging... regardless of the number of repetitions performed or how heavy the weight may be. And if you lift a moderate weight for ten repetitions, the last repetition will feel very heavy, only because you lost so much strength (function) in order to reach that tenth and final repetition.

Being unable to lift for another repetition means you trained to "*muscular failure*"; in other words, your muscles fail to continue to move the weight. You either will need to reduce the weight so that you can perform more repetitions, or you will need to rest for a minute or two before performing another "set" of repetitions with the same or different weight.

Also, a person does not have to exercise this hard all the time or at all to produce results, but the effort must be high enough if you want to improve your fitness level, whether it is to run faster, to become stronger, to build more muscle, or any other goal. In fact, there must be enough effort when we exercise just to maintain what fitness was developed from previous exercise, or to slow down the normal loss of muscle and strength as we age.

The nature of intensity states a specific rule: it is inversely proportionate to volume and frequency. In other words, the more exercise you perform in a workout (volume), and the more often you exercise (frequency), the less intense you can or should exercise.

It's a little more complex than this and how these three factors fit together will be explained later. First, let's look at those other two principles of exercise science:

Volume is the amount of exercise performed in a workout, such as the number of repetitions performed in each set and how long each set lasts (in seconds and minutes) but, more particularly, the number of sets performed.

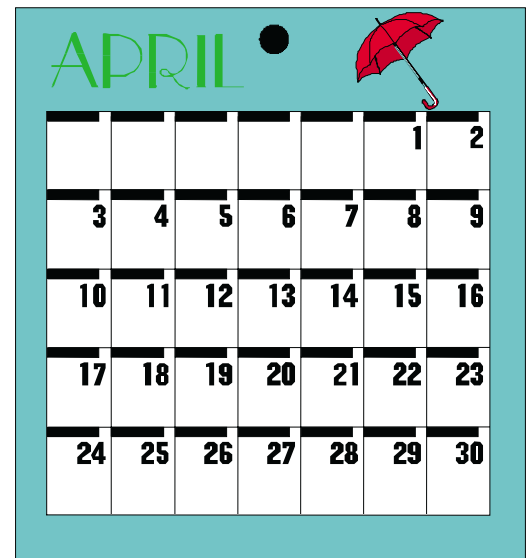
The nature of volume states a specific rule: it is inversely proportionate to intensity and frequency. In other words, the more volume (sets) you perform in a workout, the less frequently and the less intensely you can or should workout.



Most people exercise too much and too often while not exercising intensely enough

Frequency refers to the rate of occurrence of exercise sessions. For example, if you exercise every second day, then that would be your general frequency. And if you exercise different muscles on different days, but exercise each muscle once a week, then "once a week" would be your specific frequency.

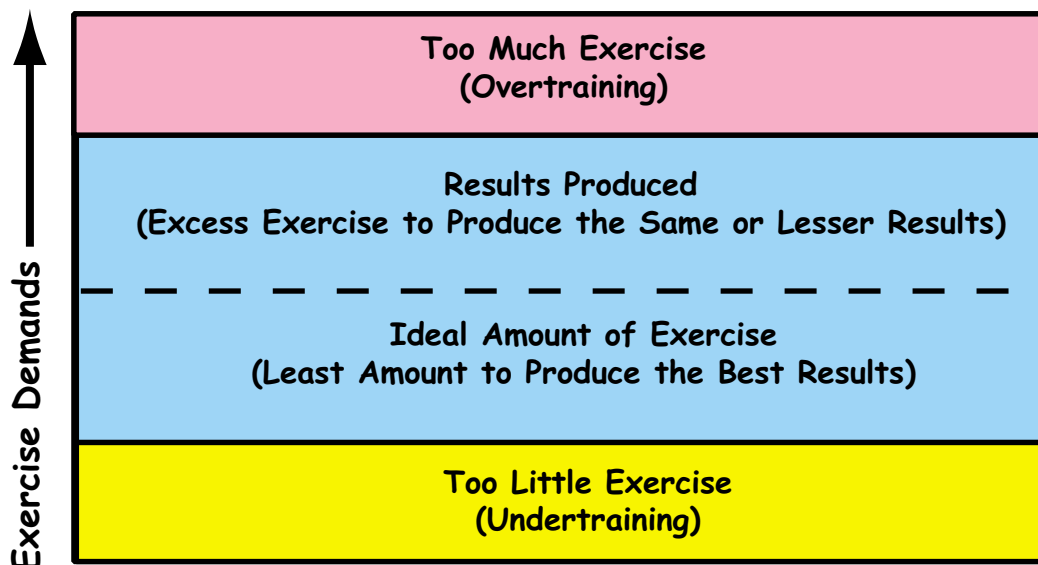
What you must remember is that exercise is a form of stress on the body and mind, just like work, school, or experiencing an accident or injury. How often you exercise in general is just as important as how often you exercise each body part specifically. Doing too much in either case is not good for you.



The nature of frequency states a specific rule: it is inversely proportionate to intensity and volume. In other words, the harder you exercise and the more you perform in a workout, the less often you can or should train each muscle specifically or any muscle in general.

Here is where it gets a bit complex. It is wrong to say that volume, frequency, or intensity *must* decrease if one of the other things increases. That *may* be the case, but not always. Check out the graph below. Each person has his or her tolerance to exercise stress, and the ability to respond to exercise. We can do too much and still produce positive results, although it is ideal to discover how much exercise each of us needs to produce the best results relative to what we are attempting to achieve, such as losing fat, or gaining muscle or strength... or even all three.

If a person does not exercise very hard, and intensity, volume and frequency are not that high, then all three factors actually can increase and still be within the "blue zone". It is only once a person begins doing too much (beyond what is "ideal") that intensity, volume and frequency need to be coordinated or balanced more carefully.



Doing far too much exercise is not a good thing since it leads to overtraining, such as a general feeling of fatigue, no motivation to exercise, a loss of strength and muscle, and a weakened system that can result in repeated colds and flus.

Not exercising enough can cause similar things to happen, such as reduced strength and muscle, a general feeling of fatigue, and a weakened system. This is obvious in people who do not exercise, since their functions and overall health are not as good as those who do exercise, but it also is obvious in people who do exercise.

To explain, if a person has a certain amount of strength and muscle, and that strength and muscle were developed by exercising with a particular amount of intensity, volume and frequency, then a person can lose some of that strength and muscle if less exercise is performed. After all, by doing less there is no reason for the body to keep what you developed by doing more.

Sometimes we can maintain what we develop by doing a bit less, but not a lot less. Other times we will lose strength and muscle no matter how hard we exercise simply because it is part of the aging process, although we can slow down the loss we normally experience by exercising regularly and within our means.

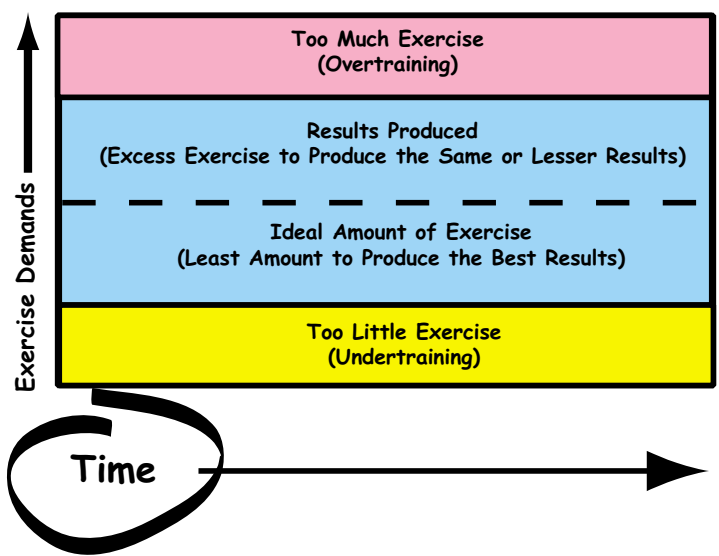


The key to all of this is that each of us needs to discover how much is necessary to produce the results we want (so long as those results are within our means) and without doing more than is necessary. This introduces us to our fourth principle of **Diminishing Returns**, a rule that states: *exercise that exceeds the minimum necessary to produce the best results possible has no value.*

This should be fairly common sense; after all, why do more if the results are no better? But, again, it's not that simple.

Take a look again at our graph, and you will notice that there is a range for an individual's tolerance to exercise, up until a critical point before a person overtrains, i.e., doing too much exercise. However, how much exercise is too much depends on the "time factor", or how long a certain amount of exercise demands is maintained.

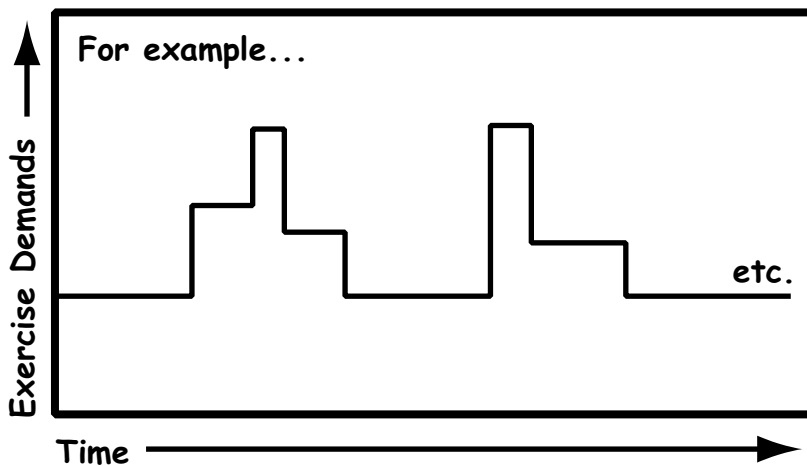
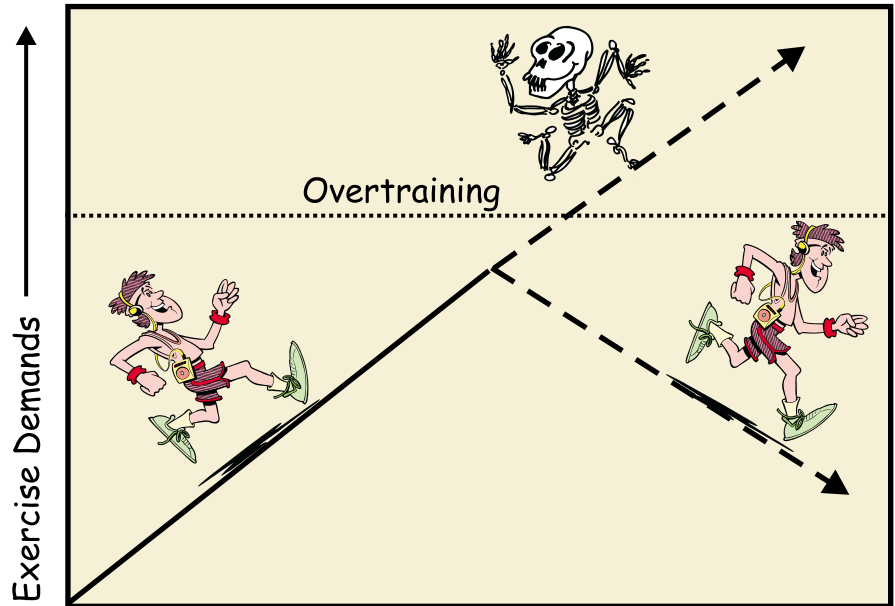
For example, suppose that 5 sets for each muscle every 7 days seems to be ideal, and you could do that much exercise all the time without overtraining. Then you decide to try a lot more exercise, such as 12 sets for each muscle every 5 days. Although you can handle that much, the ability to keep up that pace would not last very long before you overtrain. Eventually you would have to reduce your exercise demands to something more tolerable over the long-term, such as the 5 sets every 7 days.



What you may notice is that the results produced (e.g., muscle and strength) when exercise demands are increased to more than you are used to are greater per unit of time, so long as you do not cross that fine line of overtraining.

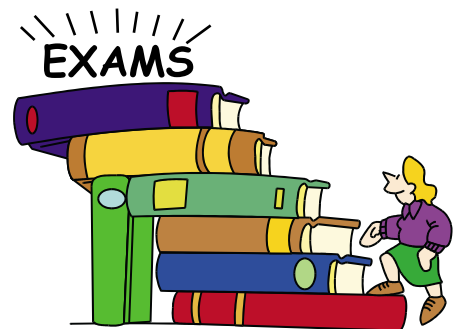
However, when the demands are very high, and to avoid overtraining, you eventually have to reduce the exercise demands and return to a program that is more ideal long-term.

This is what frustrates some people; they want to make the best results possible, but when they put their bodies into "overdrive" they can't sustain it for very long. What sometimes happens is that they try to sustain a lot of exercise and they become overtrained or injured.



To avoid this from happening, and if you try to maximize your physical results, a program needs to have ups and downs in how hard you can exercise and for how long you can maintain certain amounts of exercise. This is what athletes do to prepare for the Olympics. They are not in their best conditions all the time, but build up their conditions over several months, then return to easier exercise training once the competition is over.

All this is similar to anything else in life; you cannot work at a job or study at school as hard as possible all the time without burning out. This is why, for example, school exams do not occur every week, a pattern that explains the relationship between intensity, volume, and frequency. When there are no exams students' rate of frequency to learn is high (every day); the volume is high (new things learned every day), but the intensity of "memorizing" or remembering the information is low. Once exam time kicks in, the volume of new information to learn or know drops significantly while the intensity of knowing the information increases at a frequency that lasts for a brief period of weeks.



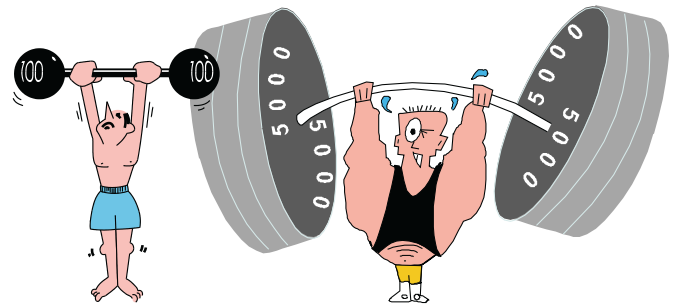
Not everyone will want to "maximize" his or her body's potential, and so altering exercise demands is not for everyone or necessary for everyone (although it helps to add variety to maintain motivation).

The need to "cycle" or alter exercise demands will depend on how far you will want to take your body. Also, the overall structure of the program eventually will depend on your goals and lifestyle.

The fifth principle is an obvious one: In order to exercise, there must be a resistance in which to exercise against, such as your body weight, barbells and dumbbells, or exercise machines. If there is no "load", then the muscles cannot work. Consequently, the **Load Principle** refers to *the amount of resistance imposed upon the muscles* and that:

A load must exist for exercise to exist.

Also, a key to increase results is the ability to overload the muscles with progressively heavier weights (or through some other factor). If you always perform 10 repetitions with 25 pounds, you will not improve beyond that point; you have to use 30 pounds, then 35 pounds, etc. This increase in weights used refers to "progression" and often is termed the Progression Principle.



If you work hard to increase both the load *and* the number of repetitions from one workout to the next, then this would be called "double progression" (see workouts 3 & 4 in the example).

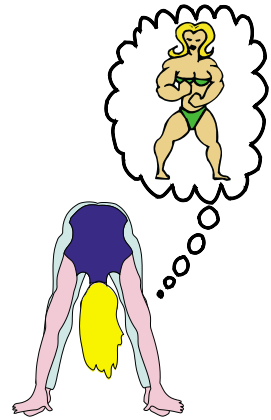
WORKOUT	LOAD	REPS
1	25	6
2	28	6
3	33	8
4	35	9
etc.	etc.	etc.

The sixth principle is called **SAID**, which is short for "specific adaptations to imposed demands." This means that the body will adapt, or change, relative to the demands of exercise imposed upon it. As a very specific example, to become good at tennis or any other sport requires specific practice of that sport. You do not become good at tennis by playing badminton; although one activity is "similar" to the other, they are not "exact."



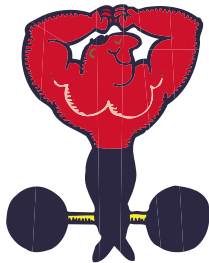
The same is true when we exercise to produce certain changes in our bodies, the exercise program must be designed in such a way that specific results are produced.

You cannot perform a yoga program and expect to build large muscles or a lot of strength. And if you want to develop your arm muscles you would not work your leg muscles.



This should seem straight forward. However:

In order to make specific physical changes such as muscle size, particularly if you want to "maximize" that aspect of your body, the program must be designed specifically relative to your individualism or how you respond to exercise.



Some people respond very well to exercise and make great progress on nearly any exercise program because of their genetics.

Most people, however, need to customize their exercise programs carefully in order to make worthwhile changes in their bodies. A "one size fits all" exercise program can work only so well for most people, and this is no different than if we were to consider that everyone has specific nutritional or medical requirements; we can make general recommendations in regard to nutrition and medicine but, eventually, we have to fine-tune those recommendations so that they fit the individual much better.

It's like buying a suit off the rack as opposed to a tailor-made suit that is designed specifically for you, regardless of your genetics. Both serve the same purpose, to clothe you, but the quality and individuality between the two is much different.



This brings us to our seventh and final principle, the **Principle of Individualism**, which states: *exercise must be prescribed in accordance to the needs, goals, abilities, limitations and psychology of the individual.*

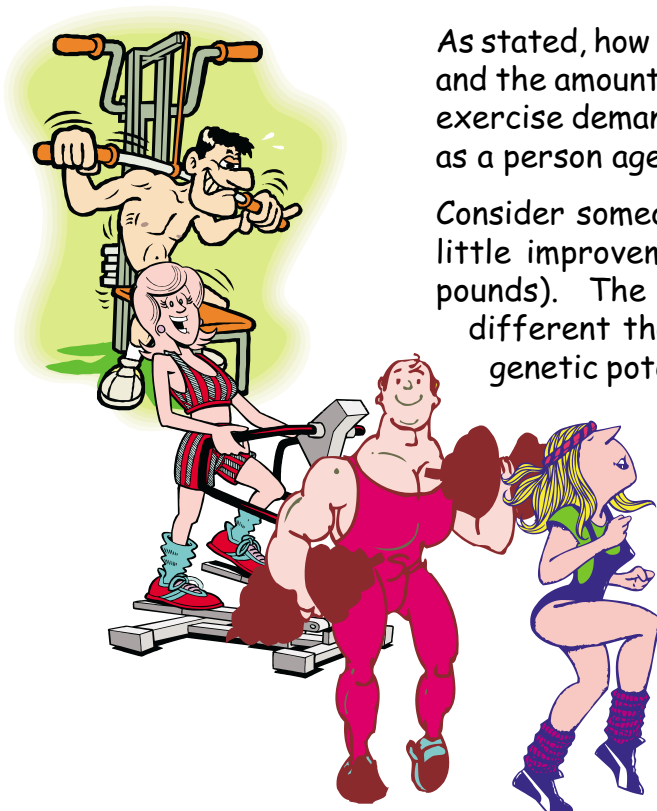
For example, a person may have the goal to lose 10 pounds of fat in one month, but he or she may have the "need" to increase motivation to sustain an exercise and diet program in order to achieve that goal.

Also, we have to look at a person's trainability (how well he or she responds to exercise) to determine if that much fat loss in a month is possible: is the person able to achieve that goal, or are there certain physical or mental limitations keeping the person from that goal?

Lastly, we have to look at the person's psychology, a much neglected aspect of a fitness lifestyle. This has a lot to do with motivation and preference for certain types of exercise. A person could have the goal and genetic potential to become very strong, but if that person does not like weight training or can't bring himself to lift progressively heavier weights, then the goal never will be realized.



It's now time for a bit of an overview as we work backward. The prime factor in determining an exercise program is the **individual**. It doesn't matter what works for any other person, including the bodybuilding, athletic, and fitness models in magazines and books. Rather, what counts is what works for YOU and what is ideal for you.



As stated, how much exercise that is "ideal" is an individual matter and the amount can change regularly, with the "ups and downs" of exercise demands and relative to the goals a person has and even as a person ages.

Consider someone who simply wants to get in shape and make a little improvement in fat loss (10 pounds) and muscle gain (5 pounds). The exercise program to achieve that goal is much different than if that person decides to maximize his or her genetic potential, to lose as much fat and gain as much muscle as possible.

The program is still different yet if the goal is to rehabilitate an injury, or whether to become good at a one mile run or a 25 mile marathon.

Because goals are so diverse and individualized, and because what we want to achieve may not correspond to what we actually can achieve (or sometimes we can do better than we realize), then it is difficult to determine exactly how much exercise is ideal unless we experiment and pay close attention to our "patterns."

This means that certain types of programs and certain amounts of exercise will produce different responses, some better than others. It is important to pay attention to your body responses to try and figure out how much exercise is ideal (relative to the "time factor") and the methods and strategies that seem to work best.

Consider for a moment that all exercise programs are, in fact, the same in regard to what they consist of, such as exercise movements, repetitions, sets, etc. Below is an example of how a workout can be different, yet still contain the same things.

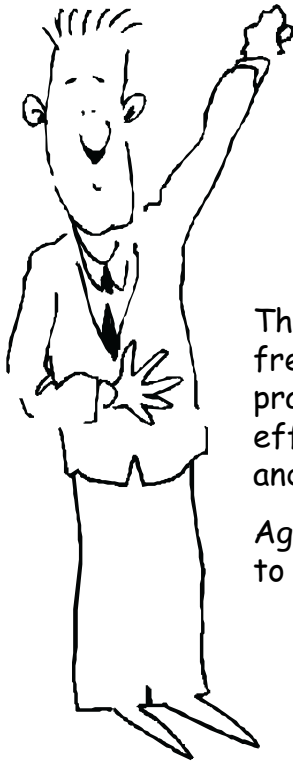
What makes an exercise program "unique" and most effective for your individuality is the measurement of all those elements, together with how we arrange them (the "strategy" or "method").

Common Elements	Workout One	Workout Two
Muscle Group	Chest	Chest
Exercise Movement	Bench Press	Bar Dips
Intensity of Effort	To-Failure	Sub-Failure
Number of Sets	2	3
Repetitions	8-6	10-8-6
Load	100 pounds both sets	Body weight
Rest Between Sets	60 seconds	45 seconds
Frequency	Every 7 days	Every 8 days

All this should tell you two things:

One, the goal is to perform the right amount of exercise, and so we must take into consideration the **Principle of Diminishing Returns**. Doing too much has no value and it can cause overtraining, which leads to muscle weakness and other health-related problems.

Second, the specific "nature" of the exercise program (the measure and arrangement of the "elements" in accordance to the **SAID Principle**) must be considered, and that it needs to match the "trainability" and goals of the individual.



The **Principle of Diminishing Returns** helps guide us as to how much **intensity**, **volume**, and **frequency** is required. We have to experiment with those three factors to find out what works best, while making certain we discover the least amount exercise overall that is necessary to produce the best response relative to the goals we are attempting to achieve.

No easy task! That takes time and patience, besides some careful thinking.

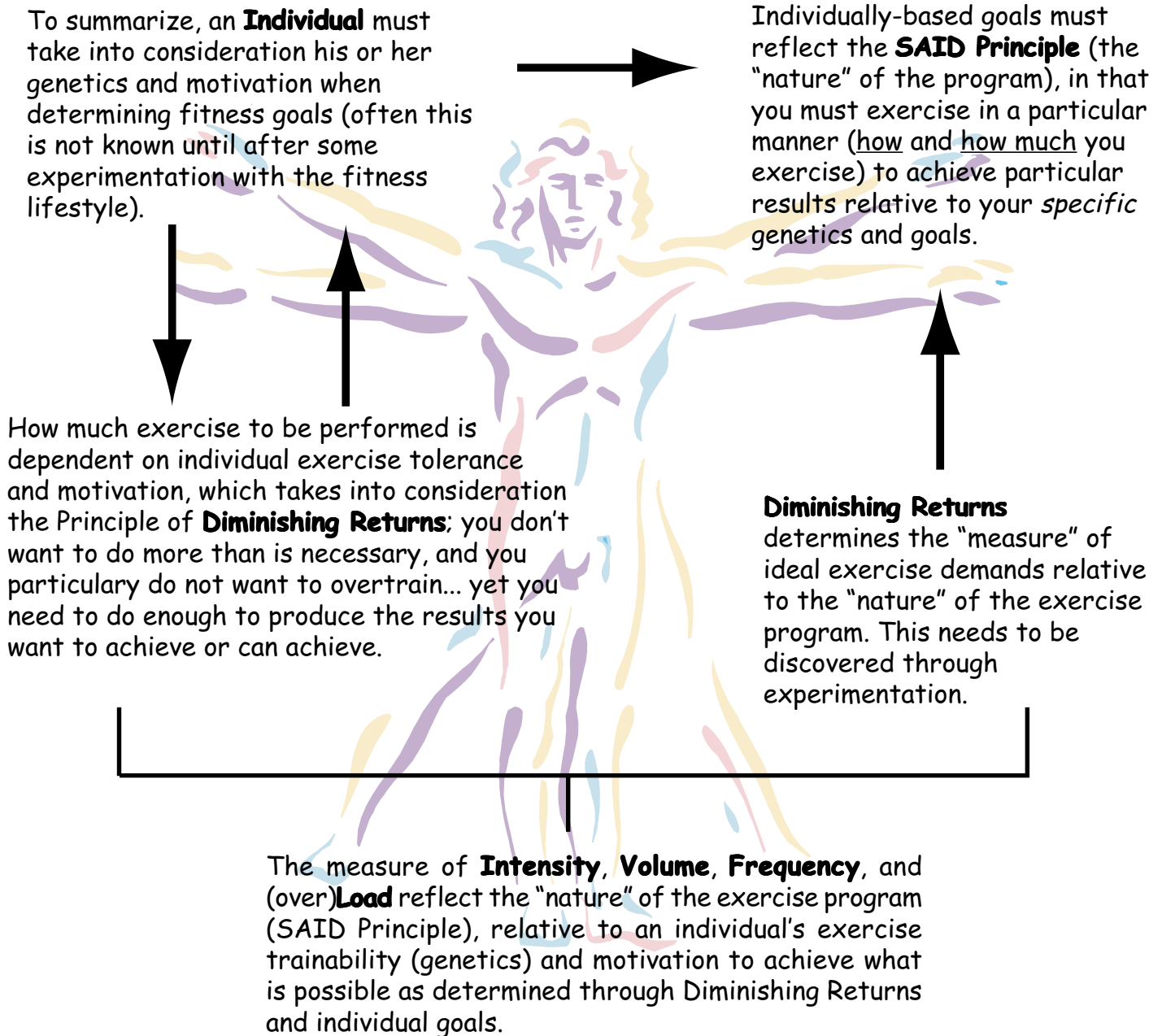
The **SAID Principle** likewise helps us determine how much intensity, volume, and frequency is needed. There are some basic guidelines, such as "to build endurance practice endurance training" and to build muscle and strength, the intensity of effort has to be rather high and balanced with an appropriate amount of volume and frequency as we attempt to overload progressively in the weights we use.

Again, it takes experimentation to know exactly how much exercise is necessary to achieve certain results since we all respond to exercise differently.

Also, the SAID Principle determines the load or resistance to use when exercising. If the goal is to build strength and muscle, the weight must be heavy enough to challenge the muscles in under two minutes... more than two minutes of steady activity is more of an endurance or aerobic challenge. However, the weight must not be too heavy as to increase the risk of injury.

How much **load** is used has an effect on **intensity**. For example, if you trained "sub-failure" for 8 repetitions with 25 pounds, then next workout you attempted 8 repetitions with 35 pounds, the added weight may cause you to train "to-failure", and both the increase in load and intensity place greater demands and strain on the body, i.e., it is harder.

Because of this relationship, using progressively heavier weights can affect how much workout volume and frequency you can or should perform as you become more muscular and stronger and learn to exercise more intensely.



We hope you have enjoyed this overview of the exercise principles. For further reading, and to learn about data collection and individualized program analysis/prescription methods, check out the I.A.R.T. book *Prescribed Exercise: Exercise Science Made Simple* at:

www.IARTonline.ca

or speak with your I.A.R.T. fitness professional.