

*This chapter is dedicated to my
wife, Alicia, and our son, Ryan.*



There are many benefits of strength training. First of all, increasing your muscular strength will improve your capacity to perform everyday tasks more easily.

Strength training will also increase your muscle mass and decrease your body fat which will improve your body composition and physical appearance. In addition, strength training will increase your bone mineral density, thereby combating the destructive effects of osteoporosis. There are psychological benefits as well including increased mental alertness, self-confidence and self-esteem.

Most fitness authorities agree that strength training can be extremely beneficial. Many, however, disagree over which approach is best for increasing muscular strength. The different approaches – and the abundant amount of conflicting information – often leave people quite confused.

In our society, time has truly become a precious commodity. Welcome to New Jersey where a New York minute lasts about 30 seconds. Clearly, most people simply don't have an abundance of free time. Because of this limitation, you should seek and implement a strength-training program that produces the maximum possible results in the minimum amount of time. Therefore, efficiency should be a major consideration in developing your strength-training program. Another important consideration, of course,

is safety. It makes little sense to do a program if it has a high potential for injury.

Of interest, science has been unable to determine that one strength-training method is superior to another. Research has only shown that a variety of methods can increase muscular strength. One researcher, for example, found that similar increases in muscular strength were produced by nine different training routines consisting of various combinations of sets and repetitions. Increases in muscular strength can also be produced by a variety of equipment. Many studies have shown that groups using free weights and groups using machines produce similar improvements in muscular strength.

GET STRONG!

Since just about any type of program or equipment can produce favorable results, you must decide what's most practical for you based on safety and time considerations. You can construct an efficient and effective strength-training program – using virtually any type of equipment – by applying the information that follows.

The Level of Intensity

The most important factor that determines your results from strength training is your genetic (or inherited) characteristics (which include the insertion points of your tendons, your predominant muscle-fiber type and so on). Unfortunately, you cannot control the

Chapter 4

Strength Training

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genetic cards that you were dealt. The most important factor that you can control is your level of intensity. (With respect to strength training, “intensity” shouldn’t be confused with “a percentage of a maximum weight.” Rather, “intensity” is another word for “effort.”)

A high level of intensity is necessary for maximizing your response to strength training. This level of effort is characterized by performing each set to the point of muscular fatigue or “failure.” In simple terms, this means that you’ve exhausted your muscles to the extent that you literally cannot raise the weight for any additional repetitions.

If you fail to reach a desirable level of intensity – or muscular fatigue – your increases in muscular strength will be less than optimal. So if you produce too little fatigue, then you may not have stimulated your muscles to adapt. But if you produce too much fatigue, then you may not have permitted your muscles to adapt; it may even cause a loss in muscular strength. Therefore, your level of intensity should be high . . . but it should also be appropriate. In brief, you should train with a high level of intensity without overdoing it.

How do you know if the demands on your muscles are too little or too much? You should monitor your performance in terms of the resistance that you use and the repetitions that you do. If you continue to

make progress in your performance, then the demands are appropriate.

That being said, you must also use your judgment in deciding what level of intensity is suitable for you. “Intensity” is a relative term that depends upon your current level of fitness. Exercise of low intensity for an active individual may be of high intensity for an inactive individual. So if you haven’t been training on a regular basis or aren’t in the best of shape, then you should adjust your effort accordingly. Remember, you can control your level of intensity when you train: your efforts can be as easy or as difficult as you desire.

Progressive Overload

It’s not uncommon to hear of someone who performs the same number of repetitions with the same amount of resistance over and over again, workout after workout. Suppose that today you did a set of the bicep curl for 10 repetitions with 50 pounds and a month later you’re still doing 10 repetitions with 50 pounds. Did you increase your strength? Probably not. On the other hand, what if you were able to do 11 repetitions with 60 pounds a month later? In this case, you were able to perform 10% more repetitions with 20% more resistance.

You must overload your muscles with progressively greater demands. For this reason, your muscles must experience a workload that’s increased steadily and

systematically throughout the course of your strength-training program. This is often referred to as “progressive overload.”

In order to overload your muscles, every time you train you must attempt to increase the resistance that you use or the repetitions that you perform in comparison to your previous workout. Stated otherwise, you must impose demands upon your muscles that they haven’t previously experienced by using more resistance or performing more repetitions. Specifically, your muscles adapt to such demands by increasing in strength.

In a nutshell, progressive overload would be accomplished in this manner: if you reach muscular fatigue within your prescribed repetition range – say that your range is 15-20 and you did 18 repetitions – you should repeat the resistance for your next workout and try to improve upon the number of repetitions that you did; if you attain or surpass the maximum number of prescribed repetitions in an exercise – say that your range is 10-15 and you did 15 repetitions – you should increase the resistance for your next workout.

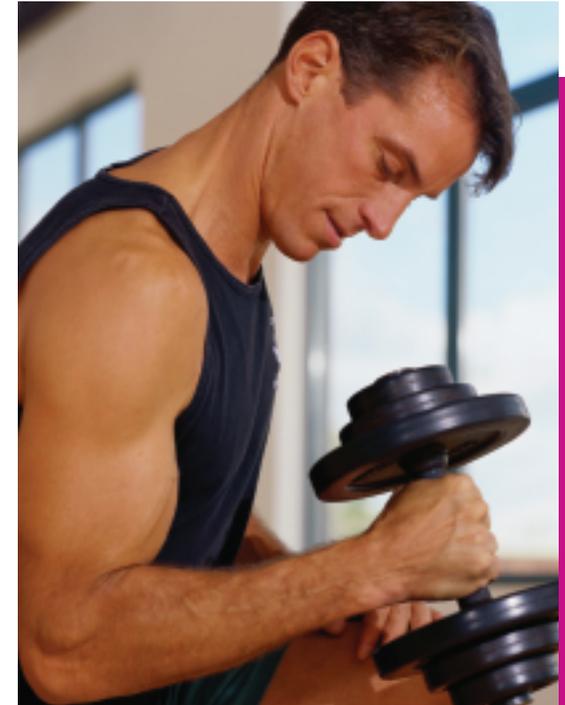
You should increase the resistance in an amount with which you’re comfortable . . . but the resistance that you use must always be challenging. Your muscles will respond better if the progressions in resistance are about 5% or less (depending upon the degree to which the exercise was challenging).

Number of Sets

For many years, most people have done multiple-set training simply because that’s what they’ve read or been told to do. The roots of this advice can be traced back to the time when virtually every authority in strength training came from the ranks of the professional strongmen, competitive weightlifters and, to a lesser degree, bodybuilders. In the early 1970s, the notion was advanced that people could improve their strength with far fewer sets – and, thus, less volume of training – than had been thought.

Know this: science has been unable to determine how many sets of each exercise are necessary to produce optimal increases in muscular strength. But the overwhelming majority of scientific evidence indicates that single-set training is at least as effective as multiple-set training. An exhaustive literature review by researchers at Adelphi University (New York) examined all studies that compared different numbers of sets (dating back to 1956). Collectively, their research found 5 studies that showed multiple-set training was superior to single-set training and 57 that did not.

So, the basis for performing single-set training – or a relatively low number of sets – has powerful and compelling support in the scientific literature. But is single-set training actually done in the “real world”? More



A high level of intensity is necessary for maximizing your response to strength training.



importantly, can experienced or “trained” individuals obtain the same results from single-set training as they can from multiple-set training? The answer to both questions is “yes.” The fact of the matter is that single-set training has been popular since the early 1970s. And to quote the aforementioned researchers: “There is no evidence to suggest that the response to single or multiple sets in trained athletes would differ from that in untrained individuals.” Indeed, numerous authorities advocate single-set training including the strength coaches for many collegiate and professional teams. Dan Riley – a veteran strength coach with more than 22 years of experience in the National Football

League and another 8 at the collegiate level (Penn State and Army) – offers this advice to his players: “Your goal must be to perform as few sets as possible while stimulating maximum gains. If performed properly, only one set is needed to generate maximum gains. In our standard routines, one set of each exercise is performed.”

Recall that in order for your muscles to increase in strength, they must experience an adequate level of fatigue. It really doesn’t matter whether your muscles are fatigued in one set or several sets – as long as you produce a sufficient

level of muscular fatigue.

If doing one set of an exercise produces virtually the same results as several sets, then single-set training represents a more efficient means of strength training. After all, why perform several sets when you can obtain similar results from one set in a fraction of the time? There’s one caveat, however: if a single set of an exercise is to be productive, the set must be done with an appropriate level of intensity – that is, to the point of muscular fatigue. Your muscles should be thoroughly exhausted at the end of each exercise.

This is not to say that multiple-set training cannot be done. If performed properly, multiple-set training can certainly be effective in overloading your muscles. If you have a preference for multiple-set training, you should be aware of several things. First of all, simply doing multiple sets doesn’t guarantee that you’ve overloaded your muscles. If the weights you use aren’t demanding enough, then you will not produce sufficient muscular fatigue and your workout will not be as effective as possible. Remember, a large amount of low-intensity work doesn’t necessarily produce an overload. So if you’d rather do multiple sets, make sure that you’re challenging your muscles with a progressive overload. In addition, keep in mind that performing too many sets (or too many exercises) can create a situation in which the demands on your

You should emphasize the quality of work that you do rather than the quantity of work. (Photo by Matt Brzycki.)



muscles have surpassed your ability to recover. If this happens, your muscle tissue will be broken down in such an extreme manner that your body is unable to adapt to the demands. Also, doing too many sets (or too many exercises) can significantly increase your risk of incurring an overuse injury such as tendinitis and bursitis. And multiple-set training is relatively inefficient in terms of time so it's undesirable for time-conscious individuals. The point is this: keep your sets to the minimum amount that's needed to produce an adequate level of muscular fatigue.

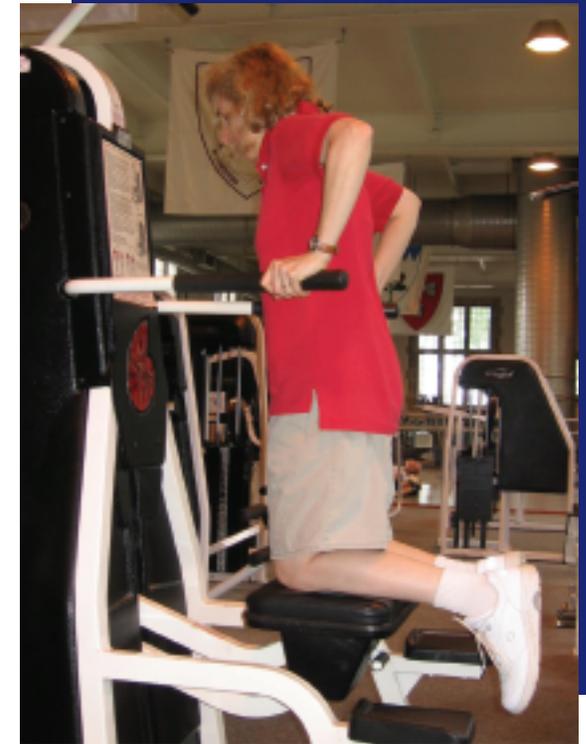
You should emphasize the quality of work that you do rather than the quantity of work. Don't perform meaningless sets – make every set count.

Number of Repetitions

Determining an appropriate repetition range depends upon a number of factors and, even then, has some degree of variability. Understand first that strength training isn't an aerobic activity that's characterized by long-term, low-intensity efforts. Rather, it's an anaerobic activity that's characterized by short-term, high-intensity efforts. Therefore, the duration of a series of repetitions – that is, a set – should be in the anaerobic domain. Efforts that last from a split second to several minutes are considered to be anaerobic (assuming, of course, that the level of effort is great enough to justify an anaerobic

response). Since intense efforts at the lower end of this time frame carry a higher risk of injury and those at the upper end have a greater reliance on the aerobic pathways, narrowing the window of time to roughly 40-120 seconds represents a safe and effective range for strength training with higher durations assigned to larger muscles and lower durations to smaller ones. (Larger muscles – such as those in your hips and legs – should be trained for a slightly longer duration because of their greater size and work capacity.) Thus, time frames might be 90-120 seconds for a hip exercise, 60-90 seconds for a leg exercise and 40-70 for a torso exercise.

Be that as it may, doing sets for a specified amount of time can be tricky and tedious. But you can use the aforementioned time frames to formulate repetition ranges. Suppose that you prefer to use a speed of movement that's six seconds per repetition. Dividing six seconds into the time frames that have been noted yields the following repetition ranges: 15-20 for your hips, 10-15 for your legs and about 6-12 for your torso. (A minimum of 8 repetitions is recommended for torso exercises that have a short range of motion). Remember, these ranges are based on six-second repetitions. Different repetition speeds require different repetition ranges. Suppose that you prefer to use a speed of movement that's 10 seconds per



Clearly, how well you lift a weight is more important than how much weight you lift. (Photo by Matt Brzycki.)



A repetition should be done throughout the greatest possible range of motion that safety allows. (Photo by Kim Piche.)

repetition. Dividing 10 seconds into the time frames that were mentioned earlier results in the following repetition ranges: 9-12 for your hips, 6-9 for your legs and about 4-7 for your torso. (You're encouraged to experiment with different repetition speeds and vary them based on your personal preferences.)

A final point: it's safer for certain populations to perform more repetitions than have been suggested in order to reduce orthopedic stress. Slightly higher repetition ranges are recommended for younger teenagers and older adults (particularly those with hypertension) along with anyone doing rehabilitative training. For example, repetition ranges might be 20-25 for exercises involving the hips, 15-20 for the legs and 10-15 for the torso. These higher repetition ranges necessitate using somewhat lighter weights which reduces the orthopedic stress placed upon the bones and connective tissues.

Proper Technique

The technique that you use to perform your repetitions is critical to the success of your strength-training program. Clearly, how well you lift a weight is more important than how much weight you lift.

A repetition has four checkpoints: the positive (or raising) phase, the mid-range position, the negative (or lowering) phase and the range of motion.

Checkpoint #1

A repetition starts with the raising of the weight. You should raise the weight in a deliberate, controlled manner without any explosive or jerking movements.

Raising a weight in a rapid, explosive fashion isn't recommended for two main reasons. First of all, high-speed repetitions that are performed in a ballistic manner are actually less productive than low-speed repetitions that are performed in a controlled manner. Here's why: when weights are lifted explosively, the muscles produce tension during the initial part of the movement . . . but not for the last part. In simple terms, the weight is practically moving by itself. In effect, the load on the muscles is decreased – or eliminated – and so are the potential gains in muscular strength.

As an example, imagine that you raised the weight so quickly on a leg-extension machine that the pad left your lower legs partway through the repetition. Think about it: The pad is attached to the movement arm of the machine that, in turn, is connected to the resistance by some means (such as a chain, cable or belt). If the pad is no longer in contact with your lower legs, there's no load on your muscles. If there's no load on your muscles, there's no stimulus – or reason – for them to adapt. Sure, you will obtain

some benefit when your muscles were loaded during the first part of the repetition (when the pad was against your shins). However, you will not obtain any benefit when your muscles were unloaded during the last part of the repetition (when the pad left your shins).

Secondly – and more importantly – high-speed repetitions also carry a greater risk of injury than low-speed repetitions. Raising a weight too fast increases the shearing forces encountered by a given joint; the faster a weight is raised, the higher these forces are amplified. In one study, a subject who squatted with 80% of his four-repetition maximum incurred a 225-pound peak shearing force during a repetition that took 4.5 seconds to complete and a 270-pound peak shearing force during a repetition that took 2.1 seconds to complete. This is clear evidence that a slower speed of movement reduces the shearing forces on joints. When the forces exceed the structural limits of a joint, an injury occurs to the muscles, connective tissues or bones. To ensure that your repetitions are safe and productive, it should take at least 1-2 seconds to raise the weight to the mid-range position.

Checkpoint #2

After raising the weight, you should

pause briefly in the mid-range position where the muscle is fully contracted. Where's the mid-range position of a repetition? These two examples should help make it clear: when performing a leg extension, the mid-range position is where your legs are completely extended (or as straight as possible); when performing a bicep curl, the mid-range position is where your arms are completely flexed (or as bent as possible).

Most people are very weak in the mid-range position of a repetition because they rarely, if ever, emphasize it. Pausing momentarily in the mid-range position allows you to focus your attention on your muscles when they're fully contracted. Furthermore, a brief pause in the mid-range position permits a smooth transition between the raising and lowering of the weight.

Checkpoint #3

A repetition ends with the lowering of the weight. The importance of emphasizing the negative phase of a repetition cannot be overstated. Numerous studies have reported that repetitions involving both raising and lowering a weight produce greater increases in strength than those involving just raising.

Remember, the same muscles that are used to raise a weight are also used to lower it. In a bicep curl, for example,

Intensity

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your biceps are used in raising and lowering the weight. The only difference is that when you raise the weight, your biceps are shortening against the load and when you lower the weight, your biceps are lengthening against the load. So by emphasizing the lowering of the weight, each repetition becomes more productive. Because a “loaded” muscle lengthens as you lower a weight, emphasizing the negative phase of a repetition also ensures that the exercised muscle is being stretched properly and safely.

In any given exercise, you can lower more weight than you can raise. It stands to reason, then, that the lowering of the weight should take more time to complete than the raising of the weight. To ensure that your repetitions are safe and productive, it should take at least 3-4 seconds to lower the weight back to the starting position.

Effectively, it should take at least 4-6 seconds to perform a productive repetition. In one study, subjects who raised the weight in two seconds and lowered it in four seconds increased their upper-body strength by 50% and their lower-body strength by 33%. Furthermore, two additional studies reported average increases in muscular strength of 55% in 17 subjects and 58.2% in 31 subjects. In both of these studies,

the subjects used the same six-second guideline to raise and lower the weight.

Checkpoint #4

A repetition should be done throughout the greatest possible range of motion that safety allows, from a full stretch to a full muscular contraction and back to a full stretch. Doing your repetitions throughout a full range of motion will allow you to maintain (or perhaps increase) your flexibility. Moreover, it ensures that you’re stimulating your entire muscle – not just a portion of it – thereby making the repetitions more productive. Clearly, doing full-range repetitions is a requirement for obtaining full-range effects.

Duration of the Workout

When it comes to strength training, more isn’t necessarily better. If you lengthen the duration of your workout – by increasing either the number of exercises or sets that you normally perform – you must reduce your level of intensity. And, of course, using a lower level of intensity isn’t desirable.

It’s important to note that carbohydrates are your preferred fuel during intense activity. Carbohydrates circulate in your bloodstream as glucose and are stored in your liver and muscles as glycogen. Most people exhaust their carbohydrate stores



after about one hour of intense activity. For this reason, your strength training should be completed in approximately one hour or less. (Note that this one-hour window of time will dictate the number of exercises and sets that you can perform in your workout.)

The exact duration of your workout depends upon several factors such as the transition time to prepare for each exercise/set (such as changing plates, moving pins and so on) and the recovery time between each exercise/set. Generally speaking, however, you should be able to complete your workout in no more than about one hour.

You can make your workouts more efficient – and more intense – by taking as little recovery as possible between exercises/sets. The length of your recovery interval depends upon your current level of fitness. Initially, you may require several minutes of recovery between exercises/sets to “catch your breath” or feel that you can produce a maximal level of effort. With improved fitness, your pace can be quickened to the point where you’re moving as quickly as possible between exercises/sets. (The speed with which you do your repetitions shouldn’t be quickened – just the pace between exercises/sets.)

Volume of Exercises

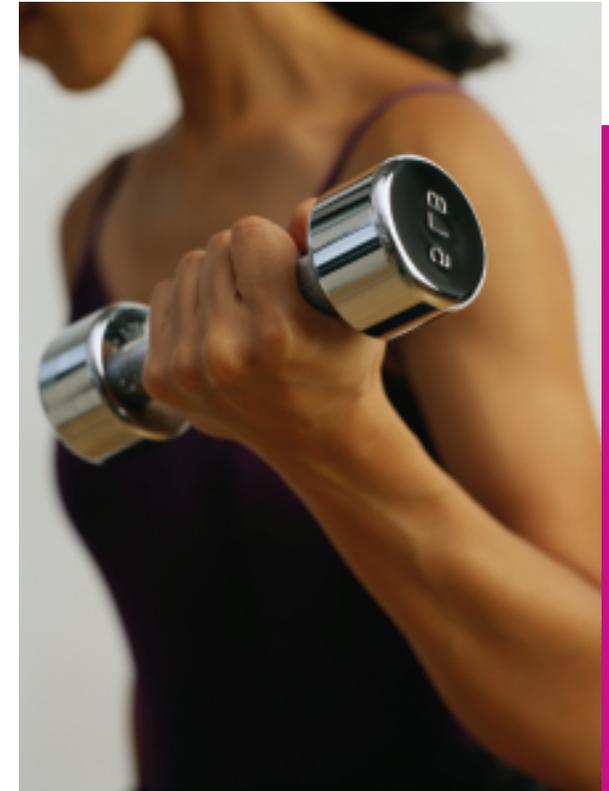
Most people can perform a comprehensive, total-body workout using 14 exercises or less.

The focal point for most of these exercises should be your major muscle groups (that is, your hips, legs and torso). Include one exercise for your hips, hamstrings, quadriceps, calves/dorsi flexors, biceps, triceps, abdominals and lower back. Because your shoulder joint allows movement at many different angles, you should perform two exercises for your chest, upper back (your “lats”) and shoulders. You can choose any exercises that you prefer in order to address those body parts.

For some “weekend warriors,” a thorough workout may require slightly more than 14 exercises. For instance, if you participate in a sport or activity that requires grip strength – such as softball or golf – your workout should include one exercise for your forearms.

Once again, more isn’t necessarily better when it comes to strength training. Performing too many exercises can produce too much stress which will impede progress. A total-body workout that contains 20 exercises could be devastating for someone who has a low tolerance for strength training. And the more exercises that you perform, the more difficult it will be for you to maintain a desirable level of intensity.

This is not to say that you cannot do an extra exercise or two in order to emphasize a particular body part. As long as you continue to make improvements in your strength, you aren’t performing too many exercises. So if





your workout consists of 20 exercises and you're making progress, then you aren't overtraining. But if you start to level off or "plateau" in one or more exercises, it's probably because you're overtraining – the volume of your training has exceeded your ability to recover.

Sequence of Exercises

The order in which you perform your exercises is essential in producing optimal improvements in your muscular strength. As a rule of thumb, the idea is to train your most important muscles as early as possible in your workout. It stands to reason that you should address those muscles while you're fresh, both mentally as well as physically. In effect, your workout should begin with exercises that influence your largest muscles and proceed to those that involve your smallest ones.

In a total-body workout, the best order of exercise would usually look like this: hips, upper legs (hamstrings and quadriceps), lower legs (calves or dorsi flexors), torso (chest, upper back and shoulders), upper arms (biceps and triceps), abdominals and finally your lower back. If performed, exercises for the lower arms (the forearms) would be done after those for the upper arms.

If you prefer to do a "split routine" – in which you "split" your body parts into several workouts instead of one total-body workout –

the aforementioned order of exercise would still apply. In a workout that only targeted the chest, shoulders and triceps, for example, you should still address those body parts from largest to smallest.

Frequency of Training

Intense strength training places great demands upon your muscles. In order to adapt to those demands, your muscles must receive an adequate amount of recovery between your workouts.

Adaptation to the demands occurs during the recovery process. Believe it or not, your muscles don't get stronger during your workout . . . your muscles get stronger after your workout. If the demands are of sufficient magnitude, a muscle is literally torn. Although these tears are quite small – microscopic, in fact – the recovery process is essential in that it allows the damaged muscle enough time to repair itself. Think of this as allowing a wound to heal. If you had a scab and picked at it every day, you'd delay the healing process. But if you left it alone, you'd permit the damaged tissue time to heal. So in a sense, the recovery following a workout is a process in which damaged tissue – in this case, muscle tissue – is healed.

There are individual variations in recovery ability – everyone has different tolerances for exercise. However, a period of about 48-72 hours is usually necessary for muscle tissue to



recover sufficiently from an intense strength-training workout. As a result, it's suggested that you perform strength training 2-3 times per week on nonconsecutive days such as on Monday, Wednesday and Friday. (Note that this assumes total-body workouts.)

Can you achieve significant improvements in strength by doing just two weekly workouts? Absolutely. In a study that involved 117 subjects, a group that trained two times per week experienced approximately 80% of the gains in strength of the group that trained three times per week.

An appropriate frequency (and volume) of strength training can be likened to doses of medication. In order for medicine to improve a condition, it must be taken at specific intervals and in certain amounts. Taking medicine at a greater frequency or in a larger quantity beyond what's needed can have harmful effects. Similarly, an "overdose" of strength training – in which workouts are done too often or have too much volume – can also be detrimental. Performing any more than three "doses" of total-body workouts per week will gradually become counterproductive.

How do you know if your muscles have had an adequate amount of recovery? You should see a gradual improvement in the amount of resistance and/or number of repetitions that you're able to do over the course of several weeks. If not, then you're probably not getting enough recovery

between your workouts (which, again, could be the result of performing too many sets or too many exercises). Remember, strength training will be effective if it provides an overload not an overdose.

Record Keeping

If your strength training is to be as productive as possible, it's absolutely critical to keep written records that are as accurate and detailed as possible. Records document the history of what you accomplished during each and every exercise of each and every strength session. Because of this, maintaining records is an extremely valuable tool to monitor your progress and make your workouts more meaningful. Records can also be used to identify exercises in which you've reached a plateau. In the unfortunate event of an injury, you can also gauge the effectiveness of the rehabilitative process if you have a record of your pre-injury levels of strength.

You should record your bodyweight, the date of each workout, the resistance used for each exercise, the number of repetitions performed for each exercise and the order in which the exercises were completed. The bottom line: Don't underestimate the importance of using a workout card in making your strength training more productive and more meaningful.





Of interest...

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