Developing Strength - How it Works, and What to Do to Make it Work for You

By **EthanaelD**

Any athlete knows that there is always a constant struggle to continue becoming stronger. An athlete must continue to surpass himself, or risk being surpassed by his competition. Words to live by: Never think yourself complete. There is always something that can be improved upon, even in elite athletes--no athlete is as strong or conditioned as they can be, as technically sound as they can be, or as experienced as they can be. Technical soundness and experience are oftentimes mutually exclusive--technique is developed over time. Time yields experience to the athlete. For now, let's focus on strength, and how we become strong.

Takeaways

- There are different qualities of strength.
- There are different ways to train each quality.
- There are ways to enhance each quality while adding muscle mass, or without adding muscle mass.

Part 1: The Ways the Body Powers Itself

The body powers itself through processes involving various energetic compounds. Among them: adenosine triphosphate, creatine phosphate, glucose, glycogen.

During the phosphagen system, when adenosine triphosphate breaks down into adenosine diphosphate, creatine phosphate yields a phosphate group to adenosine diphosphate, and it becomes adenosine triphosphate again, meaning that it can be again used for muscular exertion. Adenosine triphosphate is the nucleotide, adenine, and ribose, bound with three phosphate groups. It is made in the mitochondria from glucose, and is the molecule that powers the body.

This is referred to as the ATP-CP cycle: the breakdown of ATP and the use of CP to "refuel" ADP into ATP so your muscles can continue to contract hard. The phosphagen system begins when the muscles need to undergo brief, intense bouts of an exercise. The phosphagen system usually takes effect during such activities as sprinting or intense, low-repetition weightlifting, where it is a sudden, all-out exertion of the muscles. The phosphagen system best takes place over the course of about 10 seconds; beyond that, most of the creatine phosphate available has been expended, and there is no extra "fuel" for the muscles.

The glucose-lactic acid system is another system that works using the components of the muscle to generate force. It is undergone when the muscle is exerted intensely over a moderate period of time: about a minute and a half. During this process, glucose is converted quickly into ATP anaerobically, and lactic acid is the result. The metabolism must be anaerobic, because at the intensity the muscles are exerting themselves, oxidative capacity is just not high enough in the muscle cell.

Glycogen plays a large part for the endurance athlete, or the athlete that requires the ability to be able to continue his activity for an extended period of time, or exhibit muscular strength for an extended period of time. When the activity can be performed for longer a time than would necessitate the glucose-lactic acid system to kick in, there is enough oxygen available for aerobic respiration. Glycogen is the usable form of glucose and is found in the muscles and the liver. During aerobic respiration, the muscle can acquire energy more easily and through a wider variety of means. It can pull it from the bloodstream, as from the intestines, from food one has eaten. It can use the remaining glycogen in the muscle. It can also get glucose from the breakdown of the liver's glycogen stores (this is referred to as gluconeogenesis).

Part 2: The Factors Resulting in Strength

Strength is a product of many different qualities: Physiological factors, neurological factors, and mechanical factors.

Physiological factors include the size of the muscle, physiological cross sectional area (referred to often as PCSA or simply CSA), availability of crossbridging, the types of muscle fibers present (Type I, Type IIa or Type IIb), the muscle's response to training stimulus, and more. Such physiological factors also include the moisture content of the muscle and the muscle's ATP stores, CP stores, and available glycogen. ATP is adenosine triphosphate. It is the body's unit of energy. When we exert our muscles, adenosine triphosphate loses phosphate groups, degrading into adenosine diphosphate or adenosine phosphate. CP is creatine phosphate. More on that a little bit later.

Mitochondria is also an important factor in considering the physiology of a muscle. Mitochondria is the "fueling station" for your muscle cells. It is where glucose is converted into adenosine triphosphate. Contrary to popular belief, glucose is not the body's pure fuel--it has to be broken down first. Yes, it is the easiest sugar to break down, but it itself does not directly fuel the cells of the body. If a lot of mitochondria is present in a muscle fiber, it can break down glucose into ATP rapidly and use it to contract and exert the muscle strongly.

Neurological factors are those such as the muscle-nervous system connection that results in utilization of motor neurons and causes synapses to fire when a force is exerted from the muscle. Some training techniques rely on the ability of the neuromuscular link strengthening under frequent exposure to a stimulus in an attempt to become more efficient at firing the pattern of synapses that will allow one to exert more force in a particular movement. In other words, "practice makes perfect".

There is also mechanical strength, which is essentially beyond our control--this is attributed to the genetic configuration of one's musculature: leverage, limb length, placement of tendons, and similar factors. If you have ever noticed how between a taller person and a shorter person arm-wrestling the shorter person often wins or at least presents a surprisingly difficult struggle to the taller person, it is because of the shorter person's mechanical strength; their limbs are shorter, therefore they have more leverage over the taller person's longer limbs. The shorter limbs do not have to travel as far in order to exert the same force that the taller person's limbs do, though due to the effect of cross-sectional area on one's strength, physiologically, the shorter limbed person will not always win. In theory, between two people of identical cross-sectional area and neurological strengths, of different heights, the person of lower stature will always win due to the advantage of their leverage.

Part 3: The Different Types of Strength

So, factors affecting strength aside, what kinds of strength are there? You have probably noticed that an individual expressing the strength to benchpress 300 pounds may not necessarily be able to exert the strength to complete 100 repetitions of strict-form pushups (also known as pressups). Likewise, an individual expressing the ability to be able to complete 100 repetitions of strict-form pushups may not necessarily be able to benchpress 300lbs. (These numbers are completely fabricated and used for an example--so don't get upset if you can or can't do both or either of the aforementioned feats.)

It would appear that there are two types of strength--the ability to exert a lot of force a few times, and the ability to exert a smaller force many times. This is correct...sort of. There are actually three main types of strength: maximal, explosive, and endurance, though there debatably are some subclasses of strength, such as speed-strength or explosive-endurance; we won't worry about those, as they are terms to describe the actions of an athlete, not terms to describe the mechanisms of the muscle itself.

a) Maximal strength is the measure of the maximum amount of force a muscle can generate. This would be what the 300lb-benchpresser was manifesting; the ability to exert a maximal amount of force from his muscles (lifting the heavy weight successfully). Maximal strength is sometimes referred to as "starting strength" or "limit strength". When someone asks you, "Hey, buddy, what's your one-rep max?" he or she is assessing your maximal strength. There are two parts to maximal strength--two "phases"--in the completion of a rep; concentric contraction and eccentric contraction. Let's use the example, now, of a simple bicep curl. The concentric phase would be contracting your bicep, generating the force to move it up towards your shoulder. The eccentric phase would be when you lower the weight back down to the starting position. An individuals eccentric strength is always greater than their concentric strength, meaning that a person will always be able to controllably lower a weight heavier than that which they could controllably lift. Maximal strength originates in the fast-twitch muscle fibers, Type II muscle fibers.

Type II muscle fibers are fast-twitch. They are responsible for explosive and maximal movements. That's right, ladies and gentlemen--those slow-grinding maximal-strength movements actually come from fast-twitch muscle fibers, not slow-twitch, as many old-school trainers might have you believe. The term "fast-twitch" refers to the way the muscle breaks down ATP (adenosine triphosphate) inside the myosin head of the contractile protein, as a result of the enzyme myosin-ATPase. This results in a low resistance to fatigue (the fiber reaches failure "fast"), but the ability to generate larger amounts of force. This kind of exercise would utilize the phosphagen system. There are two types of Type II muscle fibers; Type IIa and Type IIb. Type IIa is most often utilized in maximal strength exercises.

b) Explosive strength is a concentric muscular exertion in which the initial rate of force generation is maximal or nearly maximal and is maintained throughout the range of motion. Examples of explosive strength include Bruce Lee's one-inch punch. It is the intense, focused effort of pushing as hard and as fast as possible from a standstill. Explosive strength utilizes the violent cousin of Type IIa muscle fibers--Type IIb.

Type IIb has a contraction time of about 7.5 milliseconds, and the contraction is the strongest contraction of all the other types of muscle fibers, and is very, very easily fatigued. They do not have much mitochondria at all; the least of any muscle fiber. They also have very little myoglobin. However, as you may have guessed, their levels of myosin-ATPase are the highest of any muscle fiber as well. Type IIb muscle fibers mostly rely on anaerobic respiration--the phosphagen system, from earlier.

c) Strength-endurance is the ability to exert a submaximal force many times. The guy that was doing 100 repetitions of pushups? He was exhibiting strength-endurance. Strength-endurance originates in Type I muscle fibers.

Type I muscle fibers are slow-twitch; they have high resistance to fatigue, lots of mitochondria, but they are lacking in the way of myosin-ATPase, which would allow them to generate a lot of force. Type I muscle fibers usually rely on aerobic respiration, except when the activity is so rapid it exceeds the oxidative capacity of the

muscle. When that happens, depending on the circumstances, the muscle may move to the glucose-lactic acid system for energy. An example of that might be performing as many pushups as you can in a minute--it's still a lot of repetitions, and what's more, you're exerting rapidly. This would likely result in a switch to the glucose-lactic acid system for energy.

Part 4: Types of Development
There are two ways to develop the qualities of strength; as discussed earlier, there are three factors: physiological, mechanical, and neurological. The mechanical factors we can not alter without reconstructive surgery--but I'm just kidding. Do not get surgery or, worse, perform surgery on yourself, trying to enhance your athletic ability. The physiological and the neurological are the two things we can control, and they can give one the advantage even over one who might have a mechanical advantage naturally.

a) Physiologically, there are two ways to gain strength: myofibrillar hypertrophy, and sarcoplasmic hypertrophy. These terms may be alien to some readers, so definitions:

Myofibrillar hypertrophy is a term to describe the growth of the myofibrils of the muscle.

Sarcoplasmic hypertrophy is a term to describe the growth of the sarcoplasm of the muscle.

Now, an analogy: If the muscle cell was a jelly donut, the sarcoplasm would be the jelly, and the myofibrils would be the donut. It is the "jelly" that can helps make your muscle stronger and more able to contract forcefully. The sarcoplasm is more or less just the contents of the myofibril--it allows for more capillarization, which is a good thing. Capillarization means more oxygen getting to the muscles, which means it is easier for them to sustain prolonged activity due to increased oxidative capacity. However, sarcoplasmic hypertrophy will not really increase any particular strength quality. Myofibrillar hypertrophy is what you will want, if you are an athlete. Capillarization will result from your cardiovascular training--more on that later. Sarcoplasmic hypertrophy is what bodybuilders often train for; the hypertrophy of the sarcoplasm results in bigger, harder muscles. But those bigger, harder muscles might be weak and have the contractile strength of a piece of bologna--it's mostly for show. And it goes alright with mustard. But this isn't about mustard. Myofibrillar hypertrophy still results in bigger, harder muscles, but it will not cause the muscles to get as big or as hard as fast as would sarcoplasmic hypertrophy. Myofibrillar hypertrophy, however, is the more "functional" of the two hypertrophies, and, pound for pound, you will be stronger (overal than one who has been training for sarcoplasmic hypertrophy. Generally, however, when one is training for hypertrophy, the hypertrophy experienced is a combination of sarcoplasmic and myofibrillar, though several factors affect which form of hypertrophy is dominant. More on that later.

b) Neurologically, one can "teach" the muscles how to most efficiently fire so as to be able to perform the greatest quantity or intensity of whatever activity you "teach" it. This occurs in a process called neuromuscular facilitation, also sometimes called synaptic facilitation. This is the "practice makes perfect" application. The more you do something, the better you get at it. This isn't just a witty saying or a philosophical meandering. Neurologically, it's true. If one were to be able to do 100 pushups before reaching muscular failure (once again, using the pushups example.), and that individual were to do 60 pushups every few hours for two weeks, and then take a day off and re-test the maximum number of pushups they could do, they would discover they could do more than they could before. This is a result of neuromuscular or synaptic facilitation. When you do something very frequently, your body will learn how to do it better. This technique of performing your activity very frequently need not be limited to pushups, or even high-repetitions. It can be utilized for maximal force generation (maximal strength), explosive strength, and other things, in a particular movement. That is, the motor "path" of benchpressing 300 pounds once may be different than the motor path of doing weighted pushups with 300 pounds--therefore, one who uses neuromuscular facilitative techniques to increase their ability to benchpress might not necessarily be increasing their ability to do heavily weighted pushups simultaneously, even though many of the same muscle groups are involved--because the motor path is different. Neuromuscular facilitation is a good way to develop the ability to perform specific movements.

5) Rep Ranges and Developing Strength

a) Physiologically, hypertrophy is the way to go. For the athlete, you will probably want to hypertrophy myofibrillarly, as you will get the most overall relative strength for your size. Now, we get into the nitty-gritty of training; volume, resistance, load, reps, sets, rest time. All these things will affect the way your muscles physiologically adapt to your training stimulus.

Completing 1-3 reps using a resistance of about 90%-100% of your one-rep max will facilitate the development of maximal strength by increasing the contractile ability of the muscle, in part due to neuromuscular adaptation (do not be confused and think that this means that 1-3 reps at 85%-100% constitutes "neuromuscular facilitation"; more on that later.). There will not be very much hypertrophy, unless a large amount of volume is included--more on that later.

Completing 4-6 reps using a resistance of about 80%-90% of your one-rep max will facilitate the development of maximal strength by a combination of increasing the contractile ability of the muscle through neuromuscular adaptation and some myofibrillar hypertrophy, though not much. More hypertrophy will occur in the 4-6 at 75%-85% rep range than occurs at the 1-3 at 85%-100% rep range.

Completing 7-9 reps using a resistance of 75%-80% of your one-rep max will result in maximal strength development, mostly myofibrillar hypertrophy, not very much neuromuscular adaptation, and a little bit of sarcoplasmic hypertrophy. It is most often thought that 7-9 reps at 75%-80% will result in the most maximal strength development of any of the other rep ranges.

Completing 10-12 reps using a resistance of about 70%-75% of your one-rep max will result in less maximal strength than the lower rep ranges, but more hypertrophy. At this point, about 90% of the maximal strength development is due to myofibrillar or sarcoplasmic hypertrophy, and almost none of it due to neuromuscular adaptation. In this range, you will begin to develop muscular strength-endurance.

Completing more than 13-20 reps using a resistance of 60%-70% of your one-rep max or less will result in the development of a blend of muscular strength-endurance and maximal strength via hypertrophy; however, it is important to note that here, the hypertrophy is dominantly sarcoplasmic, meaning that working in this range will cause you to "puff up". It will also mostly increase your muscular strength-endurance rather than maximal strength.

Completing an upwards of 20 reps using a resistance of 60% or less will result in strength-endurance and less and less muscular hypertrophy of any kind as you adapt to complete more and more repetitions. At this range, most of the changes going on inside the muscle cells will be metabolic.

b) Neurologically, as it has been explained before, some neurological adaptations will occur when your muscles contract against a resistance. The lower the rep range, the more the adaptations within the muscle will be neurological in nature--neuromuscular adaptations. So what about neuromuscular (synaptic) facilitation? Neuromuscular facilitation is a technique popularized by Pavel Tsatsouline, and it has been applied by many powerlifters for years without knowing it. For powerlifters, it essentially works like this:
Lift a weight that is about 90% of your one-rep max once or twice; do not go to muscular failure (not being able to complete another repetition). Wait several minutes. Complete another set. Repeat several times. In this way, you are incorporating volume and neuromuscular adaptation while giving a lot of rest time. This causes the neuromuscular connections to become stronger and stronger, due to repeated exposure. You are easing your way into lifting heavier and heavier weight as your nervous system becomes more geared towards lifting that heavy weight. Talking about neuromuscular adaptations, volume, and all that mess is best left to another section, so:
There are, however, ways to incorporate the synaptic facilitation method into a strength-endurance program; this will be covered shortly.

c) What about sets? Rest time? And volume?

It is important in designing your strengthening program to consider your goals. Do you want to get big and strong? Just strong? Just big? Depending on your answers to these questions greatly affects how you should incorporate rest time, different numbers of sets, and other things.

Volume is essentially just a consideration of how many reps you are completing, total, throughout your sets. The term is most often used with regards to maximal strength development, but can be applied to the development of any strength quality. If one were to complete 10 sets of 3 reps, the volume would be 30. If one were to complete 3 sets of 10 reps, the volume would also be 30. Generally speaking, the higher the volume, the more hypertrophy will occur.

Incorporating rest time can act as a "buffer" of sorts against gaining a lot of hypertrophy through volume.
The key to hypertrophy is a lot of volume in a short amount of time.
1-2 minutes is considered a short period of rest; 3-4 minutes is moderate; 5 or more minutes is a higher amount of rest.
If one were to complete 5 sets of 1 rep at their one-rep max, 100%, with 5 minutes of rest time between sets, they would not hypertrophy as much as if one were to complete 5 sets of 1 rep at their one-rep max with 3 minutes of rest time between sets. This is because the volume is the same, and the time it takes to complete that volume is lower. However, the more rest time is allowed, the more maximal strength will develop.
To go a step further, one who completes 10 sets of 1 rep at their one-rep max with 3 minutes of rest between sets will hypertrophy more than either of the two prior mentioned examples. An individual who completes 10 sets of 1 rep at their one-rep max with 5 minutes of rest between sets will hypertrophy less than the 10x1x1x3 minutes individual, but will experience greater strength gains.
As you can see, a lot of rest time is essential to maximal strength development, and not as much rest time is essential for hypertrophy. It is something of a continuum. The more rest time, the less hypertrophy, the more strength development. The less rest time, the more hypertrophy, the less strength development.

So, in terms of maximal strength, more sets and more reps and less time will result in more hypertrophy than fewer sets and fewer reps and more time, but the latter will

yield more maximal strength development than the former.

These are just the basics, however; there are many different rep schemes and techniques for playing with reps and sets and rest time and volume and all these things in order to result in a variety of different effects on strength development. There are many different theories.

But for now, a few solid things that have been established to work.

3 sets of 3 reps with 90% of your one-rep max with 6 minutes of rest between sets is an effective way to increase maximal strength through neuromuscular adaptation without much hypertrophy--though what hypertrophy does occur will be almost completely myofibrillar.

5 sets of 5 reps with 85% of your one-rep max with 5 minutes of rest between sets is an effective way to put on some muscle mass through myofibrillar hypertrophy and a lot of maximal strength, due to the nature of the 5-rep 85% set; it is one of the most efficient ways to get bigger and stronger in closer proportion than many other programs.

3 sets of 10 reps with 75% of your one-rep max with 3 minutes of rest between sets is an effective way to put on muscle mass via sarcoplasmic hypertrophy. You will gain a little bit of maximal strength and a little bit of strength-endurance, but nothing really to shake a stick at--so to speak.

3 sets of 20 reps with 60% of your one-rep max with 3 minutes of rest between sets is an effective way to put on a good amount of strength-endurance, with a little bit of hypertrophy. The hypertrophy will be a blend between myofibrillar and sarcoplasmic, but there is no concern over this, as the amount of hypertrophy generally experienced is so small it is of no consequence.

These examples do not cover all the qualities of strength, but these exampls were not intended to; the intent of their inclusion in this section was merely to introduce volume, sets, reps, load, and program creation so we can address it more completely a little later on.

6) The Main Muscle Groups of the Body
If you're reading this, it's most likely you already have an interest in the human body, or athleticism, or otherwise have at least some knowledge of the different muscles of the body. For that reason, this section will be short(ish) and sweet (but don't expect a love poem). From the head to the toes, the main muscles of the body:

Neck muscles: These are the muscles of the neck. They're used to keep your head upright, and control the movement of the head. For combat athletes, the neck muscles are of particular importance; when you are struck in the head, the neck muscles stabilize the head so it doesn't snap back--which would result in a knockout--or snap off--which would result in death.

Pectorals: The muscles of the chest; the muscles involved in the benchpress, pushups, and just about every movement involving the upper body to some degree.

Upper back: The part of the back opposite the pectorals; it, too, is involved in almost every movement involving the upper body.

Deltoids: The three-headed muscle at the top of your arms. Its heads are referred to as the anterior, posterior, and the lateral. The anterior deltoid is used when you raise your arm straight up in front of your body. The posterior is using when you raise it to the side of your body. The lateral is used when you bring your hand across to the side of your body, such as when you slap someone with one hand on the opposite cheek.

Triceps: The triceps are on the back of your arm, the backside of the length of your arm between the deltoids and the forearm. They are involved in many upper-body motions, such as the benchpress, pushup, and punching. This is that "horseshoe" muscle on the arm that some of you may be familiar with. It's infamous.

Biceps: Oh, the biceps. The muscles involved in motions such as curls, lifting things with your palm out, pullups, chinups, and many overhead movements to some extent. They are a two-headed muscle, and are often thought of as a "beach-body" muscle, however they serve a very important purpose to any athlete. If nothing else, they stabilize the triceps; if the biceps are far underdeveloped and the triceps are well developed, you will have an imbalance, and injury is more likely to occur. Also, in some cases, underdeveloped biceps can actually inhibit the triceps from generating as much force as they could, because the nervous system naturally limits the load the triceps are allowed to bear, because its not stabilized by the biceps.

Core: There are way too many muscles that can be considered part of the "core" to constitute individual namings, but the main ones are the rectus abdominus (the "six-pack" muscle), the obliques (on the sides of the "six-pack"; there are two types, the internal obliques and the external obliques), the transverse abdominus (a postural muscle behind the rectus abdominus), and the lower back (which balances with the rectus abdominus and transverse abdominus to promote good posture). The core is full of stabilizing muscles and is involved to some degree in every move you make with the arms or legs. If you have a weak core, it will show in everything you do. You will be unable to generate much force with any other muscle of your body, and you will not be able to rotate strongly. (This is especially important for fighters--for ground fighters, the core enables you to throw your opponent and take side control, or maneuver out of a mount. For a striker, the core provides power to your kicks and punches due to rotation. "Torque", so to speak. It has been figured that about 80% of a striker's power originates in the core muscles.)

Quadriceps: The uppermost muscle of your leg. When you squat down, this is the main muscle engaged. When you run, this muscle is also engaged as you push off the ground. It's used when you kick, run, jump, and almost every other movement in which the legs are involved.

Hamstrings: The muscle directly behind the quadriceps, above the knee. It's very important for stabilization of the quadriceps, but is one of the most underappreciated muscles around. It helps keep the knee and entire leg in proper alignment, and if that isn't enough, it performs many of the same actions that the quadriceps do: it helps you run, jump, kick, and more.

Calves: That little muscle above your foot that you feel has about a dozen knives lodged in it somewhere after you've run more than you have in a long time. It's a muscle made mostly of slow-twitch muscle fibers--the calves are built for endurance.

7) Training the Different Qualities of Strength
Luckily, you understand volume, load, the nature of muscles, and all these things. This makes building a training program much easier.

Consider the three main qualities of strength: maximal strength, strength endurance, and explosive strength.

The body adapts to the given stimulus; if you want to lift heavier things, lift heavier things. If you want to lift heavy things many times, lift heavy things many times. But what about explosive strength?

a) Explosive strength is a rather unique quality, in that it was not really understood very well until the past 50 years or so. Athletes have been doing pushups and pullups and squats and lifting heavy objects in pursuit of enhanced maximal strength or strength-endurance (though they didn't necessarily call them by these names at the time) for hundreds upon hundreds of years.

Recently, it came into light that when one's muscles learn how to absorb shock via forceful, eccentric contractions, and then using the retained force to "spring" the resistance back up, they get better at reacting explosively--being able to generate a lot of force in a very short period of time. Essentially training for explosive strength is training to engage Type IIb muscle fibers. How do you do this?

Plyometrics. Things like clapping pushups, jump-squats and the like. A plyometric is commonly defined as any exercise in which the amount of force generated is such that the individual performing the exercise exceeds the force of gravity. For example, pushing up so hard that you are able to clap your hands together once, twice, or even three times, before you land back on the ground. Generally, plyometric movements are done in sets of 10 or so, not to failure, ever. Because plyometric movements typically work only with bodyweight or very light weight, but are never worked more than a handful of repetitions, they typically do not impart mass, unless done in high volume. However, high-volume plyometrics are a bad idea due to increased risk of injury (as plyometrics put a larger than normal amount of strain on the joints and tendons), as well as diminished gains.

There are other techniques for training explosive strength, such as Dr. Yuri Verkhoshansky's Shock Method, which is something of an extension on conventional plyometrics. In the Shock Method, the athlete will lift a heavy weight, around 85%-95% of their one-rep max, rest, then perform a set of plyometric exercises that use the same or mostly the same muscle groups. Doing this results in the ability to exceed the normal amount of explosive (plyometric) strength one can normally exhibit, as the heavy set "primes" the nervous system to exert a large amount of force.
For example, one might squat 300lbs for one or two reps, rest five minutes, and then perform ten jumping squats, rest five minutes, and repeat two to three times. This method does, in fact, take longer to perform, but will yield much higher gains in explosive strength than would conventional plyometric training.

b) Maximal strength is a bit simpler. To develop purely maximal strength, lift several sets of one to three reps at 85%-95% of your one-rep max with several minutes of rest in between. You will want to fully recover in between sets, and be as fresh as possible when you start. This will result in the maximum amount of strength gain possible, and will result in very little mass.

But that's just the physiological way to increase muscular maximal strength.

Neuromuscularly, we can use the synaptic facilitation method. This method is not practical for just about everyone, but it can work if applied properly. The recipe for synaptic facilitation is this: frequency + intensity + freshness. Train as often as you can while being as fresh as you can, and lifting heavy weight each time. You'd only want to do one set of each movement per session when doing the synaptic facilitation method.

You will want to train several times a day; probably every 3-4 hours. Simply complete one heavy set (1-3 reps, 85%-95% of your one-rep max) of each of your movements, and then go do whatever it was you were doing before you started, and come back a few hours later to do the same thing. Slowly, you will be able to lift more and more weight.

c) Strength-endurance, too, is not as diffcult to train for as explosive strength. Strength-endurance is possibly one of the most widely used measures of physical fitness, perhaps because one can perform a wide variety of exercises using one's own body weight for which many repetitions may be completed.
In terms of the evolution of humankind, we are strength-endurance creatures. Our ancestors who tried to compete hand-to-hand with the raw power of wild animals died quickly, leaving those who could outlast the competition to survive and reproduce. This is the reason that our deltoids as well as our calves and a few other muscles contain mostly Type I muscle fibers--the kind that endure. If our ancestors' calves had been mostly Type II fibers, they wouldn't have been able to run long distances or travel for extended periods of time without having to rest from muscular fatigue.

To train for strength-endurance, it is fairly easy: simply perform a lot of repetitions of an exercise of your choosing, and cover the chosen muscle groups. One-hundred pushups, one-hundred squats, twenty pullups, whatever your goals are. It is possible for you to train to muscular failure when training for strength-endurance and still see large gains. Arguably, strength-endurance is easier to train for than maximal strength.

There is some debate over whether or not doing as many repetitions as possible is more effective in gaining strength-endurance, or doing as many repetitions as possible in a given time. For best results, I recommend doing both. One day, you might do as many pushups as you can. Another day, you might do as many pushups as you can in thirty seconds, rest a couple of minutes, and then do another thirty-second all-out set of pushups.

Neurologically, the synaptic facilitation method may be applied here, too. Simply perform one set of about 3/4 as many repetitions as you can muster for each exercise you would like to increase your strength-endurance on several times a day. Training strength-endurance with the synaptic facilitation method is much more practical for a lot of people, as anyone can drop down and crank out a set of pushups at any time during the day. It may fetch you some very strange looks from passerby, but that is besides the point.

8) Putting it Together; Conclusion
So, what do you want to train for? Regardless, it is likely you would like to gain functional strength. Who cares about how much you can bicep curl if you cannot do a pullup to save your life?

You will want to select compound-exercises that work many muscle groups at once. Many of the compound-lifts also work the core muscles, as the core stabilizes the heavy weight being used.

The deadlift, dragonflag, squat, benchpress, military press, and pullup are five examples of very effective compound exercises that work multiple muscle groups simultaneously, resulting in better full-body strength, rather than strength in individual muscles that can barely be considered actual strength, as it exists only in the weight room.

If you would like to work the core more, you might choose to substitute the benchpress for a one-armed dumbbell bench press, and the military press for a one-armed dumbbell clean and press or military press. The deadlift is an awesome core exercise unto itself, and may be used as a substitute for the squat if there is no squat rack available.

In most cases, it is best to do strength work two to three times a week. Do not do strength workouts within 24 hours of each other; it is best to have at least 48 hours in between each strength workout.

Work out every muscle in order to avoid creating imbalances and build a strong body and healthy physique.

Try to avoid having intense strength training sessions in which the overall time exceeds 45 minutes. After about 45 minutes, testosterone levels begin to drop, blood glucose begins to plummet, you're tired, and if you continue to work much more, you will cause your body to elevate cortisol levels. Cortisol, basically, is a hormone that is produced as a result to stress on the body, and causes one to retain fat. We don't like cortisol.

I hope you have gleaned some insight and perhaps even benefited from reading this text on strengthening. Best wishes and happy training.

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