

# Muscle Fibers - An In Depth Analysis



Researched and Composed by Jacob Wilson, BSc. (Hons), MSc. CSCS

## Introduction

Have you ever contemplated how the body can explode with hundreds of pounds force in one instance, and in another place only ounces of controlled pressure? It just so happens that this kind of thinking can be very anabolic. Yes, very anabolic indeed! You see weight training is a manipulation of our body's everyday functions or movements if you will. If we can thoroughly understand how those functions are carried out then we can simulate them directly under resistance. And not half hazardly as most trainees seem to enjoy doing, but rather with the precision of a skilled surgeon! This is without a doubt the goal today. You will not only learn what each muscle fiber's functional duty is, but how to translate those duties into maximized potential in the weight room! Come with me if you want to grow!!

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## What Will Be Covered In This Article!

1. In Depth Coverage of our bodies Energy Systems!
2. Detailed Explanations of The Three Types of Muscle Fibers in the Body
3. How To Force Each of Those Muscle Fibers Into Immediate Growth
4. Why You Are Most Likely Slowing Growth Big Time, and How To Turn Things Around!
5. An Understanding of Why Each Body part has a different fiber makeup.
7. Learn how To Boost Your Body's Ability To Utilize Fuel! In other words turn your body into a fat burning furnace!
8. All This and much much more!

**Note:** I have explained what a muscle fiber is in the article entitled: " Anatomy of a Muscle. " This article is meant to be built on that knowledge. On a brief note, muscle fibers are responsible for contraction of a muscle group. The way you work these out is what will determine whether you become huge or not.

## Tonic And Phasic Muscles - The Original Name For Fast and Slow Twitch and Why It Still Applies!

The words Phasic and Tonic in regards to our muscles are extremely old school terms that pretty much died out with the 70's. However, this does not take away from their applicability today. They provide a very practical approach to understanding the different types of fibers housed in our bodies. In fact, this is how legends such as Sergio Oliva and Larry Scott would have termed fast twitch dominant and slow twitch dominant muscle groups!

If a muscle was dominantly made up of slow twitch fibers then it would be termed a Tonic or endurance muscle, if it was made up of mostly fast twitch muscle fibers then it would be dubbed a Phasic or a low endurance power muscle. Once you acquired this knowledge you would understand how to train a particular muscle group. Therefore, since the triceps are dominantly fast twitch, they would be deemed phasic. I will delve into this further into the article.

An important aspect in regards to this subject is why a body part would almost always be either a tonic or phasic in most individuals. What I mean is this. The hamstrings are a dominantly fast twitch muscle group in about 59 out of 60 human beings. Therefore you can pretty much bet that yours are as well.

The real question is why? The answer is simple, a muscle's fiber composition will normally reflect what its job or jobs are in the body. If a muscle is meant to maintain your posture ( which if you are standing in line can be for hours ) then it will most likely be predominantly slow twitch. If it were not then you wouldn't have the endurance to stand for that long a time. The soleus ( lower calf muscle ) is a perfect example of this. It must be dominantly slow or as I stated, standing( or walking ) in line would be much more difficult then it actually is. Another example would be your neck muscles, which essentially work/contract all day long just to hold your head up! Therefore a muscle that mainly maintains posture is usually going to be a pure tonic muscle. And a muscle that is meant to produce optimal force such as the hamstrings will most likely be a phasic or fast twitch dominant muscle group.

In addition you can have a muscle group that is expected to be in between such as the quadriceps. They are greatly responsible for our ability to walk/stand, which calls on slow twitch muscle fibers. And if the need to run or jump( both explosive fast twitch dominated activities ) should occur they are also heavily relied upon. Therefore the muscle contains about 50 percent slow twitch muscle fibers and 50 percent fast twitch muscle fibers.

On an overall note this is a decent way to grasp the concept of fast twitch and slow twitch cells. Slow twitch fibers are mainly for endurance activities and fast twitch fibers are mainly for intense movements. If a muscle is unlikely to be called upon to perform explosive movements or needs to be heavily relied on for slow endurance activities such as the soleus, then it will most likely be slow twitch dominant. And of course as I stated above there are examples of fast twitch dominant muscles and muscle groups that are essentially 50 50.

The problem with purely viewing each as either phasic or tonic is that the subject is more complicated then this. You see, muscle fibers can be broken down further then simply fast twitch and slow twitch. There are actually 3 " main " cell classifications in the body that need to be addressed in detail. This is what I intend to accomplish today. However, before I do this, I need to discuss our body's source of energy, because each muscle fiber works dominantly with a particular energy system.

**note:** I mentioned that most muscle groups are dominantly slow or fast in the majority of human beings. Tuck that concept away if you will, because I am going to re-address it further into the article in a big way! This was simply an overview of muscle fiber types and why they are *usually* dominant by one fiber type or the other.

## The Body's Three Energy Systems Used For Movement

When driving to work or school each morning, you normally aren't dwelling on the fact that your car is running on gasoline to power its movements. Actually I take that back, almost all college students know exactly how well their cars are utilizing fuel! If you're taking a full boat, its difficult to work long enough to pay the bills. You know however, that like physique building your hard work will pay off 100 fold in the long term! The human body runs off of an energy source in a similar manner. Every contraction made by your muscles is fueled by a substance known as ATP. In fact as I type my body is utilizing this fuel source to maintain the continuous contractions made by my fingers against the resistance of the keyboards! When you have completed this article you will not only understand this concept, but you'll know how to manipulate it to literally skyrocket your gains in the weight room!

**Pause In The Article** - Before continuing, I would like to pause, and address the topic of energy.

The best way to define energy is to describe what it does. Energy is the ability to do work or cause motion. Common forms of energy in our world include heat, light, sound, electrical energy, mechanical energy, and chemical energy. Most metabolic processes in the body use **chemical energy**, which is held in the bonds between the atoms of molecules and is released when these bonds are broken. Your muscles are no different. When at work, they require energy so that they can contract. The unique feature about muscular contraction is that the chemical energy is transformed into kinetic energy - or the energy of movement.

## So What Exactly is ATP?

ATP is the primary energy source for every cell in your body, including muscle cells (fibers) (1)! When I say primary I am not just talking about muscular contraction here, I literally mean that it is used to fuel cell repair as well! If that doesn't excite you, and you are a bodybuilder, then you need to check your pulse! After all, the efficiency of your body's ability to repair a muscle fiber( growth! ) is perhaps the most vital aspect in this sport!

ATP is an extremely complex molecule that is short for adenosine triphosphate( one adenosine and three phosphate groups). Phosphates are high energy molecules! This simply means that when a cell removes a phosphate from its group, a high level of energy is released. It is this energy that our muscles harness in order to contract! You should also understand that when one phosphate is removed from ATP it becomes ADP or adenosine diphosphate. In a moment the significance of this will be made obvious.



Consequently most of the stored energy is found between the 2nd and 3rd phosphates. Interestingly enough though, a phosphate can be removed and is removed from an ADP to rephosphorylate a second ADP molecule, forming an AMP and ATP molecule. This is one of the ways the body sustains its ATP supply.

In review, this is our muscle fibers primary energy source for essentially all of its functions, including several responsible for hypertrophy. Therefore it is vital that you know that food is the ultimate source of material for constructing ATP (2). These macronutrients however must be manufactured or turned into ATP. With this in mind the next item of significance is what exactly in our bodies is responsible for its production. As I stated in my article the anatomy of a muscle fiber, most of the supply of this molecule is constructed in our mitochondria( which is inside of our sarcoplasm). Therefore mitochondria converts carbohydrates, fats, and in some cases protein to ATP. Moreover, each energy system that I will explain is heavily dependent on a particular macronutrient( i.e. either fat or carbs ) for fuel and I will explain this in detail along with the systems.

Finally you should know that our muscle cells' sarcoplasm ( the sarcoplasm was covered in detail in the anatomy of a muscle and you should understand what it is, as it has significance to this article ) stores the nutrients above, in it to sustain contraction. Again, I want you to hold that thought, because I will refer to it in detail soon. For the moment just understand that the more mitochondria you have, the more ATP you can produce. And the greater capacity your sarcoplasm has, the higher the storage of vital nutrients for exercise and repair you can house! This translates to elevated energy levels and increased hypertrophy( growth)!

### The Three Energy Systems

What we will now discuss is how our muscles are fueled to contract in virtually every situation possible. You see, a different energy system dominates for a heavy set of 4 repetitions then compared to a set of 12 repetitions. Each of these is linked with a particular muscle fiber type. If you can manipulate the energy system, then you can drastically increase muscle mass.

Firstly I need to emphasize that our muscle fibers store ATP. The problem is that we only have enough to fuel contractions for about 3 seconds, and even in the most well trained bodybuilder that supply can only last for a few seconds. So what is the point of having such a low amount of stored energy? It's essentially designed to give you a quick burst. You name the sport and every athlete will tell you the benefits of being able to call on a quick burst of energy! What becomes painfully obvious at this point is that this will not power traditional bodybuilding sets. Therefore our body must have a way of producing more energy to sustain contractions! This is where the 3 fueling systems come into play!

**note:** again, all three energy system's function is to produce ATP. These processes dominantly take place in the mitochondria( about 95 percent of the ATP in your muscle stores to be exact ! ) that lie inside of the sarcoplasm of the muscle fiber.

## Phosphagen System

To replenish the ATP levels quickly after the initial energy boost is used up, muscle cells contain a high-energy phosphate compound called creatine phosphate(PC). To state the obvious, this compound contains a phosphate. Your muscle cell releases enzymes that break the phosphate off of the PC molecule, then this phosphate is transferred back to the ADP to reform the high energy molecule ATP.

To recap, when your body uses ATP, it breaks one phosphate off of it which produces energy. This burst fuels contractions. What is left after a phosphate is broken off of ATP is the molecule called ADP. Our muscle fibers contain 5 times as much creatine phosphate then it does ATP. Your cell sends out enzymes that break off the phosphate from the creatine. The Energy released from this sever and the phosphate molecule are recombined with the ADP to again form ATP. The PC system provides an additional 9-10 seconds of energy when at full power to allow us, as bodybuilders to continue an intense set! However, it does contribute longer than this, but does not dominate.

A process such as this can occur in the blink of an eye, which makes it very efficient! You see creatine phosphate stores run out about this time. This system is the powerhouse for extremely high intensity activities. If it is weak then you will have a difficult time lifting heavy weights for any extended period of time. This will be extremely detrimental if your goal is to hit the denser fast twitch IIB fibers.

One way to increase your creatine stores is obvious. You can easily saturate your muscle cells with creatine by actually supplementing with it. Your body already produces it, but supplementation assists in the saturation process. You can see why this is a proven product. It literally speaks for itself in functionality, and has proven to be one of the safest substances on the shelves today! Millions have used creatine for over a decade with absolutely no side effects whatsoever. And the amount of studies to back up its safety are second to none! This is a tried and true power house. You can learn more about it by reading my article, creatine myths and facts. My recommendation is to load it for 5 days at 15-25 grams broken up into 5 grams servings per meal. This will saturate your muscles with creatine. Following this period simple maintain saturation with 5-10 grams a day. Then start the process over in about 8 weeks. On a side note, steak is also beneficial to refilling your PC stores. It to is rich in this substance!

What System is Beneficial For - It allows you to contract your muscles up to a total of 30 seconds of intense exertion( with the ATP system )! The benefits are obvious. Anytime you lift heavy, you call on this system to back you up. If you play other explosive sports then it is also obvious. A play in football is relatively short and would rely heavily on the PC system. Hockey shifts are also relatively short, many elite teams only allow 30 seconds shifts of all out work per player. You name it: martial arts, soccer, rugby, all have the need for superior functionality of the PC system.

## Glycogen-Lactic Acid System

The second and probably most used system by bodybuilders is the glycogen-lactic acid system. You see our muscle fibers have stored carbohydrates in them. This is why you will hear athletes say that they are carb loading, or their stores are low. The form of carbohydrate that is found here is called "glycogen." It is a complex carbohydrate. Your muscle cell first splits the glycogen into glucose (a sugar) and then metabolizes it to make ATP. This is called anaerobic metabolism, because it completes this process without the use of oxygen. This system provides much more total energy than the creatine phosphate mechanism. The difference however is twofold. Firstly it takes longer to produce the ATP. This is why this system is best used for 30-90 seconds of work. That is a positive, there is however a negative! The breakdown of glucose into ATP leaves a byproduct called lactic acid.

The more acidic the interior of your muscles get, the more interference the chemical processes needed for contraction get. This also interferes with ATP production. The aforementioned combined with depleted energy stores eventually causes failure if intensity is maintained(4).

## Vital Information in Regards To Glycogen Depletion!

What you need to understand in regards to this energy system is that following a workout your glycogen stores are depleted! The significance is this: Your body needs ATP to fuel growth! In fact two ATP molecules are required to form one peptide bond between two amino acids. If your stores remain low, then you will not be able to fuel growth (protein synthesis requires ATP to occur). Further, if you do not pay attention to replenishment, your energy levels will suck, big time your next workout. In other words a mistake can result in

1. No muscle growth from all of your hard work
2. A low energy level and probably a reduction in strength the following workout

Therefore it is vital, that you immediately begin replacing your stores following a workout. This can easily be done by consuming a dextrose maltodextrin solution (see: Knowlden 2002, Window of Opportunity, Knowlden 2004, Scientific Investigation into the Rationality of Carbohydrate Consumption Criteria in Correlation to Post-Training Anaerobic Depletion Patterns: A series of sub-divisional essays, Venom 2003, Dextrose, Maltodextrin an In Depth Analysis). If your goal is mass then you should follow this up by consuming plenty of complex and fibrous carbs in each of your meals. As a rule of thumb, the more fibrous and unprocessed the carb, the less likely you will be to store fat. The exception is of course during your post workout meal, simply because your muscle cells are sensitive to insulin, and you are very, very unlikely to store fat at this moment. This is just one of the reasons why I stress the post workout meal so heavily.

Consequently, if you have not read my 13 weeks to fat burning article, I discussed why fruit is a poor choice for refilling muscle glycogen stores. You see fructose will be most likely stored in your liver. From a bodybuilding standpoint, this is not the optimal use of a carb(3). Let me also say, that this style of replenishment goes for any athlete. You will screw your performance up big time if you don't replenish after practice or a game.

Much of the energy used for this system is stored in the muscle cell as glycogen. However, your body also uses blood glucose to produce ATP, and these ratios change depending on the intensity of the training session. This has significance, specifically concerning the meal before you train. You want to have a good level of glucose in your blood( again this is if you want maximized energy stores, and your goal is mass. Energy stores will suffer somewhat when fat burning is the goal ) before training. This doesn't mean that you should drink a sugar drink before training. Quite the contrary. It simply means to eat a carbohydrate conducive to energy which will last for the duration of your training session. I recommend again, a fibrous carb. I personally prefer cottage cheese and oatmeal before training. It provides a slow source of carbohydrates, and also a steady source of amino acids.

## **Aerobic Respiration**

The two previously discussed energy systems were anaerobic or took place without oxygen. This system is contrarily dependent upon Oxygen. It is called the aerobic respiration system. It breaks down mainly glucose and fats in the muscle cell to produce ATP. Now in the last system we discussed the lack of oxygen prohibited the complete breakdown of glucose, thus you ended up with the bi-product known as lactic acid. In the presence of Oxygen, glucose and fats are completely broken down and do not leave lactic acid behind.

You will know that you have begun utilizing this system when you start to heavily breathe at the end of a set.

Aerobic Respiration can actually be broken down into two sub-systems.

**1. Glucose System** - It primarily breaks down Glucose in the presence of Oxygen during more difficult activities. In other words the harder you are able to work while still using oxygen the more your body relies on carbohydrates.

The muscle cells draw from three resources for energy when it comes to glucose:

- remaining glycogen supplies in the muscles
- absorption of glucose from food in the intestine, which gets to working muscle through the bloodstream
- and finally glucose released by the liver, which gets to working muscle through the bloodstream.

**2. Fat System** - It primarily breaks down Fat in the presence of Oxygen during lighter activities. Therefore the lighter the activity while still using oxygen the more your body relies on fats for the production of ATP. It gets this energy, from our fat stores.

Again, the same dieting strategy would apply if you want to maximize performance in this area. A lot of you are thinking right now, who cares about this energy system? It can actually be quite vital when your goal is to hypertrophy slow twitch muscle fibers. Moreover, improving your ability to oxygenate your body can have several other benefits toward the bodybuilder. One of which is improved recovery between sets!

That's right, how do you think your ATP, PC, and Glycogen-Lactic Acid system get replenished in between sets? Your body needs Oxygen when it replenishes these

stores while you are resting. It is for this reason that you breathe heavily between sets, even when you only performed 2-4 reps! Your body is working extra hard to take in Oxygen, because it needs it to complete the process of restoration! This links to our body's cardiovascular system, and will be discussed further on.

### **Tying Them All Together**

As you can see from above each energy system has a specific purpose and uses a particular source of fuel to power it. Your body can switch from one energy system to another, in much the same way a car can change gears. Think of it this way, a baseball player can walk around the field using his Aerobic Respiratory system. This is simply because he is not using much energy. Then at the crack of a bat, when he charges a ground ball he immediately switches to using his most powerful energy system, which is his actual stored ATP-PC system. Also I'd like to clarify, that when you begin an activity all three systems are actually at work. But...your actions are controlled primarily or should I say dominantly by a particular one!

### **Final Example**

I would like to give one final example of how your body can actually use all three energy systems in one set.

Lets analyze perhaps the most brutal shocking method ever devised! The 20 rep squat. For those of you who do not know what it is I'll briefly explain it. You choose a weight you can lift 10-15 times and rest pause it out for a total of 20 reps. You see when squatting you can lock out at the top of a rep, which provides a perfect form of rest pausing. It takes tremendous amounts of pressure off of your quads, hams and glutes. Therefore when failure approaches, you simply stand straight up with the weight on your shoulders and rest until you feel recovered enough to continue.

A shocking method like this will utilize all three energy systems. Lets take a look! You step under the rack, rest the weight on your shoulders and move backward. Adrenaline is being released at an enormous rate and you want to take clear advantage of it. This translates to an explosive and powerful first rep. The weight feels as if it was going to fly up and break the ceiling because of your powerful contraction. Guess what? You just used up essentially all of your ATP stores! As you go into the second rep your body begins recycling ADP back into ATP to fuel the contraction. It is still almost as powerful rep one.

You continue pulverizing the weight until you reach rep seven! The contractions are now less explosive and a tingling, almost numbing feeling arises in your hamstrings. This means that the lactic acid system is in full gear! By the 10th rep your whole lower body is on fire and you know it's time to rest pause or the lactic acid build up will totally prevent any further contractions. Standing with your legs locked you notice that you are breathing heavily. Your body is now using its Aerobic Respiration system to fuel the muscles responsible for stabilizing your body while standing. This is the upper back and the shoulders to name a few. Moreover oxygen must be supplied to replenish glycogen stores.

After sufficiently resting the set continues. Moving at a medium pace and again relying on the lactic acid system you complete 5 more repetitions. You again rest

pause. This time however breathing becomes almost unbearable! This is due to the fatigue in the stabilizer muscles, and the fact that you are running intensely in the Aerobic Respiration zone. Finally you somehow manage to continue the set getting one rep...two reps...then on your third the lactic acid build up simply will not allow your muscles to contract and the weight falls back onto the safety rack! Following this brutal set you are in agony, breathing like you have never breathed before! You guessed it, the body needs oxygen to replenish its stores for the next bout! So suck that wind warrior, cause you need it!

**This Article Is Continued In Part Two Of The Series! [Click Here To Read It](#)**

Sincerely

Jacob Wilson [jwilson@abcbodybuilding.com](mailto:jwilson@abcbodybuilding.com)

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