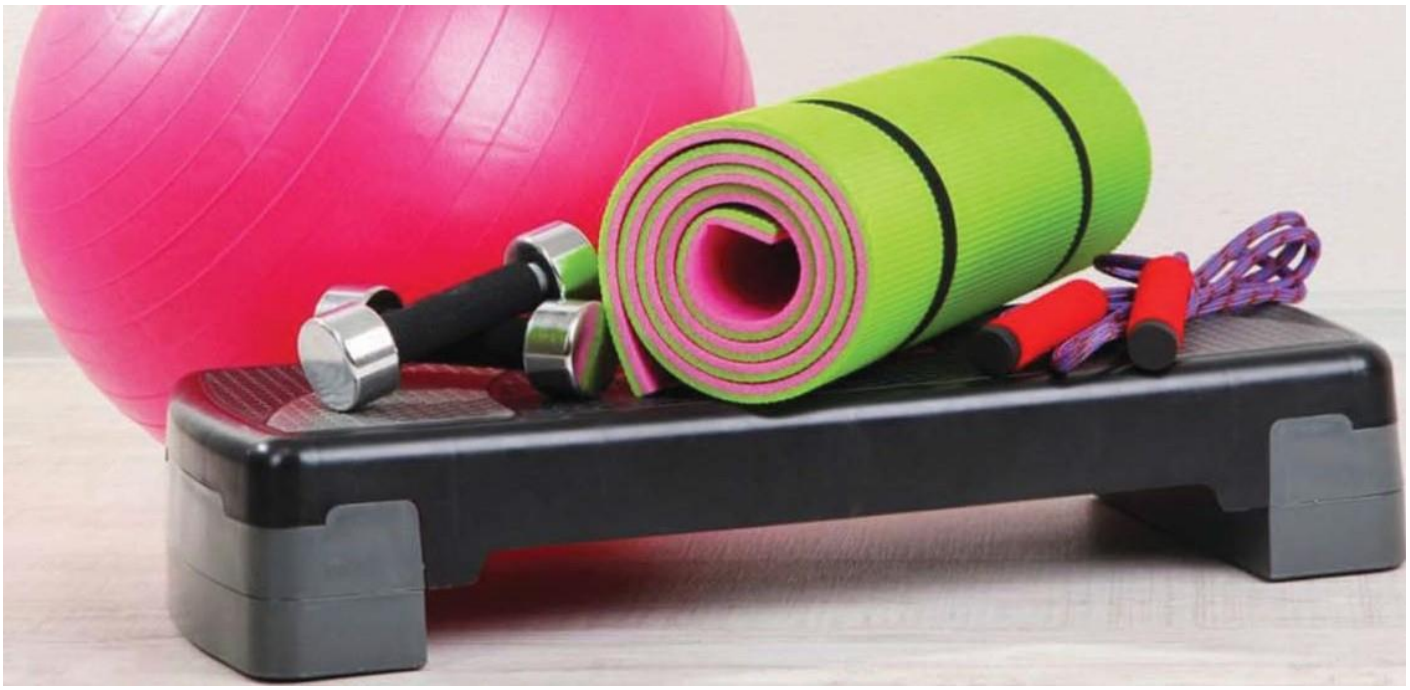
TRUTH BEHIND THE FITNESS FADS

A Fitness Resource for Beginners



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fitandfunctional

in conjuction with:

THE ARENA FITNESS

The Truth Behind The Fitness Fads

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The purpose of this book is to educate everyone on the basic principles of exercise and how your body functions. This manual is different because it was written by real professionals who not only do research and write for nationally recognized personal trainer certifications, but actually practice our craft. We took the same information professionals learn in order to become personal trainers and rewrote it, so the average person can use it every day. This book is made up of various articles, text books and courses written by our authors. Understanding basic human function inside and out will give you new insight on how you exercise. Everyone is different and should be trained based on individual needs and condition, not simply based on something that worked for someone else or on the latest trend. This manual provides proper evaluation techniques and general recommendations that are a great starting point for any level. Since no two people are the same, we advise that each person see a professional trainer but at the very least read this book. It is important to research your trainer and to not assume that because they have worked in a club for many years, that they are an expert. Unfortunately, many trainers are not well educated in exercise physiology and sport-specific functional training. Educate yourself so that uneducated trainers cannot fool or hurt you.

CHAPTER I

THE TRUTH BEHIND THE MOST COMMON EXERCISES AT THE GYM

Exercises to Avoid

In the fitness world, there are so many opinions on what is right and wrong. The truth is many of the exercises you see in the gym are not safe for the general population. Exercises do not have warning labels so when these trendy extreme exercises and programs meant for elite athletes trickle into the gym it creates a danger. There are so many myths that become gym law over time without any real explanation. I can't even begin to list the ridiculous things I heard working out in the gym as a teenager and young adult. In many cases the misinformation came from the biggest guy in the gym and bodybuilder magazines. We are going to expose these myths and exercises and will provide alternatives with explanations based on real science and experience. Keep in mind this is geared towards the general population and athletes just starting a sport. Some of these exercises may have a place for specific people in certain circumstances but it is not the norm. The truth is if an exercise is even slightly questionable why bother with it when there are so many alternatives out there that are safer and just as good or better. In some cases, doing a safe exercise wrong can be just as dangerous as doing a high-risk exercise. For example, if you do not have proper hip control, core strength and poor form during a squat you will most likely get hurt.

When selecting exercises to perform in the gym the first two questions that should be asked are why am I doing this exercise and what is the risk vs reward? Once you figure that out, the next question should be if the exercise is optimal for that intention. Most people come to the gym uneducated about fitness and select trendy exercises without knowing their background, purpose, and flaws. If you really enjoy doing an exercise but it happens to be on this list, we urge you to just consider what we are saying. Be warned that some of your favorite exercise may lead you down a road of regret. Rather than learning the hard way, take a second to open your mind and let go of the emotional attachment you have with some exercises that are unnecessary and potentially detrimental to your physical progress.

Do not be surprised if you see trainers in your local gym advocating these exercises as well. This chapter is a testament to the lack of education that some personal trainers have.

Avoid: Smith Machine Squats

- Fixed plane of motion
- Takes pressure off of the back, but puts significant pressure on the knees
- Minimizes hip extension, which takes hamstring involvement out of the exercise. The hamstrings however, are the muscle group that help to stabilize the kneecap
- Alternative: The box squat

Alternative: Box Squats

Wrong:

- Tendency to sit with weights
- Rounding the back

Right:

- When you perform box squats, position the barbell on your shoulders. Then position yourself near a box or bench, as shown above. Descend under control until you feel the bench touching you, then push the weight upwards until you reach the initial position again.
- Remember to keep your back as straight as possible and your abs tightened throughout the lift.

****Never sit or rest on the bench with the weight on your back!!****

Avoid: Smith Machine Bench Press

- Fixed plane of motion
- Works same muscle fibers in every rep
- Takes the natural motion out of the movement
- Puts extra pressure on the joints
- Alternative: Barbell bench press or dumbbell bench press

Alternative: Bench Press

- Place feet flat on the floor under thighs
- Keep shoulders pulled backwards & down towards the hips
- Hold bar with a grip wider than shoulder width, keeping elbows less than 90 degrees in relation to the shoulder
- Lower the bar to the chest and press up. You may need to modify the range of motion for some clients.

Avoid: Bench Dip

The bench dip puts the shoulder in an unhealthy position. When you place your hand behind your back, you medially rotate your Gleno-humeral joint and you force the scapula-thoracic joint into elevation and an anterior tilt. This over activates the upper Trapezius and puts the Pectoralis minor in a shortened position. This can also increase the chances of sub-Acromion bursa impingement over time and can lead to arthritic changes in the Acromion-Clavicular joint.

Alternative: Tricep Rope Pushdown

Standing with a slight bend in the knee and hips place both hands on the rope. Despite popular beliefs you should start with the elbows above 90 degrees, elbows tucked into the sides directly under shoulders and push straight down into full elbow extension. This accomplishes the same movement without all the shoulder stress. Keep the shoulders down and back and do not shrug.

Avoid: 45 Degree Leg Press (sled)

There are many variations of the leg press, but this version is by far the worst. This exercise puts a tremendous amount of stress on the lumbar spine because it forces the spine into an anterior tilt. The angle of the machine forces the knees into the chest into extreme flexion and limits Glute recruitment for hip extension. This puts even more stress on the lumbar spine. The motor pattern in this exercise has no functional value because it does not carryover to any activity in real life.

Alternative: Deadlift

1.

2.

3.

The traditional deadlift is one of the most basic exercises and is more effective than any machine. Unlike the leg press there is a tremendous amount of carryover into real life activity. Start by placing a bar with weight on the floor. With feet slightly wider than shoulder width, place hands on the bar slightly wider than shoulder width, maintain a neutral spine then pull the bar from the floor into a standing position. Keep the bar close to the shins and thighs throughout the movement and do not hyperextend your back at the top of the movement.

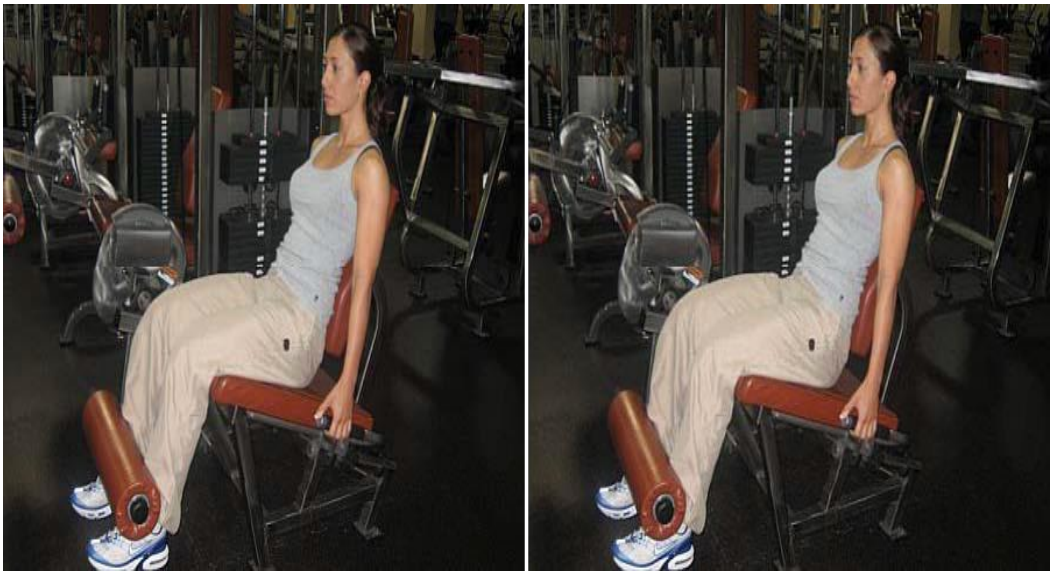
Avoid: Weighted Side Bend

The side bend is a movement that causes lateral flexion of the spine. This exercise can be very risky and dangerous to perform without proper understanding of pelvic and spinal stabilization. The side bend recruits the internal and external obliques of both sides of the abdomen, however, it will also recruit the Quadratus lumborum, due to flexion and rotation of the spine. With weight, there will be a serious amount of torque and sheer forces placed on the vertebrae and deep tissue of the lumbar spine. This movement should be avoided until the person has an understanding of core stability.

Alternative: Side Bridge

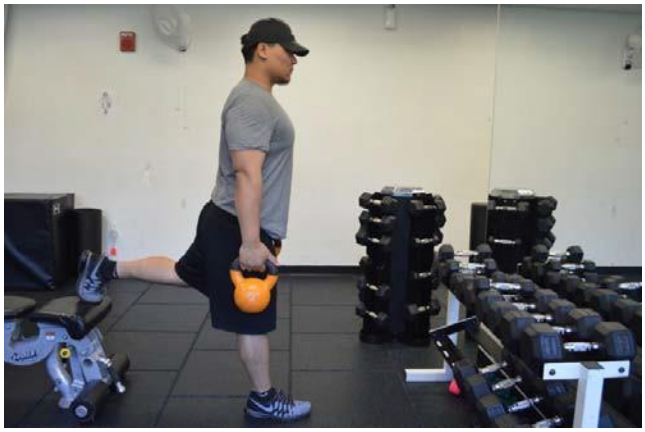
The side bridge begins by laying on your side and your elbow. Make sure that the elbow is aligned properly under your shoulder so that you decrease the strain on the AC joint. With your feet stacked together raise the hip and knee off of the ground until you reach a neutral position. It is safer to go from a state of controlled flexion to a neutral position in comparison to the side bend. This will engage the internal and external obliques more efficiently without excess spinal flexion in a safer manner.

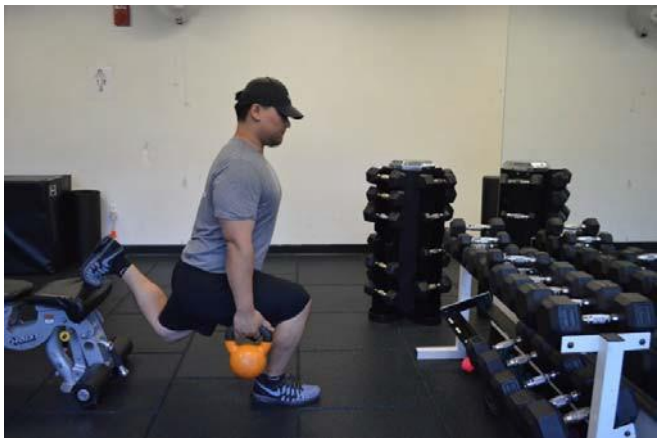
Avoid: Leg Extension



- The four parts of your quadriceps are designed to work together as one, but a recent study in *Medicine & Science in Sports & Exercise* found that leg extensions activate the sections slightly independently of one another. Even a five-millisecond difference can cause uneven compression between the kneecap and thighbone, inflaming the tendon that connects the kneecap to the shinbone.
- When this is an appropriate exercise, a very specific range of motion should be used with the shin pad being placed higher up on the lower leg and the resistance with no more than a 90-degree angle.
- Unless you are stepping on a bodybuilding stage or rehabbing a knee injury there is no reason to isolate your quads. In the case of the latter, the quad is only isolated in a certain manner to optimize VMO recruitment which helps stabilize the patella during knee flexion and extension. The weight of the leg extension machine also has the potential to shear the proximal end of the tibia anteriorly. This now creates a pattern of excessive tibia deviation anteriorly in the sagittal plane during lower push movements.
- Alternative: Single leg squats

Alternative: Single Leg Squats



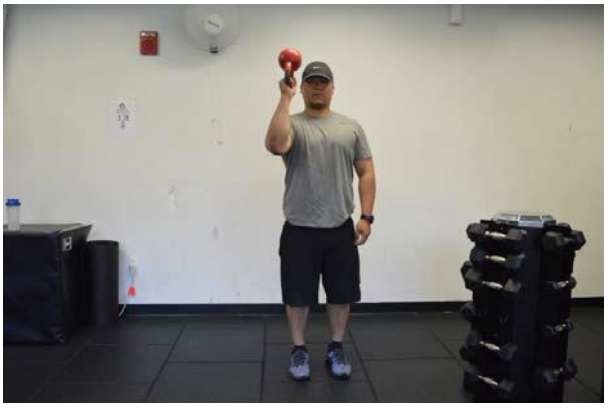


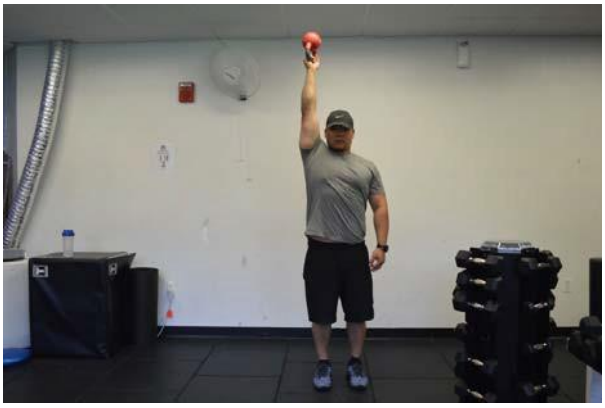
- Start with one leg out in front of the body, keeping the knee and foot in line with the hip. The opposite leg should be resting on a stepper or bench
- Perform a half squat
- The split squat is a more efficient VMO/quadriceps exercises as well as a great glute exercise. Weights can be added as a progression to the movement
- Return & repeat

Avoid: Behind the Neck Press

- Just as posterior pull downs strain your shoulders on the way down this exercise hurts them on the way up. It also puts too much stress on the acromioclavicular joints (those little knobs on the top of your shoulder), which can lead to an overuse injury.
- Neck injury
- Alternative: Seated Shoulder Presses

Alternative: Bottoms-Up Kettlebell Press





- A bottoms-up kettlebell press will challenge your glenohumeral and carpal joints to stabilize the weight
- Start by setting the arm in a neutral position, shoulder in a slightly flexed position, keeping the elbow slightly lower than your shoulder. Then press the kettlebell in the air, making sure you get a proper upward rotation movement from your scapula and flexion of the shoulder
- If pressed correctly, there should be no pain and your shoulder should be relatively close to your ear

Avoid: Behind the Neck Pulldown

- Potential rotator cuff strain
- Potential neck injury
- Training the shoulder while in near maximal external rotation with a compound movement is a red flag. If you lack the scapular retraction and downward rotation needed for this position your shoulder will take a hit or you will compensate by hyper-extending at the thoracic spine, over flexing the cervical spine, or both
- Alternative: Lat pulldowns to the front

Alternative: Lat Pulldown to the Front

- Grasp lat bar at outermost bend with overhand grip
- Bring lat bar to upper chest by pulling the upper arms and shoulder blades downward and backward
- Maintain the natural curve of the back
- When doing lat pull-downs, set the hands so that they are slightly externally rotated (where the bar begins the bend). This will set the shoulder and scapula in relation to your elbow in a more efficient loading angle
- The first engagement should be to depress your scapula and then pull the bar down towards your clavicle (collar bone) while maintaining a neutral spine. Brace the core and try not to hyperextend your lumbar spine
- Having a slight backward lean can help engage the lats if one lacks the thoracic mobility to perform the lift properly

Avoid: Traditional Sit-Up

- The spine requires mobility to perform flexion, lateral flexion, hyper-extension, and rotation for ADL's such as tying your shoe, backing up your car and looking behind you. Repeatedly flexing your spine under load does not equate to core strength and stability. Some reasearch has shown that too much flexion can harm the disc
- The core was meant to be trained as an anti-mover to the transfer force from triple extension. Train your core with movements in which you are resisting the loss of a neutral spine. Challenge the core with multriplanar movements
- Alternative: Plank - Support the body in a plank position with forearms shoulder width apart and feet together. Keep a straight line through the knee, hip, and shoulder. Maintain contraction of the abdominals

*Sit ups done correctly have value and can be safe.We suggest avoiding them because we believe only an experienced trainer should decide when to implement them. In general there are lower risk exercises with higher rewards.

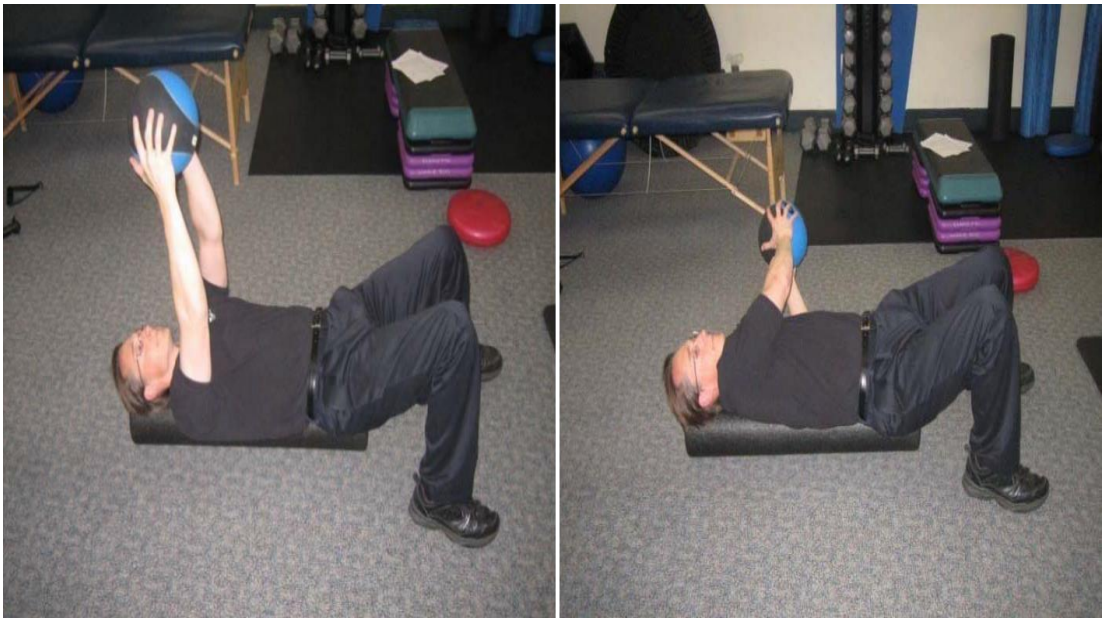
Alternative: Crunch on a Dyna Disc


- Place dyna disc under lower back. The closer to the tail bone, the harder it will be to perform
- Start with the back off the floor, crunch up and return to start
- Avoid touching the floor
- Imagine a see-saw motion where the disc acts as the central fulcrum. Perform this while trying to maintain a neutral spine

Avoid: Leg Raise

- Over activation of the psoas and minimal activation of the target muscles
- Lower back pain because the majority of people do not have proper pelvic control
- Alternative: Cross bridge on foam roller

Alternative: Cross Bridge on Foam Roller

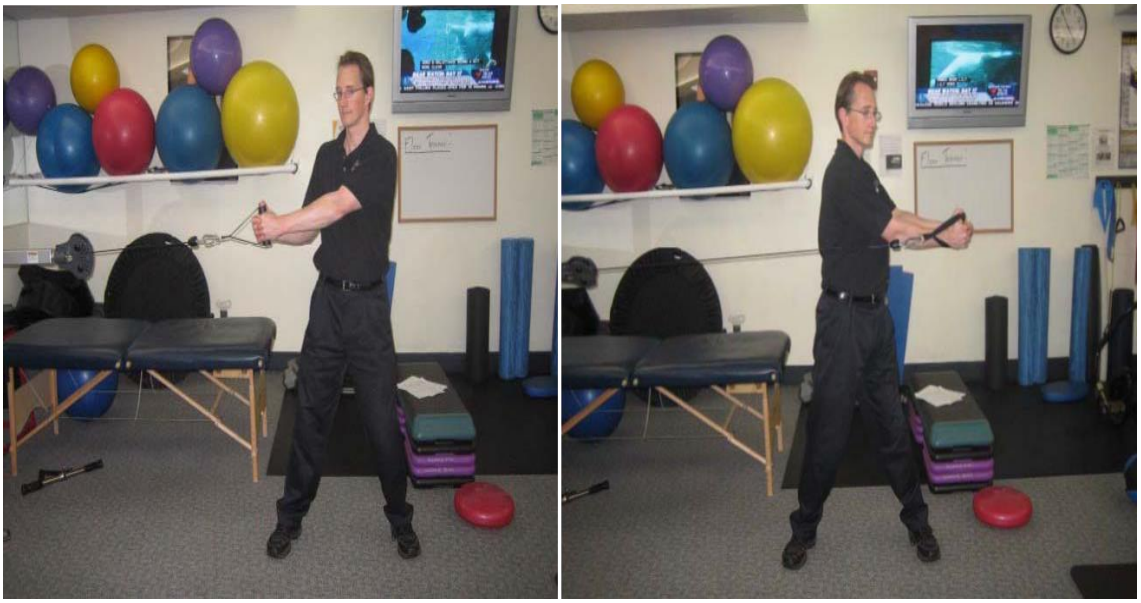


- Lie on foam roller with feet on the floor, holding medicine ball
- With arms straight and keeping abdominal muscles tight with a neutral spine, move the medicine ball from side to side
- Return and repeat

Avoid: Bicycle Crunches

- Over activation of the psoas
- Lower back and neck strain
- Limited functional carryover to daily activities or sports
- We can make the same claim of repeated spinal flexion. However, this is even worse because it is coupled with rotation and in the case of some beginners, a touch of lateral flexion as well. Sprinkle in some hip flexor over activation, which is not meant to be done lying on the floor, with the spine deviated from neutral and you have yourself a pretty bad exercise
- Alternative: transverse cable chop

Alternative: Transverse Cable Chops



- Keep abdominal muscles tight and a neutral spine
- Twist from your hips while pulling through with your arms. Keep shoulders and hips lined up
- Repeat

Avoid: Flutter Kicks


- The psoas activates from 0-20 deg.
- Flutter kicks done close to the ground will over activate the psoas and pull the lower lumbar spine into a hyperlordoctic curve, increasing the anterior pelvic tilt, thus stressing the lower back.
- Combine this with sitting all day and its chronic back pain waiting to happen.

Alternative: Stability Ball
Pike

- Start in a neutral push up position with your feet on a physioball.
- Begin the movement by raising the hips up and rolling up onto your toes.
- Make sure to come down slowly, back into a neutral position without hyperextending the spine and increasing the lumbar curvature of the spine.
- Always reset into a good neutral position with the shoulder, hips, and ankles aligned in a straight line.
- If stabilization is too difficult, progress from the floor first before moving to the physioball.

Avoid: V-Sit Up

- If you cannot touch your toes with a neutral spine, right off the bat this exercise is not for you
- The excessive hip flexor activation creates strain on the lower back. The position alone puts all your body weight on the lumbar spine. Doing repeated spinal flexion in this position is risky for most people.

*Without movement this can be considered a boat pose in yoga. Only people with proper core strength and control should attempt this pose.

Alternative: Baby Get-Up

- Flex your knees to 90 degrees and set them hip width apart.
- Set the arm on the floor to 45 or 90 degrees relative to your shoulder mobility.
- Set the opposite arm so that it is fully extended in the horizontal plane.
- Tongue on the roof of the mouth, neck in a neutral position, and depress the rib cage. Transfer body weight to the arm down on the floor.
- Come up onto forearm and punch opposite arm to the ceiling

Avoid: Sit-Up Machine

- Forced lumbar flexion while being seated and over activating the Psoas.
- Locked range of motion in a seated position, disrupting the ability to stay neutral
- Alternative: crunch on the stability ball

Alternative: Crunch on the Stability Ball

- Lie back with ball supporting lower back
- Place fingertips behind head but don’t pull on your neck. Look at the ceiling and don’t poke chin out
- Crunch your body forward raising shoulder blades off the ball. Do not come up too high and flex the spine
- Lower back down but avoid shoulder blades touching the ball

Avoid: Russian Twist

- When done on a physioball or with feet stable this advanced exercise is usually safe as long as the client can keep their body still while maintaining a neutral spine
- Typically, it is performed on the floor with the feet up in the air. The inability to keep the spine neutral resusults in sheering and will result in injury
- The other problem is people always try and reach the ball to the floor which results in too much flexion
- Simply rotate in a transverse plane or train anti-rotation

Alternative: Pallof Press


- With a cable machine and handle, set your body in a neutral athletic position with our feet shoulder width apart, chest out and shoulders pinned back and depressed.
- Stand in line with the cable column and fully extend your arms and pause for a 1-2 sec count and then return back to the starting position.
- Common issues with the movement are that people push their hips forward and shift their center of gravity. If this occurs, lower the weight or widen your stance to create a more stable foundation.

Avoid: Seated Chop

- Doing a chop from the seated position takes the hips out of the rotational movement making less applicable to everyday activities and movement.
- The amount of pressure put on the vertebrae in a seated position is amplified of that in a standing position.
- Adding rotation in the seated position can compromise the intervertebral disc in the lumbar spine.

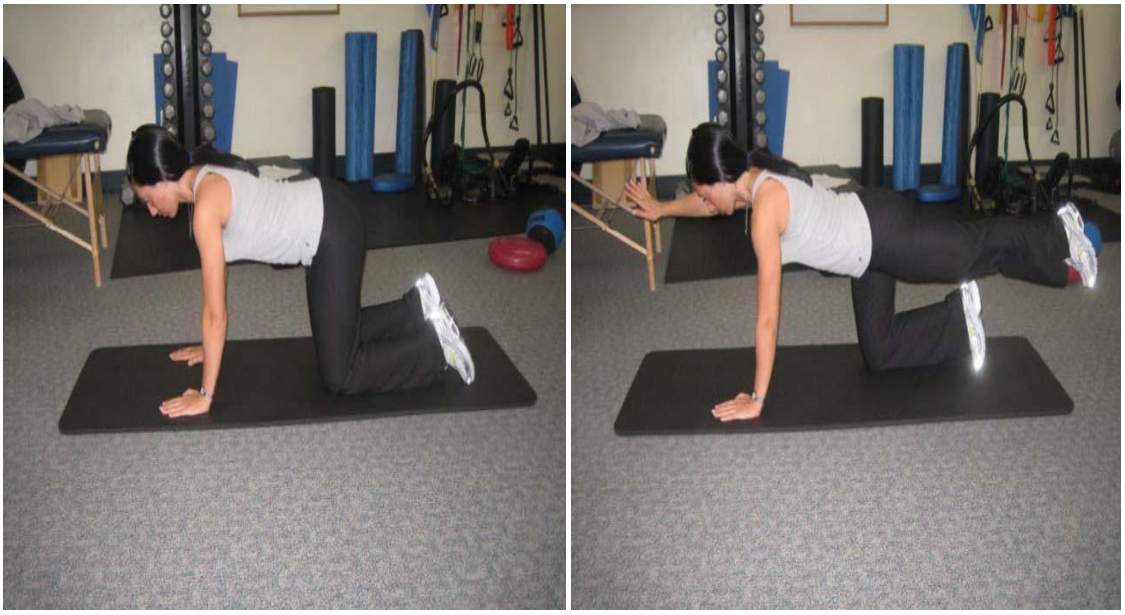
Alternative: ½ Kneeling Upward Chop

- Set up in a half kneeing position perpendicular to the cable column.
- Set the torso and hip in a neutral position with the glutes engaged (primarily focus on the glute engagement of the knee down on the ground.
- Have the arms fully extended as you pull the rope across the torso and then finish the movement by punching the arm closest to the cable column to the finished position.
- The purpose is to feel core engagement of the internal and external obliques as well as keeping the torso and hips in a neutral position without leaning or favoring one side.

Avoid: Superman

- This results in over 6,000N (about 1,300lbs) of compression to a hyperextended spine, loads the facets, and crushes the interspinous ligament
- “This is a poorly designed exercise” – Stuart McGill, PhD
- Alternative: Quadrupled arm-leg raise

Alternative: Quadrupled Arm-Leg Raise



- Start on all fours, knees under hips and hands under shoulders
- Brace the core & squeeze the glutes
- Press the heel straight back to straighten the leg while keeping the torso level and spine neutral

Avoid: Hack Squat

- Patella Femoral shearing can occur due to limited hip movement created by the pad
- Forced range of motion that does not account for an individuals specific anatomy
- Alternative: squatting against the wall with a stability ball or foam roller

Alternative: Foam Roller Wall Squat

- Stand with foam roller placed on low back, feet about shoulder width apart & about two feet from the wall
- Keeping abdominal muscles tight, roll body downward into a squat position, then roll back up to start

Avoid: Upright Row

- Impaired rotator cuff range of motion
- By maintaining a closed grip with palms and thumbs facing you, you have created internal shoulder rotation.
- As the bar is raised, your shoulders are abducted and internally rotated, which can create a pinching combination. As the soft tissue structures within the shoulder are pinched, they become chronically inflamed.
- Active elevation should not be trained without caution because it can throw off the recruitment pattern of the upper back, which will then affect upper pull exercises. The scapula and glenohumeral joint do a dance with each other; they need to be a certain distance away from each other for optimal shoulder girdle function.
- Teaching your body to recruit upper trap in a compound movement can set you up for disaster. Internal rotation of the shoulder requires retraction of the scapula.
- When people perform an upright row the higher they go, the more internal rotation of the shoulder there is. Conversely most people tend to keep the scapula statically retracted which is counter intuitive to the shoulder girdle.
- This exercise is advanced and should not be done by the general public. Only a qualified professional should determine when and why to do an upright row

Å Alternative: Deltoid Fly & Shoulder Shrug

Alternative 1: Deltoid Fly

- On an incline bench, holding weights straight down with palms facing each other, raise arms up in an arc-like motion, squeezing through the mid-back
- Keep elbows slightly bent and palms facing in. Hold then lower with control
- Repeat

Alternative 2: Lateral Side Raise

- When performing a side lateral raise, make sure to depress the shoulder blades and set the spine in a neutral position without hyperextending the spine to raise the weight
- Engage the glutes to hold the hips neutral and also engage the core to set the spine
- Raise the dumbbells to 90 degrees, with your thumbs pointed up, as shown in the finished position

Avoid: Adductor Machine

- Forced range of motion
- Tightens an area that is already tight on most people
- The hips must simultaneously rotate & rise laterally which places great stress on the lumbar spine, especially when heavy weights are used.
- There is even greater danger is this movement is done quickly, with a jerk, or if there is excessive hip rotation
- To work the adductors, more emphasis should be put on flexibility unless otherwise directed by a physician
- Alternative: Sumo Squat

Alternative: Sumo Squat

- Start with feet wider than shoulder width & toes slightly pointed outward
- Holding the weight in front of you between your legs, squat without letting knees cave in and keeping your back straight
- Only go down as far as you can so as to maintain a neutral spine
- Flexibility is important in these muscles. You should also perform an adductor stretch

Alternative: Adductor Stretch

- Stand with toes pointed forward and step out sideways into a side lunge position
- Keep body upright by holding a chair
- Shift weight from side to side, holding each way, to feel a stretch in the inner thigh & groin area

Avoid: Good Morning

Extreme force on lower back, which can lead to disk injury.
This should be called the bad morning because when you blow that disk out there will be nothing but bad mornings.

Alternative: Stiff Leg Deadlift

Right:

- Bend at the waist with your head up, your back straight and knees soft. Hold bar with hands about 16 inches apart. Straighten up while holding the bar at arm's length.
- This can also be done standing on a bench or box (so that plates don't touch the floor) or with dumbbells.

This exercise is great but is often done incorrectly. You must have good core strength and hip mobility.

Wrong:

- Hyperextending or locking the knees
- Going too heavy
- Letting the weight hit the floor
- Heels lifting
- Rounding the back

*A person's flexibility will determine the range on this exercise. This exercise needs to be practiced before adding resistance. People with lower back injuries may be excluded unless prescribed for rehab. It may be a good idea to slightly bend the knees for beginners with tight muscles and limited range. When performing these lifts under normal circumstances it is important that the knees are not hyperextended.

Squats: A Word of Caution

- Squats are a demanding exercise and should be worked up to
- FORM IS CRUCIAL
- Shoulder/Neck issues – alternate dumbbell squats with arms at side
- Knee issues – modify squat range of motion or use a physio ball to decrease knee torque
- Do not squat if you suspect a back or spine injury
- There is no conclusive evidence that states the knee passing the toe is bad. In fact, there are times when it is necessary. A good rule is if pain is absent the knee may pass the toe

Incorrect Squat

Wrong:

- Rounding the back
- Heels lifting
- Weights too heavy
- Excessive forward lean
- Bar too high on neck

*Squatting incorrectly can cause joint problems throughout the entire body, especially the lower back. Proper core strength is imperative if you wish to squat correctly. If the core is weak, you will not be able to maintain a neutral spine and drive the necessary force through the hips to move the weight. Lack of core strength will also overload the lower back and promote faulty movement patterns. In most cases, you'll see the glutes aren't working and that the erectors are doing all of the work.

Correct Squat

Description: Center a barbell behind the neck and across the shoulders with hands approximately halfway between the shoulders and the weights. Feet should be positioned approximately shoulder width apart with feet pointing slightly outward. Lower yourself under control into the squat by bending at the knees and hips until thighs are parallel to the floor. Return to the starting position by extending the knees and hips. Remember to keep your knees in line with your toes throughout the movement and keep your eyes fixed straight ahead, not upward as this could lead to neck injury. Don't bounce at the bottom of the movement and don't allow thighs to travel below parallel at the bottom position or allow the back to deviate from the upright position.

*Things to watch: squats are a demanding exercise and should be worked up to. Keeping form is crucial. If the person has shoulder or neck issues it may be best to do dumbbell squats and hold them at your sides. Remember you are loading the spine not just the legs so people with back injuries sometimes shouldn't squat. Core strength is very important and should be noted. It would be a good idea to get every client to be able to do some form of squat. Clients with knee injuries may need to modify the range or use a ball or roller on a wall to decrease knee torque.

There is no conclusive evidence that states the knee passing the toe is bad. In fact, there are times when it is necessary. A good rule is if there is no pain then the knee may pass the toe, but that debate is too in depth for this course.

Brace Yourself!
Weight Belts & Knee Braces: A Help or Hinder to the Core?

Knee Wraps: Relying on wraps during regular workouts could decrease the training effect. When the wraps are doing some of the lifting, your muscles aren't which can overload the joint itself and create improper motor patterns. Also, there is little evidence that wraps prevent injury. They may actually do more harm than good. Heavy wrapping can warm your knees too much, or conversely, the tightness could cut off some circulation causing a drop-in temperature. Either of which will weaken the muscle tissue. Also, tight wraps may cause damage by increasing the friction between the knee cap and leg bone, and the edge of the wrap may dig into the skin causing micro-tears in the muscles and tendons.

In addition, the wraps can bunch up in the back of the knees, tending to separate the joint during a deep squat. This is similar to putting a wedge in the door jam and trying to close the door.

Finally, heavy wrapping may slow down the quickness that is critical in Olympic-style lifting.

Weight Belts: A belt is very effective for stabilizing the abdominal area. However, it's so effective that your core muscles aren't challenged and don't contract effectively. The nervous system doesn't know to activate more muscle fibers because of the false sense of stability created by the belt. This causes reliance on the belt. It will also lead to synergistic dominance, not only in the trunk but in the extremities. A weak core will overload the extremities and open the athlete up to injury. A belt should really only be used for near-maximal lifting with very heavy weights during competition. If you need a belt to do bench presses or barbell curls, you should re-examine your form and honestly evaluate your core strength. You may be setting yourself up for a back injury. A belt works to stabilize your core by making your abdominal muscles push outwards against it and limiting movement.

Lesson: Ease yourself off the belt if you currently use one. You will need to slowly work back up to your current weights to ensure you don't hurt yourself. When you go to do a lift, brace your abdominal muscles while breathing and maintaining the brace. You will develop far better core strength and stability as well as tighter abs.

CHAPTER II

STRETCHING

Stretching

Stretching is a very important part of a training program but unfortunately, it is often overlooked. Lack of flexibility is at the root of many problems. When a muscle is hypertonic, it is limited in its ability to contract and lengthen properly, causing inefficient movements and joint stress. They are also more likely to contribute to faulty biomechanics. Appropriate stretching and moderate exercise may prevent many musculoskeletal injuries prevalent in today's society. Stretching and strengthening, when implemented appropriately, produce a solid foundation for healthy biomechanics. Without this foundation, biomechanics and movement patterns will become inefficient, leaving one, not only performing at a less-than-optimal level, but with a possible increased risk of injury.

Arbitrarily, increasing the joints' range of motion without considering the individual and the tasks they need to perform may be detrimental. Studies have shown a decrease in muscle power output and increased muscle reaction time following a stretch. Stretching certain muscle groups may be contraindicated when strength and/or power are required of them during the activity.

In some instances, a decreased range of motion of the body will enhance performance. An example would be the torso of a sprinter. Energy derived from the ground is transferred to the trunk by the lower extremities. Some of this energy can be lost to excessive lengthening of the trunk musculature. Therefore, in order to develop a training program that will improve upon the desired results, it is important to understand specific motion patterns. Furthermore, there is no evidence that stretching decreases the risk of injury. In fact, work by Dr. Stuart McGill has shown that the low back range of motion of injured workers had little relationship with their return to work. Also, a negative correlation between low back flexibility and back injury has been documented. Muscle injury (tear/strain etc.) rarely occurs at end ranges, discrediting the notion that stretching decreases the risk of soft tissue injury. Therefore, a training/stretching program must be tailored for each individual/athlete, and the tasks they need to perform.

Precautions

Always consult a health care professional before initiating a stretch program. Stretching can be dangerous in the presence of musculoskeletal injury or disease. It is also important to warm up muscles before stretching them. Stretching a cold muscle can result in injury.

Problems with static stretching prior to exercise:

- Scientific evidence demonstrates that static stretching of muscle decreases isometric and dynamic muscle strengths at different velocities.
- Isometric strength is important for stability during complex movements.
- Dynamic strength has obvious importance when it comes to actual movement.
- In plain English, this means you will be slower and weaker on tasks that are fundamental to high-level performance.

Static Stretching Acutely Impairs:

- Slow-speed, high force movements (power lifting)
- High-speed, low force movements (jumping & sprinting)
- Research also demonstrates that balance, reaction time and overall movement time are negatively affected
- Endurance athletes will be interested to know that static stretching also reduces muscular endurance.
- Static stretching some muscles before activity may be required if they are so tight they impede movement. Usually the psoas and the scalenes fall into this category. There are always exceptions to the rule so be aware of client needs.

Muscle/Tendon:

- Prolonged stretching can actually make the muscle and tendon overly compliant.
- Whenever we want to develop force in a muscle, it is important that we have plenty of stiffness, as this allows for better use of stored, elastic energy in the muscle and tendon and ensures that everything lines up properly at the level of the muscle fibers.

Nervous System:

- Due to motor control and reflex sensitivity, stretching makes it harder for the nervous system to tell the muscle to fire.

Benefits to Static Stretching Post-Workout:

- Relaxation
- Increase or maintain a particular range of motion
- After weight training
- After walking/running
- After aerobic activity

Stretching Principles

The Stretch Reflex

The stretch reflex is a neurological process in which the body responds to a sudden change in the length of a muscle. This pathway includes the muscle fibers, receptors, and sensory & motor neurons of the spinal cord.

Stretch receptors (muscle spindles) are located within the sarcomere, or muscle cell, and when lengthened send a signal to the spinal cord through sensory neurons. These neurons synapse, or transfer, the signal to motor neurons that control the muscle being stretched. This causes contraction of the muscle in order to maintain its resting length.

Autogenic Inhibition

Autogenic inhibition is the neurological process whereby proprioceptors (Golgi tendon organs), located at the musculotendinous junction, detect an increase in tension in that muscle. When a certain amount of tension is detected, the muscle is then inhibited in the spinal cord, preventing it from contracting. As a result, it will relax.

Reciprocal Inhibition

Reciprocal inhibition is the process by which the contraction of an antagonist muscle neurologically inhibits the contraction of the antagonist muscle. This occurs as a motor neuron that causes contraction in the agonist muscle synapses or transfers its signal to an inhibitory neuron that will inhibit the antagonist muscle. In other words, the antagonist muscle will relax, or be prevented from contracting.

Reciprocal inhibition may also contribute to muscle imbalances. If an agonist muscle is hypertonic, or overactive, its antagonist will be inhibited, causing

lengthening and a decrease in functional control. This will further allow the agonist to tighten, or shorten, creating a cyclical pattern of dysfunction.

Types of Stretching

Static Stretching

Static stretching is slow and involves holding the end point of tension for 20 to 30 seconds. This type of stretch targets the passive elastic component of the muscles.

Passive Stretching

A passive stretch is achieved by having an external force such as a partner's push, wall, floor, machine, etc. applied in order to attain and hold the end position. Using a well-trained partner can help to achieve greater range of motion (ROM) and also target specific muscle groups.

Active Stretching

Active stretching uses agonist muscle contraction in order to stretch antagonist muscles. This type of stretching uses the principle of reciprocal inhibition.

Dynamic Stretching

Dynamic stretching uses active contraction of the antagonist muscle, which creates motion in order to produce a stretch to the agonist muscle. This type of stretch targets the elastic component of the muscles. A study conducted by Yamaguchi and Ishi have demonstrated an increase in power during leg extensions following dynamic stretching. This may be due to the rhythmic contraction of antagonist muscles raising the temperature and post-activation potentiation, which is the improvement in muscular performance following contraction. This study was only performed on recreationally active men, not athletes. Therefore, the effect of dynamic stretching on power is not known in competitive athletes.

Ballistic Stretching

Ballistic stretching involves active motion through a joint and creates a bouncing motion at the end range of the stretched tissue. The goal is for the bouncing to cause an increase in motion past the end range on every repetition. This type of stretching may be detrimental to the target or surrounding tissues. It is not suggested to repeatedly force a joint or a soft tissue through its end range, as this could cause irreversible laxity and instability in the non-contractile tissues of the joint (ligaments, joint capsule).

This could also activate the stretch reflex, which would in turn cause the target muscle to respond by contracting, or tightening. This type of stretching is associated with injury and is only recommended under careful guidance of a professional.

Proprioceptive Neuromuscular Facilitation Stretching

Proprioceptive Neuromuscular Facilitation (PNF) includes four different types of stretching techniques. These combine muscle contraction and relaxation in order to relax an overactive muscle and/or enhance the flexibility of a shortened muscle. PNF was developed by Herman Kabat MD, PhD, Margaret Knott PT and Dorothy Voss PT in the 1940s to treat paralysis patients. Over the years, other forms of PNF were developed for the treatment of orthopedic, as well as neurologic, disorders.

Post-Facilitation Stretch

1. Target muscle is placed in mid-position
   - Midrange of the muscle's full contraction
2. Patient contracts isometrically for 10 seconds using maximum strength
   - Therapist must not allow muscle to bounce
   -Positioning and leverage are key!
3. Relaxation phase
   - Patient is instructed to let go
   - Therapist immediately stretches muscle
   - Patient may have to practice how to let go immediately
4. Stretch
   - Muscle is held at new barrier for 10 seconds
5. Repeat at new barrier
   - If no increase in ROM was achieved, start at mid-position
     *Increase in ROM due to autogenic inhibition

Post-Isometric Relaxation (PIR)

1. Engage barrier
   - This is done by lengthening the muscle until slight resistance is met
2. Isometric contraction
   - Patient is told to exert slight resistance (10-20% muscle contraction force) in the opposite direction
   - This is held for 10 seconds
   - It is important that the contraction is isometric therefore, no movement must take place

3. Relaxation phase
    - Patient is instructed to relax
    - Wait at barrier for muscle to release and then initiate stretch
4. Stretch
    - Stretch until the next barrier is met and hold for 10 seconds
5. Repeat at new barrier
    *Increase in ROM due to autogenic inhibition

PIR with Agonist Contraction

1. Same as PIR
2. Same as PIR
3. Agonist contraction
    - Following the isometric contraction, the agonist muscle is contracted as the target muscle is taken to its new barrier.
4. Repeat at new barrier
    *Increase in ROM due to reciprocal and autogenic inhibition

Contract-Relax

1. Same as PIR
2. Concentric contraction
    - Target muscle is contracted through its full ROM against resistance
3. Relaxation phase
    - Patient is instructed to relax and let go
4. Stretch
    - Stretch until next barrier is met and hold for 10 seconds
5. Repeat at new barrier.
    *Increase in ROM due to autogenic inhibition

Note: It was assumed that the increased ROM in the muscle was based on muscle fatigue, reciprocal inhibition, muscle spindles, Golgi tendon organs, and so on. However, EMG studies have shown significant activity in stretched muscles after their contraction in PNF-type techniques. Therefore, this increased ROM cannot be solely attributed to relaxation. It has been theorized that actively stretching allows the subject to feel as if they have more control, and as a result, are more willing to extend their tissues into greater ranges.

Cramps

Muscle cramps are involuntary and often painful contractions of the muscles, which result in muscle shortening. It is a common misconception that cramps

originate in the muscle itself and that the muscle fires randomly. In actuality, cramps have been found to be a primarily neurological activity in which the motor neuron that controls a muscle fiber fires at a high frequency, causing this involuntary contraction.

Some Causes of Cramps May Be*:*

- Heavy exercise
- Pregnancy
- Hypothyroidism
- Depleted magnesium or calcium stores or other metabolic abnormalities
- Alcohol consumption
- Kidney failure leading to uremia
- Medications
- Muscle fatigue
- Dehydration

Although cramps may be benign, it is important to note that they may also be red flags of serious neurological, endocrine or metabolic disorders. Cramping should always be evaluated by a professional.

Fasciculations

Fasciculations are single, involuntary firings of motor neurons that will cause brief twitches in the muscle fibers that they innervate. These twitches usually are low in intensity and will usually not produce motion at a joint.

Like cramps, many fasciculations are benign and do not indicate pathology. It is very common for healthy people to experience benign fasciculations. Common areas of fasciculations are eyelids and thumbs.

More serious causes of fasciculations – such as motor neuron disease, or denervation due to radiculopathy – are usually accompanied by weakness and atrophy of the affected muscle group. These pathological fasciculations generally tend to occur randomly, whereas benign fasciculations tend to occur repetitively at the same sight. As with cramping, it is suggested that fasciculations be evaluated by a professional to determine whether or not they are benign.

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Protocol: **Active warm up**
ID:
THR:
Date:

Cat / Camel

On hands and knees.
Let stomach muscles relax and spine sag down as you exhale.
Suck stomach muscles up and in and arch spine up toward the ceiling like a 'mad cat' while inhaling.
Lower back down and repeat.
Move within your pain free range of motion.

Sets:	2
Reps:	12-15
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Cross Crawl Quadruped

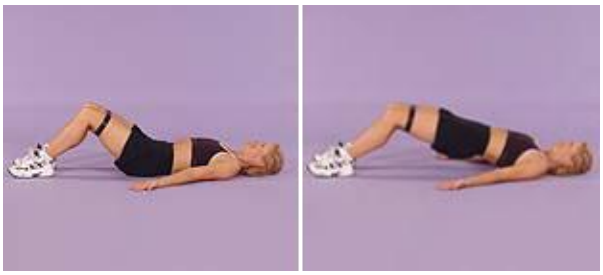
On hands and knees, maintain abdominal brace and neutral spine.
Slowly extend one leg behind while at the same time extending opposite arm out in front until parallel with floor.
Squeeze glutes
Keep trunk square and stable.
Return arm and leg to floor and alternate.

To improve core strength and spinal stability.

Sets:	2
Reps:	12-15
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:



Bridge / Tubing

Lie on back with knees bent and feet flat on the floor, with tubing or a belt around thighs.
Place arms 45° at sides with palms up.
Maintaining outward resistance into belt as well as maintaining abdominal bracing, slowly raise pelvis up off floor into a bridge position.
Shoulder blades should remain on floor.
Hold at end position, then lower and repeat.

To strengthen the muscles of the core, Glute Max, and

Sets:	2
Reps:	12-15
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Side Lying Clam

lie on side with a neutral spine
place band above knees
bend knees
open knees and keep feet together
go only as far as you can keep neutral spine

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Bilateral External Rotation

Place theraband between hands. Start with elbows at your side. Bring your hands away from each other squeezing your shoulder blades while opening the chest.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Wall Slide / Arm Elevation

Stand with back against a wall with head touching wall and chin tucked in. Place feet a few inches away from the wall and raise arms above head. Squat body down the wall keeping arms elevated. Keep low back flat on wall with just a finger space. Actively exhale while performing squat to feel a stretch in the mid back.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Side-to-Side Leg Swings

Holding on to an immovable object, rhythmically swing the leg from side to side, go further as you loosen up. Maintain good posture; chest out, shoulders back, and eyes looking straight ahead. Keep the movement around the hips. Go up on the toes of the planted foot or stand on a small block to avoid elevating the hip to swing the leg side to side.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Toy Soldier

With opposite arm and opposite leg, walk forward making sure to kick the leg high enough to get a stretch

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Sumo Squat

From a shoulder width stance, quickly but smoothly drop into a wider stance deep squat (feet should momentarily leave the ground). At landing, sit into a deep squat with arms reaching out in front of you. Use glutes and hamstrings to help quads cushion the drop, then "pop" up to a staring stance. Chest up, lower back flat, make it rhythmic

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Pull-Back Butt Kicks

Take a step forward and curl one leg toward your glutes. Using the same hand actively pull heel into your glutes and come up on toes of opposite foot. Maintain good posture and don't allow leg to move too far to the side.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


High Knee Walks

Step forward and raise one knee. Actively pull knee up and in with both hands and come up on toes of opposite foot. Maintain good posture, avoid forward lean.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

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Protocol: **General Full Body Stretch**
ID: THR:

Date:

Notes:

Hip Flexors / High Lunge

Standing feet shoulder width apart and toes pointed forward. Step one foot forward into a lunge position staying up on the toe of the back foot.
Keeping upper body upright and pelvis square, attempt to straighten the back knee to feel a stretch in the front of the thigh and hip.

Sets:	
Reps:	
Weight:	
Hold:	20-45 sec
Rest:	
2 x/day	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Short Adductors Seated

Sitting on floor with soles of feet together.
Rock pelvis forward so as to be sitting on your 'sit bones'.
Keep upper body tall, gently allow knees to drop towards the floor to feel a stretch in the inner thigh.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Lumbar Extension - Ball

Lying on back over gym ball with head supported on ball.
Hang hands overhead and/or out to the sides and let spine relax and conform to the ball.
Slowly roll back and forth to get the full length of your spine relaxed.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Adductors - Wall Splits

Lying on back with buttocks up against wall and legs up the wall.
Allow legs to drop out sideways along wall into a splits position.
Keep toes pulled back feel a stretch in the inner thigh.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Gastric - Step
Standing tall with ball of foot on edge of stair or block. Drop heel over edge to feel stretch in the calf.

To improve flexibility at the ankle joint.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Fig.4 Knee to Chest - Supine
Lying on back, knees bent with feet flat on the floor. Cross one ankle onto opposite knee. Bring the knee (that is under the ankle) straight up towards the same side shoulder to feel a stretch in the buttocks.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Calf / Runners Stretch - Ball
Lying on stomach over ball with feet outstretched behind. Raise up onto toe of one foot, resting opposite foot on top. Roll gently backward on the ball supporting upper body with the arms to feel a stretch in the calf.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Warrior Stretch with Twist
Keep back straight. Lunge forward, twist and reach overhead. Keep a neutral spine. Hold for 1-2 seconds and repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Quads Standing

Standing tall, raise one heel toward buttocks (grasp above ankle joint).
Pelvic tilt and squeeze buttocks to extend hip back slightly to feel a stretch in the front of the thigh.
Can support body with hands on a chair, to avoid bending forward.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Tibialis Anterior

Standing, place top of foot on floor behind you.
Bend knees slightly.
Pull as though you are dragging top of foot along floor to feel a stretch in the shin.

To improve flexibility and mobility in the ankle.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

QL Side Bend Reach

Standing or sitting in readiness position.
Slowly bend to one side, without rotating, bringing one arm overhead.
Keep hand that is above head slightly forward and always in view.
Support upper body with opposite hand on hip. Feel a stretch in the side of the low back.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Lats / Rot. Cuff Self Traction

Stand at a 45° facing a closed door with one foot in front of the other in a lunge type position.
Reach forward and grasp doorknob then slowly sit lower body down and backward to feel a stretch in the back and side of the shoulder.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Pectorals - Corner / Doorway

Facing corner or standing through a doorway.
Place forearms on each wall at shoulder height.
Slowly lean chest forward into corner, keeping upper body tall, to feel a stretch in the front of the chest.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Triceps

Sitting tall, place one hand behind neck.
Use opposite hand to grasp elbow and try to slide finger tips further down spine to feel a stretch in the back of the upper arm.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Adductors - Standing Side Lunge

Standing, toes pointed forward, step out sideways into a side lunge position.
Bend upper body forwards, keeping back flat and stabilizing upper body with hands on floor or by holding a chair.
Shift weight from side to side, holding each way, to feel a stretch in the inner thigh and groin area.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Standing Hamstring Stretch

Bend forward at the hip (Hip Hinge) without bending at the knees. Be sure not to round the back as depicted in the second picture.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Posterior Capsule Stretch

On your side with arm out so that shoulder is aligned with elbow bring forearm up to a 90-degree angle. With opposite arm push wrist down to floor. Lean upper body toward floor until stretch is felt.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Levator - Self Traction Chair

Sitting tall, grasp back edge of the chair with hand of the side to be stretched.
Turn head to opposite side and flex head forward ('nose toward elbow').
Let body lean to feel a stretch in the back and side of the lower neck.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

QL / Lats - Side Lying - Ball

Down on one knee, place ball against hip.
Raise body up sideways over ball, supporting with hand on floor.
Straighten top leg and bring arm over head to feel a stretch in the side of the low back and hip.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Standing Internal Rotator stretch

Using a dowel place the stick at the front of the body holding it at the end of the stick with the stretch arm and bend the elbow to 90 degrees. Use the non-stretch arm to pull on the opposite end of the dowel to stretch the shoulder.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Wrist Extensors - Wall

Standing, place arms straight out in front with back of hands against wall.
Keeping elbows straight bend wrists down as far as comfortable and hold.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Wrist Flexors

Place palm of hand on wall with elbow straight and fingers pointing down. Reach opposite hand across and pull back on thumb to increase the stretch.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Quads - Prone

Lying on stomach, bend one knee up toward buttocks. Grasp back of shoe with hand or use a towel around the ankle to bring heel toward buttocks.
Maintain an abdominal hollow and squeeze the buttocks (pelvic tilt) to feel a stretch in the front of the thigh.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Hamstring Up Wall 90°

Lie on back within a doorway. Raise one leg up along wall as far as able. Slowly scoot bum closer and closer to wall, using wall to support leg, to feel a stretch in the back of the leg. Hold.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Plantar Fascia - Bottle

Place bottle under arch of foot.
Roll foot back and forth over bottle.
(a cold bottle out of the fridge works best!)

Sets:	2
Reps:	
Weight:	
Hold:	20-40 sec
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:
Use a frozen plastic water bottle
Tennis Ball
Golf Ball
Wooden Dowel

Shoulder clocks

Lie on one side with knees bent and hands together. While keeping hips on the ground, gently bring arm to other side of the body and let it stretch for 20 seconds. Return to start position and repeat 15 times each side.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Foam Pad Quad Stretch

Place the leg being stretched on Foam Pad.
keeping chest and head up, grab the top of the foot and pull into glute. This is a bit of an advanced stretch.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

SCM stretch

In a seated place one arm behind your back and turn your head the opposite direction. Place your other hand on your head and gently push back and away from the opposite shoulder.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

CHAPTER III

Muscle Contraction

Muscle Contraction

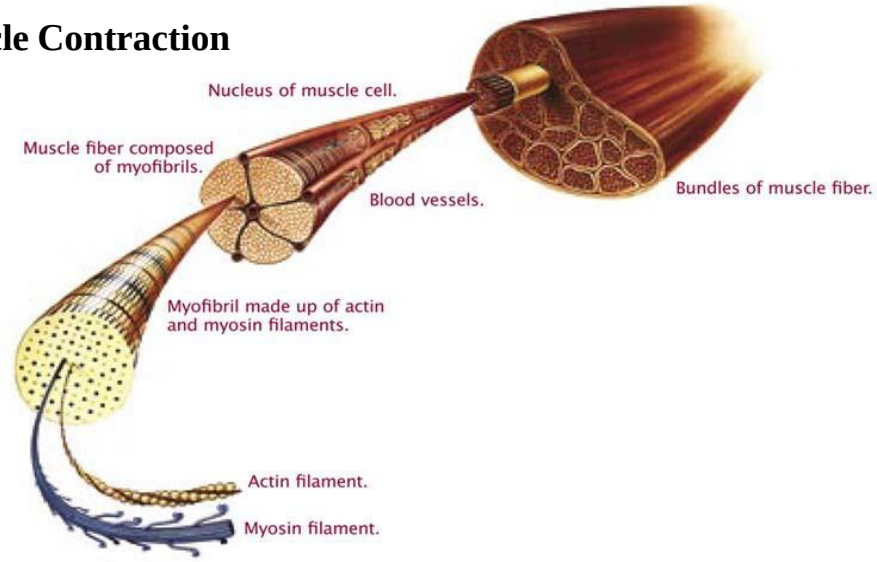


Figure 1

Myofibrils

The myofibrils are the contractile components that allow for strength and the performance of work. When the fiber is stimulated to contract, the myofibrils experience a contractile shortening and their circumference is increased. Myofibrils are comprised of the contractile proteins, **actin** and **myosin**, which actually slide over each other during contractions. Heavy, intense, low repetition resistance training has its primary effect on the actin and myosin. In fact, the process by which damaged actin and myosin are repaired is commonly known as hypertrophy "protein synthesis." During heavy resistance training, the damage to the actin and myosin can be too extensive for complete repair or it can be insufficient to stimulate adaptation. Therefore, the "controlled" damage and repair of them is the key to optimizing myofibril growth. This process can be likened to the repair of skin after being injured, resulting in scar tissue which is much stronger than the original tissue. Muscle is the same. The end result is a much larger and stronger myofibril component.

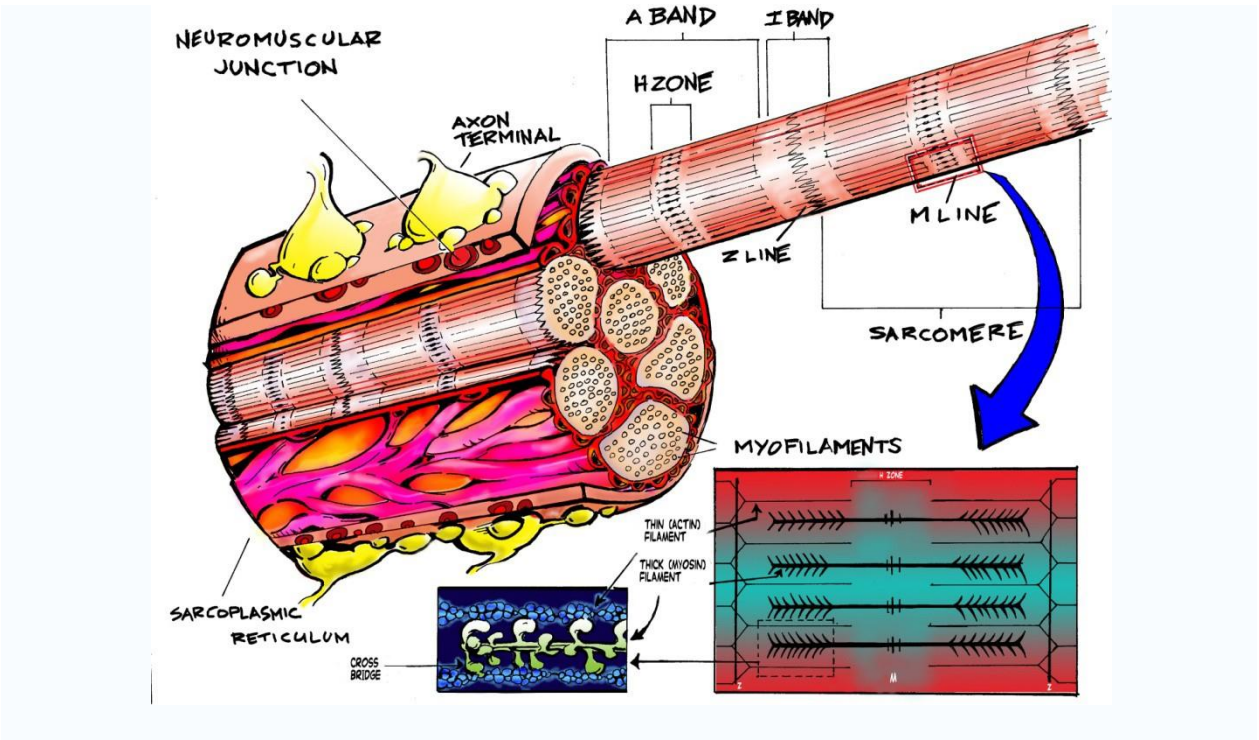


Figure 2

Mitochondria

The mitochondria are located all along the myofibrils. They provide the energy a cell needs to move, divide, secrete and contract. They are commonly known as the "powerhouses," or power centers of the cell. They are about the size of bacteria but may have different shapes depending on the cell type. The mitochondria produce energy in the form of ATP, which is used during contractions for daily activity and recovery energy needs. Through regular and intense, high repetition resistance training the cell must adapt by building more mitochondria. This will boost cellular energy storage and ATP production capacity.

Other Cellular Components

Unlike most other cells in the body, there are several nuclei in the muscle tissue cells. They are positioned all along the entire length of the muscle fiber and are embedded in the cell membrane, or sarcolemma. The nuclei contain DNA. This DNA controls all cellular functions and responds to various hormonal stimulations from the Pituitary, Adrenal, and Thyroid glands. The absence of this hormone stimulation would result in the inactivity and degeneration of the muscle tissue cell. The DNA transfers information from the nucleus to the mRNA used in the nucleolus. The mRNA's function is to take instructions from the DNA to the ribosomes. The ribosomes are the elements that manufacture protein.

These ribosomes occur in the **Rough Sarcoplasmic Reticulum**. The Rough Sarcoplasmic Reticulum is located all along the length of the myofibril components. The ribosomes are the "assembly line" that builds and repairs the contractile proteins, actin and myosin, in the damaged myofibrils using available intracellular amino acids.

Muscle Fiber

A muscle fiber (also technically known as a myocyte) is a single cell of a muscle. Muscle fibers contain many myofibrils. Muscle fibers are very long; a single fiber can reach a length of 30 cm. Muscle fibers can be grouped according to what kind of tissue they are found in – skeletal muscle, cardiac muscle, and smooth muscle. Skeletal muscle fibers can be further divided into two basic types: type I (slow twitch fibers) and type II (fast twitch fibers). The muscle cells of heart muscle tissue are called **cardiomyocytes**.

Component Variation among Fiber Types

There are differences in the myofibrils and mitochondria of all three muscle tissue fibers. With regards to the myofibrils; there are a greater number and size of these components in the white, fast twitch muscle fibers than in the red, fast twitch muscle fibers, and a greater number and size in the red, fast twitch muscle fibers, than in the red, slow twitch muscle fibers.

Muscle Composition

At the highest level, the whole muscle is composed of many strands of tissue called *fascicles.* These are the strands of muscle that we see when we cut red meat or poultry. Each fascicle is composed of *fasciculi,* which are bundles of *muscle fibers*. These muscle fibers are, in turn composed of tens of thousands of thread-like *myofibrils,* which can contract, relax, and elongate (lengthen). The myofibrils are (in turn) composed of up to millions of bands laid end-to-end called ***sarcomeres***. Each sarcomere is made of overlapping thick and thin filaments called *myofilaments*. The thick and thin myofilaments are made up of *contractile proteins,* primarily actin and myosin.

There are **seven** types of skeletal muscle, as shown in Figure 3:

- Fusiform - a muscle that has the shape of a spindle; wider in the middle and narrows at both ends. Greater range of motion, limited strength.

- Quadrate - a muscle that is square shaped with directly parallel fibers.
- Triangular - a wide origin that converges to a narrow insertion resembling a triangular shape.
- Unipennate - fibers are on the same side of the tendon.
- Bipennate - fibers on both sides of the central tendon.
- Longitudinal – fibers run straight from top to bottom (tongue).
- Multipennate - central tendon branches within a pennate muscle.

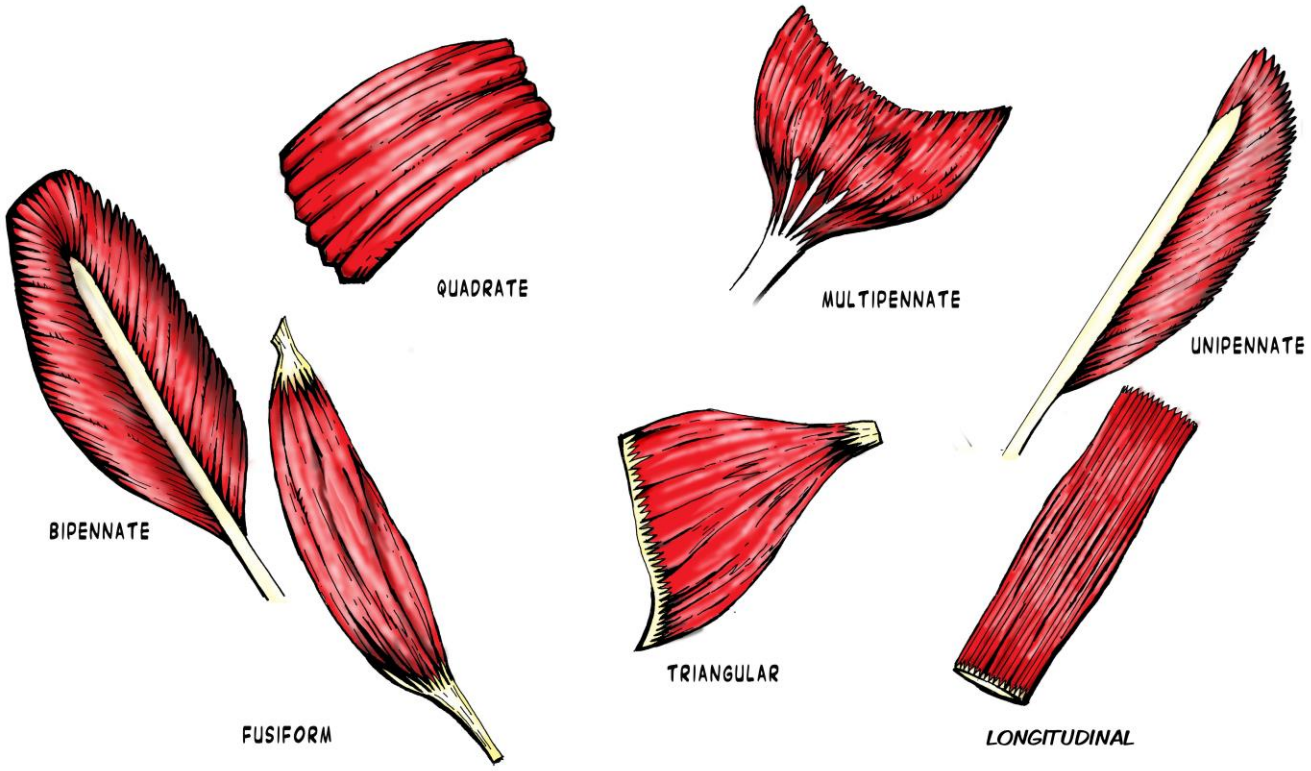


Figure 3. The seven types of skeletal fibers. Most skeletal muscles are either fusiform or pennate fibers.

Muscle Fiber Types

As mentioned, there are three types of muscle tissue: (1) white, fast twitch, (2) red, fast twitch, and (3) red, slow twitch muscle fibers. These different fibers have exactly the same internal components but vary in number and size. They have differing levels of a substance called myosin-ATPase, which breaks down ATP for energy. The more of this enzyme, the faster the contraction, thus more power as well. These fiber types have varying cardiovascular "support systems" and fuel-utilization characteristics and have different types of nerves that stimulate

them. Therefore, they are coordinated, or organized functionally, as well as structurally. The individual fiber is stimulated to contract by a branch of the neuron called an axon, which varies in thickness and the degree of myelination, or insulation it possesses. The thicker or more myelinated it is, the faster the signal can travel down it. For highly efficient aerobic metabolism to occur, oxygen must be present. This is delivered to the muscle cell by a very small tube called a capillary. Microscopic capillaries extend throughout intramuscular areas surrounding the muscle fibers.

White, Fast Twitch Muscle Fibers- Type II b

White, fast twitch muscle fibers have fewer capillaries and must rely on glycolysis for energy – thus, the name fast-glycolytic fibers. In the absence of this oxygen-rich blood supply, they cannot function for very long periods. A lot of fibers are contained within the fast twitch motor unit and the girth of the individual fiber is large, which causes them to possess more contractile proteins, since they are extremely strong.

Red Fast Twitch Fibers- Type II a

The red, fast twitch muscle fibers have a greater number of capillaries, and can, therefore, outlast the white, fast twitch fibers. But they don't have as much myosin-ATPase and, therefore, generate less tension. These muscle fibers are able to use either oxidative (aerobic) or glycolytic (anaerobic) metabolic pathways and are called Fast Oxidative Glycolytic fibers. The long-distance Kenyans and some middle-distance runners have high proportions of these fiber types.

Red, Slow Twitch Muscle Fibers - Type I

The red, slow twitch muscle fibers have a tremendous number of capillaries which allow for long-term sustained activity. However, there are fewer fibers in each motor unit, and each fiber is thinner than its fast twitch cousins, so they produce less strength. To perform well, endurance athletes must have a high proportion of these. Training can have significant effects on the capacities of these fiber types, but in most cases cannot change the fiber types.

Coordination of Muscle Fiber Types to Motor Units

All three muscle fibers occur within each muscle in genetically predetermined proportions. The muscles themselves will vary in the proportions of these fibers. For example, a postural muscle like the Soleus, which is used during standing to keep balance, has a high percentage of slow twitch fibers whereas the Gastrocnemius, just above it, is used for explosive jumps and is much higher in fast twitch fibers.

The white, fast twitch muscle fibers have very few mitochondria elements, thus restricting the duration of its contractions. The red, fast twitch muscle fibers have more mitochondria elements than the white ones, meaning it can contract for longer periods prior to failing. The red, slow twitch muscle fibers have a tremendous number of mitochondria elements, allowing for sustained contractions for much longer periods than either of the other muscle fiber types.

Skeletal Muscle Tissue

- Roughly 40 % of body
- Structure of muscle cell
- Elongated: length of muscle
- Multiple flattened nuclei along outer portion near sarcolemma
- Consists of bundles of fibers (myofibrils)
- Bundles of muscle fibers wrapped in connective tissue are called fasciculi
- Nerve connection to muscle belly called motor end plate
- Myofibrils made of contractile proteins: actin (thin myofilaments) and myosin (thick myofilaments)
- Thin myofilaments also contain proteins **troponin** and **tropomyosin** which aid in contraction
- Actin connected to myosin through cross bridges
- Muscles that work together to produce a common movement: synergists
- Muscles that produce opposing movements: antagonists

How Muscles Contract

Nerves connect the spinal column to the muscle. The nerve and muscles meet at the *neuromuscular junction*. Acetylcholine is released by the axon into the synapse, where it then stimulates the target sarcolemma. Inside the muscle fibers, the signal stimulates the flow of calcium which causes the thick and thin myofilaments to slide across one another. When this occurs, it causes the sarcomere to shorten and generates force. When billions of sarcomeres in the muscle shorten all at once, it results in a contraction of the entire muscle fiber. Its main purpose is to move you. It connects to the bones and makes them move or not move.

Muscle Contraction

- Motor nerve cell (neuron) carries stimulus to motor end plate
- Acetylcholine crosses the neuromuscular junction and stimulates sarcolemma

- After acetylcholine reaches muscle fiber, it stimulates a release of calcium in the cell, which triggers action of the troponin and tropomyosin
- Cross bridges pull thick and thin myofilaments over each other, shortening the length of entire fiber
- One neuron may innervate up to one hundred muscle fibers
- Motor unit: unit of muscle fibers innervated by one single neuron
- The less muscle fibers innervated by one neuron, the more fine control over the muscle (fine movements)
- Force is generated in two ways: 1) increasing the amount of motor units firing; 2) increasing the speed of neuro-motor stimuli
- When a muscle is stimulated to work, it can only shorten. Muscles pull on the objects they are connected to

Concentric Contraction

- Muscle contraction as fibers shorten
- Usually active, voluntary

Eccentric Contraction

- Muscles contract as fibers lengthen
- Usually involuntary, to protect the joint
- Usually antagonistic - purpose is to decelerate the agonist which usually occurs at the end range of the joint
- Strength training is more effective when includes eccentric actions
- More muscle injuries occur during eccentric than concentric phase

Isotonic Contraction

- Muscle contraction with movement around the joint

Isometric Contraction

- Muscle contraction with no movement around the joint

Isokinetic

- Muscle contraction at a constant velocity
- Example: pushing an object that cannot be moved

Agonists

- Muscle performing a particular action

Antagonists

- Muscles that act in opposition to the movement generated by the agonists
- Responsible for returning a limb to its initial position

- Reciprocal Inhibition (forced relaxation)
- Inhibited from contracting due to tight agonists

Antagonistic Muscle Groups

- Pectorals/latissimus dorsi
- Anterior deltoids/posterior deltoids
- Left and right external obliques
- Quadriceps/hamstrings
- Biceps/triceps
- Forearm flexors/extensors

Synergists

- Smaller muscles providing assistance to the larger working muscle groups

Stabilizers

- Muscles providing stability for the agonist to perform

**The individual fiber is stimulated to contract by a branch of the neuron called an axon. If you could isolate and cut a cross section of an individual skeletal muscle cell fiber and look inside, you would see that it consists of several components each have a specific function. Your training will increase in productivity when you understand how to individually and intelligently affect the cell function.

Skeletal Muscle Structure and Function

There are also seven types of skeletal muscle. The structure of a muscle is specific to its purpose and function. The types of skeletal muscle are:

- Fusiform - a muscle that has the shape of a spindle, which is wider in the middle and narrows at both ends. This allows for greater range of motion but limited strength
- Quadrate - a muscle that is square shaped, with parallel fibers that run directly from origin to insertion
- Triangular - a wide origin that converges to a narrow insertion resembling a triangular shape
- Pennate muscles - fibers run obliquely with respect to the tendon
  - Unipennate - fibers are on the same side of the tendon
  - Bipennate - fibers on both sides of the central tendon
  - Multipennate - central tendon branches within a pennate muscle

- Longitudinal - parallel fibers consisting of tendinous intersections that run perpendicular to the direction of the fibers
- Most skeletal muscles are either fusiform or pennate fibers

Connective Tissue and Blood Supply

The epimysium surrounds the entire muscle group with a sheath of connective, fibrous, and elastic tissue. The sheath of connective tissue surrounding a bundle of muscles, or motor unit, is called the perimysium. The connective tissue surrounding each muscle cell fiber is the endomysium. These different fibers have differing cardiovascular "support systems." Microscopic capillaries extend throughout intramuscular areas surrounding all these muscle tissue fibers. The white, fast twitch muscle fibers have very few capillaries, and in the absence of this nutrient rich blood supply, they cannot function for very long periods even though they are extremely strong. The red, fast twitch muscle fibers have a greater number of capillaries and can therefore outlast the white, fast twitch fibers, even though they are not nearly as strong. The red, slow twitch muscle fibers have a tremendous number of capillaries, allowing for long-term sustained activity with very little strength.

Motor Units

A motor unit is a single motor neuron plus all the muscle fibers to which it connects. Some motor neurons only connect to a few muscle fibers, while other motor neurons connect to hundreds of muscle fibers. All the muscle fibers randomly occur together in small bundles in genetically predetermined proportions. These bundles are called motor units and are named after the predominant type of fibers located in these motor units.

Motor Unit Function

Generally speaking, white, fast twitch motor units are responsible for speed and strength, and a person who has a predominance of these would be best suited for strength events. The red, fast twitch motor units are responsible for sustaining a load over prolonged periods, and a person with a predominance of these motor units would be best suited for events requiring stamina, such as boxing, football, basketball, and so on. The red, slow twitch motor unit is responsible for producing energy over long periods, and a person with a predominance of these would be best suited for endurance events.

Motor Unit Recruitment Methods

Immediate Recruitment

As a general rule, only the minimum number of motor units required to move a given weight will contract in performing work. Pick up a very light object in your hand, bend your arm at the elbow, and feel the contracted bicep with your free hand. The muscle will feel somewhat soft because only the red, slow twitch motor units are contracting. The assistance of the remaining motor units is not required. If the resistance is slightly greater, the red, fast twitch motor units will assist the red, slow twitch motor units. Once again, for example, pick up a heavier object and feel the contracted bicep. It will feel harder than it felt when lifting the lighter object because more motor units are working. If the resistance is greater yet, the white, fast twitch motor units will finally assist in the work. This time pick up a very heavy object, and not only will your bicep feel extremely hard, but you will also feel the strain against the resistance. In this case, most if not all, the motor units in the working muscle are involved. The immediate involvement of varying numbers of motor units based upon the amount of weight moved is one form of motor unit "recruitment." Immediately providing extremely heavy resistance will insure an earlier "recruitment" of the white, fast twitch motor units, which we know to have the greatest potential for growth. This also tells us that performing light resistance exercise will be of little value in optimizing growth. There is, however, still some growth stimulation of the red, fast and red, slow twitch motor units in lighter high repetition training. However, they can experience only limited growth by comparison, due to their tissues' differing composition, which will be discussed in greater detail later.

Depleting Energy Recruitment

As a result of depleting energy, another type of motor unit recruitment occurs. For example, during contractions of a muscle group against light resistance, each repetition steadily depletes the working motor units of energy, and other motor units are called upon to assist the fatigued motor units in the same order as before. First the red, fast twitch motor units assist the already working slow twitch motor units. As the red, slow and red, fast twitch motor units are continuing to tire, the white, fast twitch motor units are called upon. By the time the white, fast twitch motor units start working, the entire muscle group is rapidly exhausting. It is also quite probable that by the time the white, fast twitch motor units are called upon, lactic acid and free phosphate are accumulating, thus inhibiting further contraction. This type of recruitment minimizes the involvement and growth stimulation of the white, fast twitch motor units, which are known to have the greatest potential for growth. To experience this type of motor unit recruitment, pick a relatively light

weight and begin to perform repetitions. As the muscle becomes more and more fatigued, you will begin to notice a burning sensation, and a slight pump. As the exercise becomes more difficult, especially when performing a movement involving a very large amount of muscle tissue, such as the squat, your heart rate will become elevated and your breathing labored. As the movement becomes even more difficult with each repetition, there are more white fast twitch motor units coming into play, since these motor units are reserved until last when the work is more strenuous. When you finish the set, after performing as many as 25 repetitions, the white, fast twitch motor units may only have performed optimally for two to three of those last repetitions. This is hardly enough to stimulate optimum involvement.

Contractile Speed Recruitment

Yet another type of motor unit recruitment is based on the speed of contraction. A maximum contraction against a sub-maximal resistance will, in theory call on the red and white "fast twitch" motor units due to their faster contractile speeds. This can be accomplished through compensatory acceleration training, plyometrics, or by performing Olympic style weight lifting. Olympic style weight lifting has been applied to athletes for years by strength trainers. It is used more frequently when training for specific events requiring explosive types of movements, and without proper execution, can increase the risk of injury. Therefore, the frequency of this type of training should be controlled. It is the National Federation of Professional Trainer's (NFPT) position that the risk of injury far outweighs the benefits to be gained from Olympic lifting, especially among non-athletes or by athletes without the benefit of professional and experienced instruction. Non-load barring "plyometric" (multi-directional) training is the suggested option to enhancing power and speed.

Resistance Exercise and Contractile Failure

Neuromuscular Failure - Power and Speed, All Players

This type of failure results more in the enhancement of nerve impulse transmission rather than muscle strength and/or endurance. Examples of activities that involve neuromuscular failure includes Olympic style lifting such as power cleans, cleans, jerks, clean and jerks, and other load barring compensatory acceleration activities. These training methods are also commonly referred to as being "ballistic." These exercises have been used in the past and are still used, with the desired affect being the enhancement of speed and power through explosive muscle contraction lasting only a split second under extremely heavy loads. This trains the neuromuscular

system, and not significantly the muscular system, because the duration of the contraction is too short to cause damage to muscles significant enough to result in growth and strength increase. These exercises should be done under supervision and are trained movements over time. Moreover, there is a high risk of injury associated with these "speed" and "power" activities. There is a "multi-directional" sports conditioning training methodology called "plyometrics" that accomplishes the carry over designed for on field performance. Plyometrics should be done after building appropriate strength, core control, joint integrity and proprioceptive awareness.

Myofibril Failure 4-6 Reps - Size and Strength

The second of these four types of failure occur if the resistance is so great that the contractile components fail prior to the depletion of available energy in the working muscles. These near "maximum contractions" will call upon the immediate recruitment, damage, and growth of existing myofibrils, especially in the white, fast twitch motor units. We'll call this Myofibril Failure. The optimum repetition range to use for this effect is the four to six repetition range (this repetition range has been determined through independent research discussed elsewhere in this manual). Frequent performance of sets using fewer repetitions to failure can result in acute or accumulative damage to soft tissues. If you were to train to failure in the one to three repetition range over a long period of time, you may not outwardly feel pain from accumulative muscle tissue injury, but in reality, microscopic tears can occur in the tissues that require extended periods of time for adequate repair. The greater the damage, the larger the scar tissue and the larger the scar tissue, the greater the scar will inhibit proper musculoskeletal function. This could then lead to a very serious acute injury to the muscle. One to three repetition sets should rarely, if ever, be performed with the possible exception of competition or infrequent progress measurements. Damage to cartilage, ligaments and tendons is possible if you typically lock out joints at the top of heavy pushing movements or fully extend at the start of heavy pulling movements. This is because in these positions, the above passive structures are supporting the weight.

Intermediate Failure 12-15 Reps (Muscular Stamina)

The third of these four reasons for contractile failure occurs when the contractile components are failing at or about the same time as the short- term energy stores are depleted. This, in theory, will result in adaptation through the building of new myofibrils and mitochondria, especially in the red, fast twitch motor units. We will call this type of failure Intermediate Failure. The optimum repetition range to use

for this is 12 to 15 repetitions. Sets of 7 to 11 repetitions call on the participation of both white and red, fast twitch motor units. This should be avoided because neither type of motor unit will be optimally stressed.

Mitochondrial Failure 20-25 Reps (Muscular Endurance)
The fourth contractile failure type occurs as a result of depleted energy stores and a subsequent accumulation of contraction inhibiting substances prior to causing any growth stimulating damage. This, in theory, will result in adaptation through the increased storage of energy and the building of new mitochondria, especially in the red, slow twitch motor units. The optimum repetition range to use for this affect is 20 to 25 repetitions. Performing sets of 16 to 19 repetitions will once again call on the varying involvement of the red, fast and the red slow twitch motor units. This will not provide the optimum involvement of either of the two fiber type motor units individually.

Dispelling Common Myths
All the tissue fibers within a motor unit will contract together because the entire motor unit is stimulated to contract by the same neuron, regardless of the angle of resistance (innervations). Movements should be selected that allow the target muscles to be stressed by the heaviest amount of weight possible, calling on the involvement of the greatest number of motor units possible or the desired method of motor unit recruitment. Extremely heavy compound movements are said to have the greatest degree of leverage and should always be used in preference to partial isolation movements. It is important to once again realize that strict isolation is an anatomical impossibility since one muscle group cannot function on its own. All muscle tissue fibers run the entire length of the muscle group, from its origin to its insertion, and receive growth stimulation uniformly throughout their entire length. With this in mind, once again, it is physiologically impossible to shape a muscle. Muscle tissue structure and shape are strictly genetic.

Cardiac and Smooth Muscles
Cardiac muscle refers to the heart itself. Smooth muscles include digestive, respiratory and vascular tissues. The digestive and respiratory tissues provide for the movement of nutrients and wastes for their uptake and excretion respectively and will not be discussed in great detail here. Vascular tissue, or blood vessels, function in a variety of ways in response to exercise, adrenal hormone stimulation, and sympathetic nervous system stimulation.

Cardiac Muscle Function & Resistance Exercise

The cardiac muscle is similar in many ways to skeletal muscle. They are striated and house the same cellular components in varying proportion. The heart muscle will adapt to resistance exercise in the same way that skeletal muscles do. If the heart is forced to pump against an increased amount of resistance for prolonged periods, which is common in resistance exercise, the cardiac tissue or heart muscle will most likely adapt by increasing in size and strength.

CHAPTER IV

FOAM ROLLERS

Our Central Nervous System

Over time, our bodies may develop structural imbalances, excessive scar tissue, trauma from injury, and painful points along a muscle or in the fascia. These 'trigger points' can cause a restriction in blood flow to the muscle, shortening of the muscle, and possibly inflammation and pain. Any one of these problem s can inhibit proper posture, effective exercise form, proper joint alignment and poor neuromuscular transmission, potentially setting the stage for a more serious injury. Trigger points also put a strain on surrounding muscle and tissue that must compensate for the weakened area.

Foam rollers are an excellent method of myofascial massage. They break down the scar tissue that has formed, thereby returning the blood flow and nervous system transmission to/from the area. Removing the 'knots' will also allow for exercises to be effective in returning the structural balance and joint stability to the area and removing the stress on the muscles that have been compensating for the weak area. Greater flexibility will also be achieved.

To correct poor movement patterns, one must become aware of the pattern they've adopted and retrain their brain and central nervous system (CNS). Small, precise movements are the most effective way to retrain the CNS and restore the correct muscle movement pattern.

Foam rollers are one tool that can be used to accomplish this task. They are hard, cylindrical and unstable and their use requires complete concentration. Therefore, they are not only used for muscle exercises or treatments, but are brain exercises as well. Total focus is required to maintain stability.

It is important to be able to activate our core musculature for stability and balance, not only for anyone involved in any type of sport, but also in our day-to-day lives. As we age, we typically don't engage in activities that require using our stabilizer muscles.

Some research suggests that exercises on an unstable surface, or exercises done on one leg, challenge the core muscles to fire and aid in a person's proprioceptive awareness – your body's awareness of its limbs in relation to the rest of your body and the environment or space around it. After an injury, for example, an athlete may find their performance and accuracy aren't what they were before. This may stem from the inability of the necessary muscles to send and receive signals to and

from the brain. Proper force generated in our core translates to proper force and movement in the rest of the body.


Foam Roll Hamstrings

Begin with the foam roller at the top of the hamstrings, keeping the feet off of the floor. Use arms to roll down the hamstrings to behind the knee. Roll back and repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

Notes:

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31


Foam Roll Glutes

Begin sitting with the foam roller at the top of the glutes. Use legs to push up and roll to the bottom of the glutes. Roll back and repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

Notes:

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31


Foam Roll IT band

Begin lying on side with foam roller at the top of the hip. Keeping the leg being rolled off of the floor, use other leg and arm to roll down the leg to just before the knee. Roll back to the top of the hip. Repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

Notes:

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31


Foam Roll Low Back

Begin sitting on foam roller with roller just at the top of the glutes. Use legs and arms to roll up to the mid-back. Roll back and repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

Notes:

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31


Thoracic stretch

Begin lying on the foam roller with roller in the small of the back. Use legs to roll up the mid-back to the top of the traps. Roll back and repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Foam roller thoracic mobility

Place foam roller horizontally on the floor.
With knees bent and your hands clasped behind your head, lay back over the roller.
Lay your mid back over the foam roller and then roll your spine back and forth slowly by flexing and extending your knees. Keep a neutral spine and keep low back down as you extend over the roller.
Your head should almost touch the floor.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Foam Roll QL

Begin side lying on a foam roller with roller just above the top of the hip. Use arm and leg to roll up the side to just below the ribs. Roll back.
Repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:


Foam Roll Gastroc/Soleus

Begin with foam roller behind the knee with one leg crossed over the other. Using arms to support the body, roll down to the ankle and back. Repeat.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Foam Roller Adductor

place roller under groin area and move from side to side

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Foam Roller Lat

lying on your side place roller under you
tip back slightly so you can really focus on lats
use legs to move up and down

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Quad roll

Place roller just above knees and roll up to hips then repeat. Tipping onto one side will focus on that side.

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

Psoas roll

place roller just below hip bone and roll up onto your belly and back

Sets:	
Reps:	
Weight:	
Hold:	
Rest:	

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

Notes:

CHAPTER V

NUTRITION

*The nutritional advice in this section is meant for the general population and is not recommended for individuals with any allergies or medical conditions. In the event that you are on a special diet set by your doctor or weight loss professional, do not alter that program or combine it to fit the information in this chapter.

Nutrition

Our society is filled with different opinions and advice about nutrition. No one can seem to agree! One of the main problems is that the majority of people lose weight and gain it back only to diet again, which is a process known as "yo-yo dieting." This type of dieting only gives you short term results and can be detrimental to your health. This chapter will give insight on the science behind how the body digests and metabolizes food. Understanding how the body works will educate you proper nutrition, which is important for everyone not just athletes and active people. Everyone needs to eat a balanced diet, which includes complete proteins and essential nutrients, in order for the body to work efficiently. Learning about nutrition will also demonstrate why so many diets fail; they are just marketing ploys that have no scientific facts or research behind them.

General Pre-Workout:

Food preferences for pre-workout snacks can vary depending on the individual, type of exercise and level of intensity. For example, endurance athletes can often eat more during a long, slow cycle when their heart rate is lower, than while running or training at a higher heart rate. These guidelines will help determine if a snack is appropriate. Check to see the following before snacking:

- Contains a sufficient amount of fluid to maintain hydration
- Is low in fat and fiber to facilitate gastric emptying and minimize GI distress.
- Is high in complex carbohydrates to maintain blood glucose levels and maximize carbohydrate stores in the muscles and liver. Examples are carbohydrates such as fruits, vegetables, rice, oats and whole grains.
- Contains protein to avoid cannibalizing muscle tissue for protein.
- Is low in simple sugars and free of dyes and additives. High levels of sugar can spike insulin. When you spike your insulin, this causes the pancreas to pump insulin into the blood stream. Too much insulin will cause glucose levels to drop too low and cause hypoglycemia. In response to low blood sugar the liver now releases glucose into the blood stream. These spikes and dips in blood sugar can lead to insulin resistance and eventually diabetes. Sugar also slows the absorption of water by up to 20% and can contribute to dehydration.

The amount of food you can eat pre-workout depends on the amount of time allowed between eating and working out. Generally, the more time between eating

and exercise, the larger the quantity of food you will be able to eat. It is important to allow more time for digestion before intense exercise than before low-level activity. This is because your muscles require more blood during intense exercise and therefore less blood will be available to your stomach to help with digestion. If you have a finicky stomach, try a liquid snack prior to your workout. Liquid snacks, such as smoothies or sports drinks, tend to leave the stomach faster than solid foods do and will be easier to digest. Each person is different so play around with the listed choices to see what works best for you and your workouts. Remember it is not just about what you eat right before or right after exercise. It is about eating well all the time throughout the day.

Pre-workout Snack Ideas:

- Apple with Ostrim beef/elk stick (all natural)
- Protein bar – some brands: Cliff Mojo, PowerBar Harvest, Quest Bar, No Cow Bar, Jay Robb
- Sprouted multi grain bread with peanut/almond butter or
- Fruits and veggies with cottage cheese.
- Small bowl steel cut oats (5g - 7g of protein per ¼ cup serving) with hemp or almond milk or Quinoa porridge
- Orgain protein-only shake
- Egg Whites International pure egg protein

General Post-Workout Snack Guidelines to Follow:

- In order to see improvements in your fitness level and help your body recover from an intense exercise session or competition, it is extremely important to eat after a workout. This is because two things are happening when you work out:
    - You are creating microscopic tears in your muscle tissue (during resistance exercise)
    - You are depleting your body's glycogen stores (glycogen is stored glucose in muscle tissue, which is burned for energy during any workout).
- Experts believe that it's best to ingest easy to digest carbs and protein immediately after your workout. The research has claimed that this window of up to 45 minutes is when the body will use the carbs to both replenish glycogen stores in the muscles and liver and increase protein synthesis. There has been debate on this topic. Some experts believe that this window doesn't really exist, and that glycogen is stored as usual while protein is synthesized the same. The truth is that having good carbs and protein will

insure the body has the nutrients it needs to recover. It just makes sense even if it doesn't absorb any faster.

- Your recovery snack should be a mixture of carbohydrates (simple and complex) and protein. Carbohydrates restore glycogen to muscle while protein provides the necessary amino acids to rebuild muscle tissue. Ideally, you should look for easily digestible forms of these nutrients that your body can break down. For example, the protein in a shake is much easier digested than the protein in a steak.
- Recommended post-workout snacks vary based on your weight and goals. Keep your post-workout snack below 200 calories; bodybuilders can increase their calories to 300 kcal. If the end of your workout coincides with a mealtime, you can consume your meal instead of a snack, as long as it has both protein and carbohydrates.

Post-workout Snack Ideas:

- Plain yogurt with fruit and low-fat granola
- Banana and peanut/almond butter on brown whole wheat bread or brown rice cake
- Hard-boiled eggs with whole-grain bread
- Smoothie with whey or egg-white protein powder, frozen berries, almond milk or ground flaxseed
- Turkey wrapped in avocado with apple slices
- Orgain shake
- Egg Whites International pure egg protein

Hydration

Water is critical to your body's ability to function, remain cool, and even to stay warm. In adults, an estimated 50-65% of total body weight is water, depending on gender and age. In infants and adolescents, this is estimated to be much higher at around 75%. Water regulates body temperature and is responsible for the movement of nutrients, digestion, absorption, circulation, and excretion of wastes.

The body's average daily loss of fluids through excretion, respiration, chemical reactions, and perspiration varies from about 1 to 3 quarts. A high protein intake calls for an even greater amount of fluid intake. Water is absorbed from the small intestine at a maximum rate of 8-10 ounces every 20 minutes. It is necessary to hydrate during and after exercise. When preparing for an aerobic activity or any intense exercise, weigh in before and after. Then ingest 16 ounces of water per

pound of weight lost, at the rate of 8-10 ounces every 20 minutes, until replenishment of 16 ounces per pound lost is restored.

Electrolytes
Electrolytes are a group of minerals, such as sodium, potassium and chloride that are extremely important for maintaining hydration and proper fluid balance in the body. Electrolytes are depleted during intense long-term activity, and this may contribute to dehydration. To replenish electrolytes, the following food and drink sources are recommended:

- Coconut water, pressed watermelon water and fresh juices
    - Avoid sugary artificial sports drinks
- Banana
- Potatoes
- Prunes
- Raisins
- Watermelon
- Avocados

Sample Daily Diet:
Breakfast: smoothie with egg white or protein powder. You can use almond, rice, hemp, or quinoa milk.
Snack: natural yogurt or peanut butter on a rice cake
Lunch: turkey or bison burger on a lettuce wrap or turkey/organic beef chili.
Snack: avocado with natural beef stick or protein bar.
Dinner: Grilled fish or chicken with sweet potato; salad; sautéed vegetable with garlic and olive oil.

Guidelines for Dining Out

- Eat a healthy snack before going out to dinner, so you do not arrive at the restaurant famished and then overeat.
- Drink a glass of water before the meal and continue drinking water throughout the meal.
- Do not eat the bread on the table before the meal. Request that it is removed from the table or place it out of arm's reach.

- To start the meal, order a salad (with non-creamy dressing on the side) or a broth soup.
- Do not order fried or breaded foods
- Share your appetizer or entrée with a friend. Alternatively, cut your portion in half and ask for the second half to be brought home in a doggie bag.
- Ask for extra vegetables instead of rice or potato.
- Ask questions about how items are prepared. Choose foods that are baked, broiled, roasted, poached, grilled or steamed. Stay away from items that are sautéed, cooked with cream or butter, scalloped, au gratin, Alfredo, or batter dipped.
- All sauces and condiments should be ordered on the side.
- Reduce the amount of cheese in the meal.
- Eat slowly
- Limit alcohol consumption. If you are drinking, make sure to drink plenty of water with a goal of 2 glasses of water for every alcoholic beverage.
- Avoid high calorie desserts. If you must eat dessert, try the "three bite rule."
- Avoid buffets.
- For lunch, choose whole-grain or whole wheat bread. Choose lower calorie meats, like turkey, chicken, and lean cuts of ham and roast beef. Ask for less meat and more vegetables. Use mustard, vinegar and low-fat dressings rather than mayonnaise and oil. If you must have cheese on your sandwich, limit it to only one slice.
- For breakfast, choose Greek yogurt, oatmeal, eggs/egg whites, non-sugar-high fiber cereals, fruit, and protein shakes. When splurging,

remember that pancakes with syrup have one third less fat than French toast or a Belgian waffle with whipped cream and fruit.

CHINESE FOOD

- Drink tea to feel full sooner and slow down your meal.
- If available, choose a lunch-sized portion.
- Choose a soup as an appetizer. Egg drop soup and hot & sour soup are about 100 calories/cup. Eat plenty of fruits and vegetables, and select fruits and vegetables with a wide variety of colors.
- Select a chicken, shrimp or vegetable dish instead of a noodle or rice dish.
- Ask for brown rice instead of white or fried rice.
- Ask for twice as much veggies and half as much meat in your entrée.
- Order steamed dumplings rather than fried.
- Don't eat the fried noodles!!!

ITALIAN FOOD

- Avoid the bread basket, especially the garlic bread.
- For appetizers, choose minestrone, insalata, bruschetta, and roasted peppers.
- Select marsala, arrabiata and piccata entrees instead of scaloppini, pesto, or parmigiana. Avoid casseroles and cream filled pastas.
- Limit the cheese.
- When ordering pasta, only eat half. Choose marinara-based pasta dishes or red or white clam sauce.

PIZZA

- Go light on the cheese. Do not add extra cheese!
- Ask for vegetables toppings.
- Choose a thin crust when possible.
- Choose pizza with red sauce instead of cream sauces.

MEXICAN FOOD

- Watch your sour cream, guacamole, and cheese.
- Limit fried tortilla chips and nibble on tortillas instead.
- Use salsa, which counts as one serving of vegetables

Fasted Cardio

So, you just picked up a muscle & fitness magazine and read that fasted cardio can help you get leaner. The article you read claims that the body burns more fat while exercising in a fasted state compared to doing cardio later in the day after eating. As a result, you decide to take your morning spin class on an empty stomach, thinking you will burn more fat and build more muscle. But does the science prove this? For years this idea has been accepted as fact by fitness gurus, professionals in the industry and gym rats. However, it is only half true because it is only half of the story. While it does work and will utilize more fat as energy, it may not be any more beneficial than doing cardio a couple of hours after eating.

Part of the issue is that we, as consumers, tend to focus on what seems to be working without investigating why it works. There is so much information out there however a lot of it is conjecture and not based on scientific fact. It is important to make informed choices and not accept every article as fact or believe everything the 5% body fat bodybuilder or freak athlete preaches about. When you read an article check the sources, this is more important than the author itself. Genetics play a role in how our bodies function and there are some people that get results no matter how they badly they eat or how they poorly they train. Unfortunately, this is not the norm. The point of this article is to demonstrate that fasted cardio is NOT the end all be all for fat loss. The body prefers using carbohydrates as an energy source and performs better when using them as the main source.

Types of *Cardio Training

There are different types of cardio workouts, which affect how your body burns energy and what type of fuel is utilized. Cardio training can be HIIT (High Intensity Interval Training) cardio, low intensity long duration, or moderate intensity cardio. It is generally understood that you have the potential to burn more calories within sessions of longer duration exercise vs. HIIT. However, even though you burn more calories DURING a session of long exercise, HIIT will burn slightly more calories POST- WORKOUT due to the process of EPOC (exercise post oxygen consumption). This is also known as “afterburn”. Therefore, your ability to burn total calories will be more with HIIT because calorie burn continues even after you are done exercising!

While research supports EPOC, the truth is it is oversold and the difference is not as dramatic as marketed.

*When we use the term cardio we are referring to treadmills,ellipticals, steppers and exercise other than weight lifting.

Bioenergetics Basics

Every activity, from breathing to reaching for a glass of water, requires energy which comes from calories. We burn calories all day and even at night while we sleep. We ingest calories as fats, carbohydrates, and protein. Fat yields more energy per gram than carbohydrates because it is much denser in calories. Carbohydrates and protein are only four calories per gram while fat is nine calories per gram. Fat and carbohydrates are the preferred fuel sources for energy, while protein is spared and used for enzyme synthesis and muscle creation.

After meals, carbohydrates are readily available in the bloodstream as glucose and can be stored as glycogen in the muscles and liver. Once these glycogen stores are full, the body will convert the excess and store it as fat. This is why eating too many carbohydrates makes us fat! There is a finite amount of storage space for extra carbohydrates, while there is an infinite amount of storage space for fat in the body. As a result, all excess energy that isn't utilized by the body is stored as fat.

Proteins are made up of amino acids. The body must ingest nine essential amino acids to create usable protein for cellular uptake in the body. Think of protein like a chain and each essential amino acid as a link. If there is a link missing, then the protein is incomplete, which forces the body to break down muscle to get the missing amino acids.

Since protein is needed for higher-level functions, it is broken down for energy only as a last resort. Unlike fats and carbohydrates, protein cannot be stored or manufactured in the body, so it's "use it or lose it!" This is the reason why complete proteins must be ingested every human diet. Research shows that protein is only available for synthesis for a limited time. Since everyone is different and all proteins digest at different rates, that time varies from person to person. For this reason, research suggests ingesting protein every 2-5 hours. If you are very active and only eat small amounts of easily digestible protein, you will probably need to eat more frequently. In general, a good rule of thumb is to eat protein every 3-4 hours to prevent muscle catabolism. If you do not consume enough complete protein in your diet your body will break down muscle tissue to get the amino acids it needs. energy.

A major misconception that people believe is that protein is only needed for building muscle. As stated, protein has many functions in the body including

hormone production, fluid balance, growth & tissue maintenance, nutrient transportation, and enzyme & protein synthesis.

According to research, the average male needs 56 grams of protein per day while a woman needs 46 grams. These requirements are higher for people who are athletic. The more intense the activity, the more protein is needed. There are dozens of opinions on how much protein an active person and an athlete needs. Some say that 56g for men and 46g for women isn't enough and they require at least 50% more protein. Others state one gram per .6-1.1 grams of protein per pound of body weight. If you weigh 100lbs and are taking .6 grams of protein per pound the formula is 100 x .6 = 60 grams per day is required. A good starting place is .8g/kg of body weight of protein for both men and women, and for athletes 1.2-1.7 g/kg. The amount of protein that can be used for protein synthesis in the body is debated among articles however the theories range from 15- 40 grams per meal. A good guideline to follow is men should aim to eat 20-25 grams of protein per meal per meal and women 10-15 grams. If you feel bloated and full then it is too much; if you feel okay, try eating a little more but do not go beyond 35 grams per serving without talking to your doctor.

It is important to note that when we exercise, we are never burning just one of these for fuel; it is always a mix of carbs and fat in different proportions. To achieve our goal of being lean, we strive for a ratio of more fat and moderate carbohydrates while sparing our protein. When we do an activity that is long term, we can potentially use more fat since we have time for it to be broken down and utilized. However, when we need to access energy quickly, like when are sprinting to catch a train before it departs, your body will need to use the fuel source it can access the fastest, which is carbohydrates. Carbohydrates are more readily available than fats during exercise since they are easier to break down into energy than fat. Basically, the body uses the glucose in the blood and breaks down the glycogen stored in the lives and muscles. Once the body has depleted its stores of glycogen, it will tap into fat stores and use fat as energy. This is where the idea for fasted cardio originated. When you wake up and have not eaten, your blood and stored glycogen are low, which forces the body to start to burn fat during exercise.

New age dieting - hormonal not caloric

You may be familiar with the typical formula, which states that 3,500kcal equals one pound of fat. Most people mistakenly assume that when their Fitbit states they burned 3500kcal, that this was exclusively fat loss. It is important to understand it

was a pound of body mass, which is a big difference. The goal of dieting and exercise is not to lose weight but to lose fat. People are so obsessed with caloric intake focused diets, that they neglect the types of foods they eat and the nutrients they contain. It is more important to eat in a way which will create a hormonal environment optimal for fat loss. When you eat carbohydrates you secrete insulin, which will negate your ability to utilize fat stores optimally. If you keep eating carbohydrates all day, you are telling your body to use those carbohydrates for energy. By eating a diet consisting of complete proteins, healthy fats, low in carbohydrates all while meeting your micronutrient and phytonutrient requirements, you will create an environment ideal for fat loss, muscle building and/or maintenance.

What happens during fasted cardio?

Basically, the reasoning behind fasted cardio is that if carbohydrates are needed during cardio, then after an overnight fast, fat will need to be the primary energy source when carbohydrate sources are depleted. When the body uses fat for energy you may not be able to work out as intensely as when carbohydrates are the main source. The theory is that a person will burn more fat storage when using fat for fuel when doing the same exercise routine in a fasted state. The only problem is that if your goal is maximum output you may not be able to achieve this using fat as fuel.

Exercise is considered a type of stress and we need energy quickly when the body is stressed. Additionally, exercise requires energy and cortisol is secreted at times when we need energy. Therefore, we have increased cortisol levels during times of exercise. Cortisol stimulates gluconeogenesis, which allows the production of glucose (the building blocks of carbohydrates) from sources other than carbohydrates. It also increases free fatty acid blood levels, minimizes glucose utilization for the body, and saves glucose for the brain since glucose is the preferred energy source utilized by the brain. So far, cortisol seems great! However, it also increases protein catabolism, which means it is breaking up muscle. The body starts to metabolize protein in times of stress because it thinks it is in a survival situation (fight or flight is the nervous system response) and the muscular system, immune and digestive systems all need protein to function. This is the exact opposite of what we want to do! We need muscle because the more muscle in our bodies, the higher our metabolism and our ability to burn calories. People with more muscle mass usually have higher metabolic rates since it takes more fuel to move a bigger machine.

The main goal of exercise and healthy dieting is to increase our metabolism to lose weight. Since we can only burn so much fat during exercise, building muscle is extremely important during weight loss. Extended fasting can lead to a lack of fats and carbohydrates in your daily diet. This will force the body to break down healthy muscle for protein that it converts to energy. This can decrease your metabolism and raise cortisol. Another negative effect of breaking down protein is that it may create an acidic environment in our bodies due to the creation of ammonia during protein catabolism. Research has shown that an acidic environment promotes inflammation, disrupts hormones and makes a person more likely to get sick.

In modern society, cortisol is secreted during psychosocial stress instead of a survival situation, which is detrimental to our bodies! Our body is then working to create extra energy when do don't need it. For example, your cortisol may spike when you are sitting at your cubicle and racing to finish your work for a deadline. There are two negative issues that may arise by being in a constant state of stress with excessive cortisol. First, during this state of catabolism people under eat, which causes them to lose lean muscle. Second, the catabolism decreases metabolism so even if the person eats the same amount as usual, they will gain weight because they are not burning the calories! The body is conserving the calories for the times of stress. Most often there is a lack of protein intake, which causes the muscle to break down to fuel the body with the amino acids it needs.

Recent research has shown that this is exacerbated due to imbalances in the hormones leptin and ghrelin, which cause people to overeat and gain weight. Again, as mentioned, each person is different. The take-home message is that your hormones need to be controlled in order to properly fuel your body and control your weight.

Solution

The solution is to eat a balanced diet that includes carbohydrates, fats and protein. This will insure your body has what it needs to perform at the highest level. If you are fasting for long periods of time, make an exception and consume a protein source as soon as you wake up! Men should consume about 15 grams of protein (ideally 25-30 min prior or 15 min worst case) prior to a cardio session and over 20 grams for weight lifting and women should consume about 10 grams prior to cardio and over 15 grams if lifting weights. For those trying to build muscle or doing extended intense cardio bouts, branch chain amino acids (BCAAs) should be consumed 45 minutes into the session. BCAAs are the essential amino acids that the body needs for cellular function and muscle tissue preservation. They

will help prevent any catabolism of muscle tissue during training sessions. You can put them in your water, they are easy to consume.

Protein Sources

As discussed, it is important to consume a source of protein right before exercise. Many people choose to drink a protein smoothie or eat a small meal right before exercise. Your choice of protein source is important. A protein source is needed, but not at the expense of bogging the digestive system down with bacon & eggs on a roll or oatmeal. Remember that the goal is to preserve muscle during training by giving your body a very simple protein to synthesize during activity. Therefore, a light shake consisting of only protein and water is optimal. Another good suggestion is egg whites because they are easily absorbed and do not require much energy for digestion. In addition to the traditional whey shake, there is also an egg white based shake from a company called Egg Whites International. It is high and protein, tasteless and a great way to boost protein intake. For traditional whey and vegan proteins, recommended brands are Jay Robb, NOW, Metagenics and Orgain.

CHAPTER VI

THE ENERGY SYSTEMS

Bioenergetics, or the "energy systems," refers to the metabolic pathways from which energy is made available for muscular contraction or work. Biological organisms, such as the human body, use chemical energy to power all the living systems. A suitable fuel is needed to create the chemical energy that allows the systems to carry out their normal functions and reach their main goal of energy production. Food sources can be broken down into three main components: carbohydrates, fats, and proteins. Carbohydrates are converted into glucose, which is an extremely powerful energy source within the biological system. When in excess, glucose is stored as glycogen in the liver and muscle tissue or as body fat. During exercise, it is broken down so that it can be delivered to working muscle cells. Fats, or lipids, contain the most energy of the food sources. This is due to their chemical structure. Fat reserves are very high in relation to carbohydrates, which provides for a high energy capacity in the presence of low intensity exercise. However, the fats that are stored in the muscle as triglycerides are the most concerning. Protein, made up of amino acids, is broken down during digestion, and can also be used as a low power source when needed. Protein offers a much lower contribution in terms of energy than carbohydrates and fats but holds more importance with muscle growth and cellular repair. Of these three sources of energy, only carbohydrates can be metabolized for energy without the direct involvement of oxygen (1).

In order to understand the bio-energy systems, one needs to have an understanding of the fundamental components of raw energy utilized by the musculoskeletal system. In the living cell, the main high-energy compound is adenosine triphosphate, or ATP. ATP is a complex compound stored in all cells, particularly muscle cells. It is required for the biochemical reactions of muscle contraction to take place. It is comprised of adenosine bonded to three phosphates. During muscular contraction, ATP is broken down on the chemical level. This results in the release of free energy, the presence of adenosine diphosphate (ADP), and a free inorganic phosphate. These are generated from the breaking of a phosphate bond to the ATP structure. The greater the demand placed on a muscle, the faster this breakdown of ATP will occur to create energy. During intense exercise, the ATP stored within the muscle cells is quickly depleted and for continued muscular contractions to occur, this must be quickly replenished through some chemical means. The energy systems responsible for these chemical processes will be further discussed.

Creatine phosphate (CP) is a chemical compound stored in muscles and is important for replenishing ATP after the initial stores are exhausted. In this process, CP donates its phosphate to ADP to create ATP. In this way, the

CP serves as an immediate source of high energy phosphate which can be used to replenish ATP. Because of its limited quantity, CP only contributes to ATP replenishment for the first few seconds of high intensity exercise. Glycogen is considered to be the principle storage form of glucose and is mainly found in the liver and muscular tissues.

Now that the terminology has been covered, we can begin to examine the energy systems individually. Remember that ATP is necessary for all muscular contractions and that during exercise, the ATP stored within the muscle is quickly depleted. There are three major sources of high energy phosphate (ATP) that take part in the conservation, capture, and expenditure of free energy. These three major chemical pathways, with their common names, are:

1. The phosphagen, anaerobic, anaerobic lactic, or ATP-CP system
2. Glycolysis, anaerobic lactate, or embden-meyerhof-parnas pathway. This can be broken down into two sub-categories:
    A. Anaerobic glycolysis, fast glycolysis, lactic acid, or anaerobic l lactate pathway
    B. Aerobic glycolysis, or slow glycolysis pathway
3. The oxidative, aerobic, or aerobic respiration system.

The **phosphagen system** is an anaerobic process, in which no oxygen is present. Glycolysis is the sequence of reactions that converts one molecule of glucose into pyruvate, with the concomitant production of a relatively small amount of ATP. The oxidative system, which takes place in the cell mitochondria, is the most productive source of ATP but only functions when the body is abundant in oxygen.

As these three major pathways are explored, it should be noted that these systems all co-exist and are active in overlapping energy expenditures. However, the quality and quantity of their usage primarily depends on the intensity and duration of the demand put on the individual's musculoskeletal system. The energy systems help to replenish the depleted ATP as muscular demands develop during exercise. There is a direct relationship between the exercise intensity and duration and the energy system that the body uses to supply energy. The following is a detailed description of each of the energy systems.

The Phosphagen System

The Phosphagen System is active from rest to the beginning of all exercise and is an instant source of ATP. This system provides energy at a very high rate but only for a minimal duration of time. The main regulatory chemical reactions of the phosphagen system involve ATP and CP. Even though this system is very efficient when working, the system's duration limits its potential. There are very low amounts of ATP and CP stored within muscle tissues and cells. So continuous, long-duration activities are not sustainable before these stores are depleted and in order to provide for the energy demands, the phosphagen system needs to be supplemented by glycolysis or the oxidative systems. It has been estimated that approximately 5 millimoles (mmols) of ATP and 16 mmols of CP are stored in each kilogram of muscle. When training the phosphagen system, one should understand that type II (fast twitch) muscle fibers contain greater concentrations of phosphagens than type I (slow twitch) fibers. As a strength and conditioning professional, this fact would lead us to understand that for certain exercises or sports we should be specifically training this system. For example, if we are training a power lifter who has major demands on type II muscle fibers and needs the explosive power and strength for a short duration of time, the phosphagen system is a major contributor to this athlete's performance.

The steps of the phosphagen system begin at the start of exercise when ATP is hydrolyzed by the enzyme myosin ATPase to ADP, organic phosphate and energy. This immediate energy is released for muscular contraction, although an increased ADP concentration activates creatine kinase, catalyzing the formation of ATP from the breakdown of CP. As exercise continues at high intensity, creatine kinase activity remains elevated, and leads us to the next system of anaerobic glycolysis. As exercise intensity decreases and depending on the level of oxygen in the muscle cells, aerobic glycolysis or oxidative systems take over.

This system can fully recover ATP in three to five minutes, but it takes about eight minutes for complete CP resynthesis. Aerobic metabolism is largely responsible for the recovery of phosphagens.

Glycolysis

Glycolysis is a system that focuses on the breakdown of carbohydrates to create the high energy phosphate ATP. The sarcoplasm (cytoplasm of muscle cell) is where the steps and reactions of glycolysis take place. This pathway is composed of ten reactions ending with pyruvate, which can be used within the oxidative

(aerobic) system or lactate which can be used in the lactic acid (anaerobic) system. This metabolic pathway transforms glucose to pyruvic or lactic acid and yields two molecules of ATP. Glycolysis enhances and supplements the phosphagen system and also acts as a pre-cursor to the oxidative (aerobic) and lactic acid (anaerobic glycolysis) systems.

Due to the ability to perform with or without the use of oxygen, glycolysis can be broken down into two distinct directions of the pathway. The two separate directions lead to slow and fast glycolysis. Aerobic glycolysis, or "slow glycolysis," is the process where pyruvate is transported to the mitochondria for use in the oxidative system. This branch of the glycolysis pathway is primarily used when there are adequate amounts of oxygen present within the mitochondria and the individual's energy demands are moderate to high. When muscle tension or contraction occurs with brief periods of relaxation, oxygen uptake from outside the cell can be used to assist pyruvate in producing more ATP. This process is only used after the phosphagen system has depleted its ATP stores, the intensity is minimal to moderate, and the duration is long. For this system to take effect, there also must be an adequate level of oxygen within the mitochondria. Anaerobic glycolysis, or "fast glycolysis," uses pyruvate and converts it to lactic acid. The end product is ATP at a higher rate. This branch of the glycolysis pathway primarily functions when there is an intense demand, although sub-maximal and high energy is needed and there is a limited or reduced level of oxygen in the cells.

Muscle glycogen can be replenished within 24 hours of exercise. This greatly depends on post exercise meals. It is suggested that carbohydrates be ingested every two hours after exercise for up to six hours.

The Oxidative System (Aerobic)

Fats and carbohydrates are the main power source in the **oxidative system**. Protein is another source of energy, although its use is limited to when the musculoskeletal system has been completely depleted of fat and carbohydrate stores and the body is at its limit of starvation in the muscle tissue. If this occurs, protein is used when the energy system is pushed past a threshold of greater than 90 minutes. The duration and intensity of the exercise determines which source is used. Fats are primarily used at the starting phase of the oxidative system. As the intensity increases, a switch to carbohydrates takes place. Finally, during long term maximal exercise, the system switches back over to fats and possibly protein as the primary energy. Again, protein will only be used at the level of complete muscular starvation and depletion. At the end stages of glycolysis, the final product of

pyruvate is taken to the mitochondria and when there are sufficient levels of oxygen in the cells it begins the Kreb's cycle (Citric Acid Cycle, or tricarboxylic acid cycle).

The Krebs cycle (also known as the Citric Acid Cycle, Tricarboxylic Acid Cycle or TCA cycle) is a crucial component of the oxidative system. It is a portion of the oxidative pathway in which a series of chemical reactions in the presence of oxygen produce energy in the musculoskeletal system. This cycle does not actually use oxygen per se. The end products are extracted in the presence of oxygen by oxidative phosphorylation in order to access the potential energy in storage within the cycle. As we have previously mentioned aerobic glycolysis breaks down carbohydrates in the form of glucose into pyruvate, which, to enter the Krebs cycle, must move into the mitochondria where it is then converted into acetyl-CoA. A series of reactions occurs through the Krebs cycle and 12 high energy phosphate bonds are produced. The phosphorylation of one glucose molecule results in the creation of 38 ATP units. The Krebs cycle is the end process where carbohydrates, fat and protein metabolism are directed. This system is the most efficient and quantitative producer of ATP for energy but has limiting factors such as the need for oxygen, long duration, and minimal intensity.

Lactic Acid

Lactic acid is a chemical byproduct of pyruvic acid and is produced from the breakdown of glucose. It is seen as an end product of anaerobic glycolysis. Lactic acid accumulation within the muscular tissue is said to inhibit the contraction of muscle fiber. This fact is now being challenged.

The thought of lactic acid being a fatigue producing substance is now being challenged. Dr. George A. Brooks, a Professor in the Department of Integrative Biology at the University of California Berkeley states, "It's one of the classic mistakes in the history of science." More evidence is mounting that lactic acid is actually fuel for our muscles. Now, the understanding is that muscle cells convert glucose, or glycogen to lactic acid. When the lactic acid is taken up and used as a fuel by mitochondria, the energy factories in muscle cells. The idea that lactic acid causes DOMS (Delayed Onset Muscle Soreness) one to two days after training is thoroughly incorrect, as lactic acid is gone from your muscles within one-hour post exercise.

Metabolic acidosis is when the pH is lowered because of exercise. This decrease in pH can diminish the work rate of the cells' energy system. This may be what is really responsible for muscle fatigue.

What is the Most Efficient System?

As stated, the systems work together and at no resting state or exercise level is there one system that completes the total energy production. When dealing with energy systems, the emphasis is on the dominating system. No activity, whether it's a gentle stroll or a high-intensity sprint, exclusively uses one energy system. They all make a contribution depending on the length of time the exercise is performed, the level of energy expenditure, and the availability of oxygen. Exercise intensity is particularly important in determining the muscles' best energy source and to what extent anaerobic or oxidative systems are primarily functioning. A balanced program should include all training of all energy systems. Speed training is a major category but is generally practiced by competitive athletes only.

Rules for Any Exercise Method

A few simple rules are helpful as you develop your own routine:

- Don't eat two hours before vigorous exercise.
- Drink plenty of fluids before, during, and after a workout.
- Adjust activity according to the weather and reduce it when fatigued or ill.
- When exercising, listen to the body's warning symptoms and consult a physician if exercise induces chest pain, irregular heartbeat, undue fatigue, nausea, unexpected breathlessness, or light-headedness.
- **Warm-Up and Cool-Down Period** -Warming up and cooling down are important parts of any exercise routine. They assist the body in making the transition from rest to activity and back again, and can help prevent soreness or injury, especially in older people.
- Warm-up exercises should be practiced for at least eight to ten minutes at the beginning of an exercise session. Older people need a longer period to warm up their muscles. Low-level aerobic exercise is the best approach. This includes dynamic warm ups, walking briskly, swinging the arms, or jogging in place.
- To cool down, one should walk slowly until the heart rate is 10 to 15 beats above resting rate. Stopping too suddenly can sharply reduce blood pressure. This is a danger for older people and may cause muscle cramping.

- Static stretching is appropriate for the cooling down period, but not for warming up because it can injure cold muscles. Certain exercises may require stretching specific muscles. For example, a jogger or biker might emphasize stretching the hamstrings, calves, groin, and quadriceps. Swimmers would focus on the groin, shoulders, and back.

The **phosphagen system** is typically in use with maximal, explosive effort and is very short in duration. Rest periods from five to seven minutes are crucial because almost complete recovery of the muscle is needed to reset the phosphagen system and to again reach maximal muscle goals. The bottom line is that a well-rested muscle will allow maximal effort to be reached. Examples of usage of this system include:

- Estoteric exercises (strong men competitions)
- Power lifting (heavy bench, heavy squat, and heavy deadlift)
- Olympic lifting (snatch, clean and jerk, power clean)
- High Jump
- Sprints
- Bound like sports (football, basketball, volleyball, soccer)

Glycolysis requires a sub-maximal effort and is typically in use after the phosphagen energy stores have been depleted. As with the phosphagen system, sufficient rest periods are needed to return muscle almost to a resting state as this will enable the athlete to acquire maximal effort on the next major energy expenditure. The levels of rest should be within the realms of two to six minutes because even though the glycolysis system deals with explosive power just like the phosphagen system, the levels are slightly sub-maximal in the glycolysis training principles. Examples of glycolysis usage in exercise are:

- Wrestling
- UFC (Ultimate Fighting Championship) training
- 200/400-meter run
- 50/100-meter swimming

Aerobic glycolysis, into the oxidative system, will be in use when enough oxygen is present. The requirements involve low intensity with long duration, mainly because ATP recovery is very high. Rest periods are near minimal in these pathways because of the low intensity over a long period of time. If rest periods are

used, they should be in the realm of 0 to 90 seconds, followed by immediate return to the exercise. Examples of oxidative usage in exercise are:

- Distance or marathon running
- Cross country skiing

Understanding and Application of the Systems to Training

Applying energy systems to some sports can become quite complicated. It's easiest to look at basic running events first...

100m Sprint

Top athletes run this event regularly under 10 seconds. The **Phosphagen** energy system powers a sprinter for most of the race. If you watch a slow-motion replay of a 100m sprinter, you will notice that their respirations are low or even non-existent during the sprint. With pursed lips, their face is a picture of concentration and all of their energy production is from anaerobic processes that occur without oxygen.

800m Run

Just as with the 100m, an athlete is powered by the **Phosphagen** energy system for the first few seconds of the race. Since the athlete is not running at maximal intensity, the stores of ATP will last a few seconds longer. **Anaerobic Glycolysis** then predominates for the rest of the race, although beginning stages of **Aerobic Glycolysis** make a small contribution.

Half Marathon

The **Oxidative-aerobic** system makes the greatest contribution to this event. The **Phosphagen** and **Glycolysis** (anaerobic and aerobic glycolysis) energy systems will predominate during the first one to two minutes of the race and in a sprint finish. What determines whether the athlete is 'burning' carbohydrate, fat or protein during the run? Well, at rest, 70% of the ATP produced is derived from fats and 30% from carbohydrates. As the aerobic system begins to predominate, fats turn over to carbohydrates (ultimate efficient fuel) and make the greatest contribution to energy production at 100%. Primarily, fat will begin as the energy source but as exercise intensity is relatively low and constant, carbohydrates will last for a while. There will then be a switch back to fat as the carbohydrate stores are depleted. Fat will be relied on more as the duration of the race increases, until the duration reaches greater than 90 minutes. Here, the fat and carbohydrate stores have been depleted in the muscles, so protein may be slightly used. Carbohydrates are the most efficient source, but cannot always be relied

upon. Again, the body does not suddenly switch from one substrate to another – the cross over is a gradual shift.

Multi Sprint Sports

So far, the examples have been straight forward. What about multi-sprint sports like football, basketball, soccer, hockey and tennis? In short, **all three energy systems** make a significant contribution. This athlete uses the **phosphagen** system to jump, throw, and sprint while the **anaerobic glycolysis** system is taxed if the player has to make several back-to-back sprints. Of course, the **aerobic glycolysis-oxidative-aerobic** systems contribute for the entire duration of the game, as the levels of duration increase

Quick Summary

- Phosphagen: 0 to 6 seconds, and is dominant from resting to near maximum intensity
- Phosphagen and anaerobic glycolysis: 6 to 30 seconds, dominant at near maximum intensity
- Aerobic glycolysis: 30 seconds to 2 minutes, maximum intensity
- Aerobic glycolysis and start of aerobic system: 2 to 3 minutes at moderate intensity
- Aerobic system: over 3 minutes at light intensity

Manipulating the Energy Systems for Training Goals

The strength and conditioning professional's ultimate goal is to manipulate the systems to create the ultimate performance of the athlete for exercise, sport, or competition. The main factors to specifically manipulate are **intensity**, **duration**, **rest**, and **sport specificity**. The systems, with examples of training variables focusing on specific training for the chosen energy system, are as follows:

Phosphagen Energy System

Sprints, 12 x 20m with recovery of 2 minutes recovery between repetitions
Sprints, 5 x 60m with 6 minutes recovery between repetitions
8 x 30m shuttle runs with 2 minutes recovery between repetitions
Resistance training of 3 sets of 3 repetitions at 90% 1rm, with 5 minutes rest between sets
The intensity should be done 2 to 4 times per week for maximal performance of the phosphagen system

Glycolysis Energy System

Distance sprints, 5 to 8 x 300m, with 5 minutes recovery between repetitions
150m intervals at 400m pace with 3 minutes recovery between repetitions, until pace slows significantly
Long distance sprints, 6 x 500m with 3 minutes recovery between reps

Oxidative Energy System

4 to 6 sets of 2 to 5-minute runs, with 2 to 5-minute recovery between intervals
10 sets of 400m runs, with 60 to 90 seconds recovery between intervals
Long distance 5 to 10 km runs

Nervous System

The nervous system is a very complex and delicate component of the body. It is the central command center that allows us to gather information about our internal and external environments, process and interpret it, and then respond. The main and most important component of the nervous system is the **central nervous system**, which is composed of the **brain, brainstem and spinal cord**. The second component is the **peripheral nervous system,** which is composed of cranial nerves that arise from the brainstem and the spinal nerves that arise from the spinal cord. The third component is the **autonomic nervous system,** which can be broken down into the **sympathetic** and **parasympathetic nervous systems**. These three major components work together to transmit signals, or messages, control ling all aspects of bodily function.

The Central Nervous System

The central nervous system (CNS) represents the largest part of the nervous system, including the brain and the spinal cord. These serve as the main processing center for the whole nervous system, thus controlling all the workings of the body. It is one of two major divisions of the nervous system. Together with the peripheral nervous system (PNS), it has a fundamental role in the control of behavior.

The PNS is outside the brain and spinal cord. It consists of the nerves and neurons that reside or extend outside the CNS – to serve the limbs and organs. Unlike the CNS, however, the PNS is not protected by bone or the blood-brain barrier, leaving it exposed to toxins and mechanical injuries.

The Brain

The brain is the command center of the nervous system. It processes and sends messages throughout the entire nervous system. The brain receives sensory input from the spinal cord and the spinal and cranial nerves. It then processes these inputs and coordinates appropriate responses and motor outputs. Weighing about three pounds, the brain consists of three main structures: the cerebrum, cerebellum and brainstem. It can be further divided into the lower or mid-brain and the cerebral cortex. Figure 1 shows a detailed diagram of all the areas of the brain.

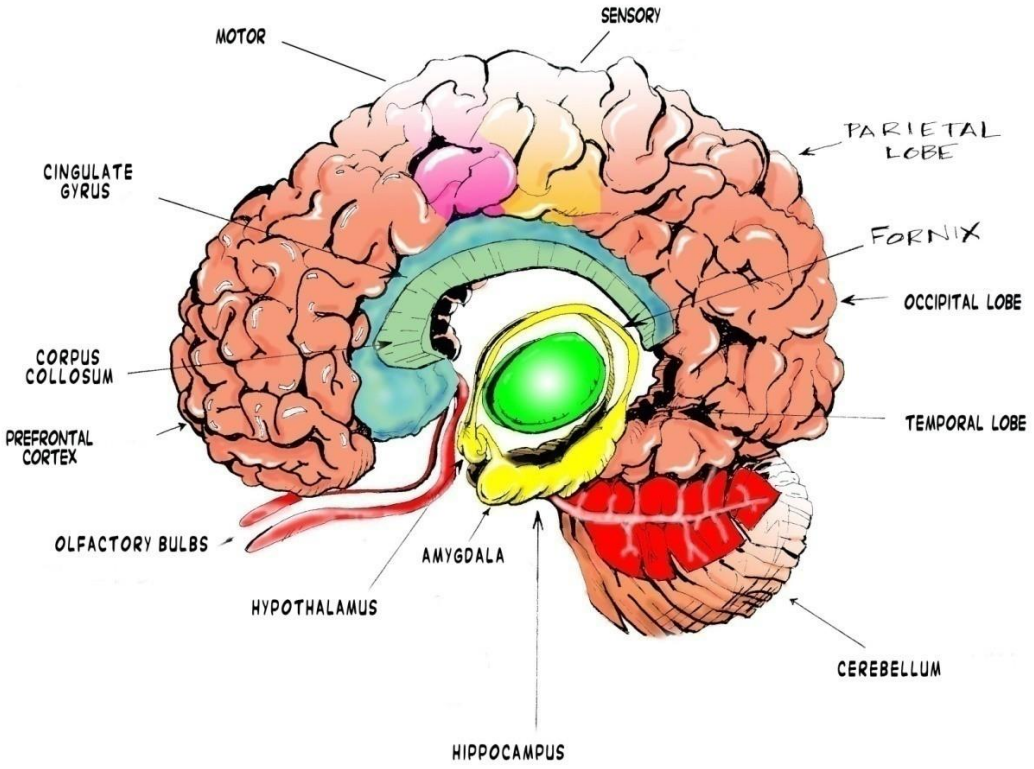


Figure 1 Diagram showing the different areas of the brain

Brainstem

- The link between the sensory and motor nerves coming from the brain to the body and vice versa.
- Connects the brain to the spinal cord.
- In charge of all the functions your body needs to stay alive, such as breathing, digestion and circulation.
- Important component of coordination and control movement, balance and posture stabilization. Necessary when performing a single-leg dumbbell shoulder press with alternating arm motion.

The Medulla Oblongata is the lower portion of the brainstem. It is responsible for controlling several major autonomic functions of the body, notably respiration and circulation.

Basal Ganglia

- Instrumental in the initiation and control of receptive voluntary movements, as well as aiding in postural maintenance and muscle tone. (i.e., walking, running, multiple repetitions during resistance training)
- Monitoring specific movement parameters such as velocity, direction and amplitude.
- Comparing actual movement with incoming sensory information to help proper movement. Necessary when performing multi-planar lunges

Cerebellum

- Compares and integrates sensory information from the body and the external environment with motor information from the cerebral cortex to ensure smooth coordinated movement.
- Decides the best way to initiate and execute movement.
- Regulates the muscle force needed with load variations.
- Ensures proper postural muscle activation for the maintenance of balance during that movement
- Assists in planning the next movement that should occur.
- Vital for all multi-sensory exercises.

The Cerebrum is the control center of the brain. It is divided into two hemispheres (left and right) and each consists of four lobes (frontal, parietal, occipital and temporal). It is the largest and most prominent part of the human brain and consists of approximately 85% of the weight of the human brain. It is the thinking part of the brain and it controls your **voluntary** muscles – the ones that move when you want them to.

The Cerebral Cortex is the outer most portion of the brain. It is also divided into four lobes: frontal, parietal, occipital, and temporal. Many areas of the cerebral cortex process sensory information or coordinate the motor output necessary for control of movement.

The Frontal Lobes are considered our emotional control center and home to our personality. They are involved in motor function, problem solving, spontaneity, memory, language, initiation, judgment, impulse control, social, and sexual behavior. The frontal lobes are extremely vulnerable to injury due to their location at the front of the cranium, proximity to the sphenoid wing, and their large size. Studies have shown that the frontal area is the most common region of injury following mild to moderate traumatic brain injury.

The Parietal Lobe is positioned above (superior to) the occipital lobe and behind (posterior to) the frontal lobe. It plays important roles in integrating sensory information from various parts of the body, and in the manipulation of objects. Portions of the parietal lobe are involved with visuospatial processing.

The Occipital Lobes are the smallest of four true lobes. Located in the rear most portion of the skull, they are part of the forebrain structure. They are behind (posterior to) the temporal lobes where visual information reaches the cortex.

The Temporal Lobes are part of the cerebrum. They lie at the sides of the brain, beneath the lateral or Sylvian fissure. Seen in profile, the human brain looks something like a boxing glove. The temporal lobes are where the thumbs would be. They enclose the hippocampi and amygdalae.

The Hippocampus is a part of the brain located inside the temporal lobe (humans and other mammals have two hippocampi, one in each side of the brain). It forms a part of the limbic system and plays a pa rt in memory and spatial navigation. In Alzheimer's disease, the hippocampus becomes one of the first regions of the brain to suffer dam age; memory problems and disorientation are amongst the first symptoms. Damage to the hippocampus can also result from oxygen starvation (anoxia) and encephalitis.

The Limbic System is not a structure, but a series of nerve pathways incorporating structures deep within the temporal lobes, such as the hippocampus and the amygdale. It is involved in the control and expression of mood & emotion in the processing and storage of recent memory and in the control of appetite and emotional responses to food.

The Olfactory Bulb is a structure of the vertebrate forebrain involved in olfaction, which is the perception of odors. Odor information is easily stored in the long-term memory and has strong connections to emotional memory. This is possibly due to the olfactory system's close anatomical ties to the limbic system and hippocampus, which are areas of the brain that have lo ng been known to be involved in emotion and place memory, respectively.

The Thalamus and **Hypothalamu**s are prominent internal structures. The Thalamus has wide-ranging connections with the cortex and many other parts of the brain, such as the basal ganglia, hypothalamus, and brainstem. It is capable of perceiving pain but not at accurately locating it. The hypothalamus has several

important functions, including control of the body's appetite, sleep patterns, sexual drive and response to anxiety.

Anterior Cingulate Cortex (ACC) is the frontal part of the cingulated cortex. The ACC forms a collar around the corpus callosum, which relays neural signals between the right and left hemispheres. It appears to play a role in a wide variety of autonomic functions, such as regulating heart rate and blood pressure, and is vital to cognitive functions, such as reward anticipation, decision-making, empathy, and emotion.

The Spinal Cord

The spinal cord extends from the medulla oblongata in the brain and continues to the conusmedullaris near the lumbar level at L1-2, terminating in a fibrous extension known as the filumterminale. The adult spinal cord is approximately 18 inches long, ovoid-shaped, and is enlarged in the cervical and lumbar regions.

The spinal cord conducts sensory information from the PNS to the brain using ascending pathways called afferent pathways. Using descending pathways called efferent pathways, the brain sends information through the spinal cord to the specific areas that need be affected. These efferent pathways typically carry motor information from the brain to our various target sites. The target sites are skeletal muscles, smooth muscles, cardiac muscles, and glands.

The spinal cord is divided into 31 different segments, with motor nerve roots exiting in the ventral aspects and sensory nerve roots entering in the dorsal aspects. The ventral and dorsal roots later join to form paired spinal nerves, one on each side of the spinal cord.

There are 31 spinal cord segments:

- 8 cervical segments
- 12 thoracic segments
- 5 lumbar segments
- 5 sacral segments
- 1 coccygeal segment

The Peripheral Nervous System (PNS)

The PNS consists of 12 cranial nerves and 31 pairs of spinal nerves and sensory receptors. These peripheral nerves serve two main functions:

- They provide a connection for the nervous system to activate different bodily organs, such as muscles. Efferent (motor) information going to an effector site.
- They relay information from the bodily organs back to the brain, providing a constant update of the relation between the body and the environment. This is afferent (sensory) information.

The peripheral nerves of the **efferent** division are divided into two main divisions, the **Somatic Nervous System**& the **Autonomic Nervous System**.

The **Somatic Nervous System** connects to the skeletal muscles of the body and provides the means for nervous system to initiate and produce movement.

The **Autonomic Nervous System** (ANS) affects all of the other tissues and organs that are not skeletal muscle. It is a self-regulatory system that allows people to involuntarily adapt to the environment. It adjusts or modifies some functions in response to stress; both physical and mental. It helps regulate:

- Blood vessel diameter and blood pressure
- The heart's electrical conductivity and ability to contract
- Respiratory function, such as the bronchium diameter with respiration
- Functions of the stomach, intestine and salivary glands, hormone secretion, and urinary and sexual functions

The ANS reaches homeostasis due to its two components: **Sympathetic** and **Parasympathetic Nervous System**.

The **Sympathetic Nervous System** (SNS) is sometimes referred to as the "Fight or Flight" system because it is activated in highly stressful situations, such as danger. It allows for increased responses of the body under conditions of physical or psychological stress.

Examples:
1. During intense exercise the body's temperature is increased, which initiates several automatic responses. Heat or thermal receptors convey stimuli to the sympathetic control centers of the brain. An inhibitory message is then sent along the sympathetic chain of nerves to the blood vessels of the skin. This causes a dilatation of the cutaneous blood vessels and greatly increases the flow of blood to the surface of the body, where heat is lost by radiation and evaporation from sweating. This is the body's cooling mechanism.

2. The SNS responds to environmental heat in another important way. The rise in body temperature is sensed by the hypothalamic center. Stimuli are then sent, via sympathetic nerves to the sweat glands, resulting in appropriate sweating. This serves to cool the body by the loss of heat resulting from evaporation of the sweat aided by a cool breeze. We cannot voluntarily influence the dilatation of our blood vessels or the adequacy of our sweating in response to heat in other ways.

3. Control of the rate and strength of cardiac contractions is also under the predominant control of the SNS. During intense exercise, there is a greater cardiac demand for blood and oxygen, so as the intensity of the exercise increases, the SNS sends transmissions to the heart to increase cardiac output by increasing the intensity and frequency of the heart rate.

The Parasympathetic Nervous System is sometimes referred to as the "Wine or Dine" pathway. This means that it is a very slow, relaxing and moderated process when stimulated. It calms the body back down and returns it to a normal state of operation.

Examples:

1. When a stimulus is applied to an organ, such as a bright light flashed into the eyes, a message is conducted through sensory fibers to the midbrain. This creates a stimulus that travels through the parasympathetic fibers of the oculomotor (third cranial) nerves to the pupils, causing automatic contraction of the pupillary muscles to constrict the pupil. This reduces the amount of light reaching the sensory cells in the retina on the back of the eyeball.

2. Food enters the stomach, creating a stimulus that is conveyed by afferent fibers of the vagus nerve to a specific nucleus of the vagus nerve in the brain. Here, messages are interpreted and then transported through efferent fibers of the vagus, back to the stomach. These stimulate the secretion of gastric juices and contraction of the stomach muscles to mix the food with the secreted digestive juices, and slowly move the digested food contents into the intestines.

The peripheral nerves of the **afferent** division contain sensory receptors. The sensory receptors are specialized structures located through the body that are designed to transform environmental stimuli (heat, light, sound, taste, motion, etc). into sensory information that the brain and/or spinal cord can then interpret to produce a response.

- **Mechanoreceptors** respond to mechanical forces (touch and pressure). They are located in muscles, tendons, ligaments, and joint capsules. They include muscle spindles, Golgi tendon organs, and joint receptors
- **Nociceptors** respond to pain (pain receptors)
- **Chemoreceptors** respond to chemical interaction (smell and taste)
- **Photoreceptors** respond to light (vision)

Muscle spindles are major sensory organs of the muscle. They are sensitive to change in length and rate of length of change. When a muscle is stretched, its spindles are also stretched. This information is transmitted to the brain and the spinal cord to update the nervous system on the status of the muscle length, and the rate at which that muscle is lengthening. When excited, the muscle spindle will cause the muscle to contract – this prevents the muscle from stretching too far, and/or too fast to prevent injury.

Golgi tendon organs are located within the musculotendinous junction. They are sensitive to changes in muscular tension and the rate of the tension change. When excited, the Golgi tendon organ will cause the muscle to relax, preventing it from being placed under excessive stress and thus resulting in injury. Prolonged Golgi tendon organ stimulation provides an inhibitory action to muscle spindles – this neuromuscular phenomenon is called **autogenic inhibition** (the contracting muscle is inhibited by its own receptors).

Joint receptors are located in and around the joint capsule. They:
- Respond to pressure, acceleration, and deceleration of the joint.
- Signal extreme joint positions and thus help to prevent injury.
- Initiate a reflexive inhibitory response in the surrounding muscles if there is too much stress place on the joint.

Anatomy and Function of a Neuron

A **neuron**, or nerve cell, is the basic unit of the nervous system. This is how synapses, or messages, are sent to various parts of the body. The nervous system is similar to an electric circuit, in which the circuitry is all connected and relays messages back and forth aiding in sensory and motor functions. Neurons are highly specialized cells and are capable of responding to stimuli and conducting these stimuli from one part of the cell to another.

They have a very high requirement of oxygen in that they can't live without it for more than a few minutes. When we are born, there are only a certain number of neurons that we have. They do not reproduce like most other cells, but some can regenerate or repair specific parts if the cell body remains intact.

There are three main functional classifications of neurons that are determined by the direction of their nerve impulses:

- **Sensory** (afferent) – transmit afferent nerve impulses from receptors to the brain and/or spinal cord
- **Motor** (efferent) – transmit efferent nerve impulses from the brain and/or spinal cord to effector sites such as muscles or glands
- **Interneurons** (Inter) – transmit nerve impulses from one neuron to another

The Basic Anatomy of the Neuron

Axon – is a cylindrical projection from the cell body that transmits nervous impulses to other neurons or effector sites (muscles, organs, other neurons, etc.). This is the part of the neuron that provides communication from the brain and/or spinal cord to other parts of the body

Axon Terminals – a specialized hair like structure at the end of the axon that is used to release neurotransmitter chemicals and communicate with target neurons, allowing conductivity into the area

Cell Body – the cell body of the neuron; it contains the nucleus (also called the soma), and other organelles such as lysosomes, mitochondria and Golgi complex

Dendrites – the branching structure of a neuron that receives messages (attached to the cell body). It is responsible for gathering information from other structures back into the neuron

Myelin Sheath – the fatty substance that surrounds and protects some axons; also provides for higher conduction velocity

Node of Ranvier – one of the many gaps in the myelin sheath. This is where the action potential (chemical mediation of a nerve impulse) occurs.

Nucleus – the organelle in the cell body of the neuron that contains the genetic material of the cell.

Schwann Cells – are a variety of neuroglia that mainly provides myelin insulation to axons in the PNS of jawed vertebrates. The vertebrate nervous system relies on this myelin sheath for insulation and as a method of decreasing membrane capacitance in the axon.

Gap Junction – where the synapse jumps from Schwann cell to Schwann cell over the gap junction by conduction of the myelin sheath.

Acetylcholine (ACh) – neurotransmitter extensively found in the brain and autonomic nervous system. It stimulates the muscle fibers to go through a series of steps that produce muscle contractions.

Ganglion –is a cluster of cell bodies of neurons. Examples are the dorsal root ganglion of peripheral sensory nerves and the sympathetic chain ganglion.

Nerve impulses are received by the dendrites and carried along the axon to the next synapse. Here, neurotransmitters are released to travel across the synapse and stimulate the next dendrite or the target tissue. If the stim ulus is great enough, the process will continue.

CHAPTER VII

BASIC PROGRAM DESIGN

Basic Program Design

In order to design a successful fitness program, it is essential to establish and understand the primary purposes of that program. Phases, or cycles, should be built into each program in order to obtain consistent challenge and overload for the participant. Each cycle should include certain parameters with realistic goals and progressions for the particular phase. Each phase should be a progression of the last; changing tempos, rep ranges, rest periods, and order of body parts insures a balanced program. Generally, a phase should last anywhere between two and six weeks depending on exercise frequency, client progression, and goals. First and foremost, a thorough evaluation must be conducted to identify faulty movement patterns and postural distortions. The findings of your evaluation will ultimately guide you in the program design and customize it for your client. Any deficiencies noted during your evaluation will require attention in order to correct and build a strong fitness foundation for the participant. You need to ensure that the client engages in proper warm-up activities according to the movements (both aberrant and normal) acknowledged in their initial evaluation. Dynamic warm ups and postural control exercises are a great way to get started. Effective program design is truly a fluid process and it is important to keep in mind that program design should be based on initial as well as ongoing evaluation findings.

A well-designed fitness program will not only address goals but function as well. The client may have specific objectives in mind, but the body needs to have a functional baseline in order to achieve such goals. For example, the participant may have an ambition of hypertrophy in the pectoralis major muscles. However, if their pectoral muscles exhibit restricted flexibility and will eventually create a cascade of dysfunction for the entire shoulder girdle, does it make sense to pursue the client's desire at this point in time? If the participant is insistent upon doing an exercise you feel is detrimental to their overall health and achievement of their goals, it is your job to educate them and provide them with a comprehensive explanation as to why certain exercises and movements may not be prudent. Be sure to demonstrate their weaknesses to them and describe the effects of their daily activities. You must target weak muscles and address any flexibility issues right from the start. Introduce shoulder stability and back strengthening exercises in the situation just discussed. If you approach program design with function in mind, you will be providing the client with sound principles upon which they can build. Progression is paramount; it's always better to err on the side of caution and be too easy than too hard. The outcomes of each session will dictate short-term as well as long-term progression.

While function should be the cornerstone of program design, how does this translate into keeping your client interested? The average person with some postural issues or muscle weakness will not want to perform rehabilitative exercises for an hour. Generally, if the participant doesn't break a sweat or become winded, they don't feel like they did anything. You need to keep them motivated by giving them safe and easy exercises that they can master quickly. If someone has a lot of issues, you can have them perform a circuit of two rehab exercises and one weight-lifting exercise, even if it's not "functional". The majority of your workout should be functional, but tossing in some safe, old-school basics can spice things
up a bit and keep your client interested. Remember: client satisfaction and progression in form and function are the hallmarks of effective program design.

Basic guidelines:
Heavy weight training and/or explosive movements should be avoided with beginners. With beginning clients, performing more sets of lower reps is better because it increases motor skill development while encouraging less fatigue. Teaching form is of utmost importance no matter how experienced your client, because you can actually create faulty motor patterns if the form is not disciplined. Also, it is important to provide a thorough explanation of how and where cardio training fits into a resistance-training program.

Minimize the amount of exercises to be performed in each session. You are teaching proper mechanics, and repetition and practice is paramount. If you do one to two sets of 15 different exercises, they will never master the form of any of them. There are no fixed guidelines on how many exercises you should include, because it will be established on the individual's performance on that particular day. However, a good baseline is as follows: include full body movements as they progress from floor exercises and focus on mastering body weight before adding resistance.

Once a person has demonstrated they are ready to do more difficult exercises, start to incorporate multi-tasking exercises. Don't do the same program for more than 4-6 weeks. You need to vary repetition ranges as well as the amount of sets, tempos and rest periods. Include super sets and tri-sets. While diversity is important, don't change the workout every time. Basic structure and consistency is necessary, and it will be impossible to track progressions if you do something off the top of your head every time you see them. The majority of the workouts should be uniform so that progress can be measured, and variety can be added so that the client is consistently challenged.

The Truth of the Trend

Research has shown that training the nervous system with Olympic lifting, plyometrics or any type of explosive high intensity training can be beneficial to the athlete when done correctly. There is much debate on the subject of CNS (central nervous system) fatigue and whether it is a real phenomenon or a false naming of adrenal fatigue, muscle fatigue, etc. Whether or not CNS fatigue truly exists or is being named correctly is beside the point. The fact is that explosive exercises with weight such an Olympic lifting place very high demands on all systems of the body and carry serious risk of injury if not learned and practiced properly.

Olympic weightlifting requires a high level of understanding and skill. Bompa has a suggested that the optimal number for training the nervous system is 1-3 repetitions with a rest period of 6 minutes between sets. In addition, ATP is only present for 6-8 seconds which is about 3-5 reps before needing at least 2-3 min of recovery. Once ATP runs out the lifts will become compromised because the muscle does not have the energy to elicit the contraction the nerve is demanding. Anything beyond said rep range starts to overload the joint because form is compromised. Since these methods are designed to tax the central nervous system it does not make sense to try to change them into strength and endurance movements for high reps. Despite the research and proven science many mainstream programs will suggest doing a set of anywhere from 10-20 repetitions or even do as many reps as possible in a 30-60 second window. Using these methods for endurance is like telling a sprinter to sprint through marathons for training.

The other issue is that these methods require a very high level of motor control. Proper movement patterns need to be practiced without resistance at a low level until the client shows proficiency in the movement. Of all the lifting methods, Olympic lifting is the most difficult to master because of the required flexibility and motor control for explosive movements with heavy weights to get the max benefit. Olympic lifting is a sport in itself and can take years to learn. From our experience it takes the average person 4-6 months just to be able to get into the positions required to properly perform the movements. Once they can move it can take another 6-12 months to learn how to correctly do the lifts with weights. Olympic lifting is a professional sport, yet everyone thinks they can do it without training. Even professional athletes should be cautious because the lifts were designed not for football, soccer or tennis, but for Olympic lifting.

Athletes should integrate Olympic style lifts into their strength and conditioning programs to reap the benefits of these movements but not duplicate them exactly. I

suggest most athletes train from the power position which is called the hang (bar just below knees) since that is what most sports require. If a super elite athlete wants to learn the full lifts, it should be determined by a very high-level coach.

Most courses that teach this method are 2-4 days and then a certification is received allowing one to teach the lifts. Since we all agree Olympic lifting is just like basketball or any other pro sport, then how is that possible? One cannot learn basketball in 2-4 days, let alone teach it, right? The answer seems obvious, yet people still spend millions on extreme home training videos and going to training facilities to do trendy high intensity programs that make no scientific sense.

The videos are the most dangerous, in our opinion. Any professional knows you cannot learn plyometrics by watching a video, and that the average person does not have the knowledge of the basic physical requirements and proper progressions. The science behind plyometrics is similar to Olympic lifting and should not be done for high repetitions either. The sad truth is that a majority of programs break the laws of proven science and safety, but their obvious flaws are overshadowed by attractive instructors, celebrity endorsements, extreme marketing tactics and industry politics. These companies are commendable, in a way, because the business intellect required to achieve such enormous revenue is impressive and there are some very good components in many of these programs. The main issues with these programs are that the parts that are wrong are so wrong it negates any of the positive aspects.

So, the big question we get is "why do they work if they are wrong?"

The fact is that if you do anything consistently and intensely while eating well you will obtain results. If you were to move bricks from one side of the yard to another for two hours a day with a 15-minute jog every 30 minutes for two months, you can be assured there will be fat loss and muscle growth. This is especially true for people who have never exercised or have done very little. So, does that make it right? This sounds crazy but one of the best NFL receivers of all time, Jerry Rice, did just that growing up. He played a lot better when he started training like a football player instead of moving bricks.

Why doesn't everyone get hurt? I know a guy who has been doing that stuff for years! Well, there are people who smoke until they are 90 and have no issues while others who never smoke die of lung cancer at 40 years old. In most cases smokers will develop health problems before 85, but there are always the exceptions. Everyone is different. There are countless variables that contribute to our physical

constitutions and what our bodies can handle before we break down including genetics, nutrition and mental/emotional patterns, just to name a few. Some people are born athletes and can tolerate these programs because they have a natural ability to perform most plyometrics correctly and are strong and flexible enough to weather the storm of poor training.

Are all cookie cutter programs bad? No. There are some great instructors out there who can run programs that follow science and elicit even better results. This article is meant to educate you and serve as the WARNING LABEL. This is not meant as an attack on any particular company or program. It is simply meant to provide information based on common sense and science so that better results can be achieved safely.

What is Functional Training?

Today, there are many different opinions on how one should exercise. Some of the common questions are: "What type of training should I be doing? Do I perform slow or fast reps? Do I use a bench or a physio-ball? Do I do one body part at a time?" The answer is that everyone shouldbe training in a manner that relates to their individual goals. There is no set routine that equally benefits everyone who does it. Performing a typical gym program of random exercises (three sets of ten with one-minute rest) has bene fits but will not be the most efficient way to attain your goals or address your specific needs. Training primarily with machines and not using free weights is inefficient because you are moving resistance along a fixed axis, and not freely in space as the body normally functions. Machines have limited functional strength transfer to real life situations in most cases and can actually create poor motor patterns in some people. Machines do have value when integrated properly however, they are often misused.

Functional training is defined as movements or exercises that improve a person's ability to complete their daily activities or achieve a specific goal. It is not a series of exercises deemed functional by some manual. A good way to start is by doing movements in the gym that strengthen the muscles involved in the movements you wish to improve outside the gym. This does not mean you can sim ply add weight to the exact movement you wish to enhance. Research has shown that doing this can actually be detrimental to some athletic movements. When a baseball player adds weight to his bat, they can actually slow their bat speed down. This is because the added resistance changes the force on the joint and disrupts mechanics. All exercises have some functional value when applied correctly. This value is determined by the exercise's transferable benefit outside the gym. Every exercise

has a functional limitation and it is up to the trainer to understand what that limit is. A good program focuses on weak areas and sets specific goals for the client. It is important to understand how to progress someone from simple smaller targeted movements to more complex multi-joint movements. Training someone functionally can range from having a tennis player perform a lunge to a chop or a bodybuilder do a slow curl for bigger bi ceps; it's all about the end goal. Always keep in mind that doing complex movements before the client is ready will actually do more harm than good.

In order to build appropriate muscle strength, joint integrity, balance, and flexibility in all planes of motion, it is essential that the body is exercised in a functional manner. It is crucial to include multi-joint and multi-planar exercises, as this recruits the body's stabilizers to synergistically facilitate movement. Doing this ensures that the nervous system is working properly and that all parts of the body are used in the appropriate manner, with the correct muscles firing at the right time. This is not to say you shouldn't include some so-called non-functional exercises, including a machine or old school exercise, as this can be beneficial, safe, and fun when applied correctly. To create a functional program, a trainer must set realistic goals and understand the client's weaknesses, daily activities, and limitations.

A trainer must be able to identify postural distortions and include exercises that correct them. More importantly, they must educate the client on what movements or activities to avoid or modify during their day. It's not what you do; it's how you do it. The ability to identify a postural distortion is dependent on the trainer's understanding of anatomy, motor patterns, and muscle function. A trainer must also be able to identify when muscles are over active and firing out of sequence, or not firing at all. Synergistic dominance is common in most postural dysfunctions. In general, if the agonist is tight then the antagonist is weak, thus creating increased stress on the joint. This can result in patterns of repetitive stress, ultimately leading to accelerated joint degeneration

Core stability, flexibility, and balance are key factors when designing a functional exercise routine. It is important to maintain posture while being able to move all joints in a full range of motion. Training with free weights and challenging the surrounding environment will promote balance and stability, which is necessary if you expect to see benefits outside of the gym. Keep in mind, that it is more important to be able to control your own body weight and concentrate on form, balance, and core endurance than to move heavy weights.

A functional core routine consists of dynamic movements, isometric exercises, and challenges the center of gravity. To completely train the core, you must also include dynamic stabilization with isometric exercises and movements to improve proprioception. This is not just for the mid-section, but for the entire trunk. Medicine balls, balance boards, foam rollers and physio-balls are great tools for core training and should be integrated into your programs. As a person ages, balance and stability become compromised. If balance and stability are not addressed, they will consistently degrade. A weak core contributes to poor stability and inhibits proper limb movements, causing muscle imbalances in the kinetic chain. This is why falls are common in the geriatric population. Many back and hip injuries are related to weak core muscles. There are many small muscles in the core that the general population knows little about or addresses during exercise. In most spinal injuries, MRI images show atrophy in these small muscles. In order to maintain a healthy spine, these little muscles need to be trained. Without stability, even the strongest person cannot effectively propel a force into the environment.

Flexibility is a very important facet of any exercise program, but it is often overlooked. A lack of flexibility in the right places appears to be the root of many problems. The body's movements are hampered when flexibility and posture are distorted. Active, dynamic, static, and PNF stretching are key factors and should all be included in any training program. When a muscle is tight, it limits the muscle's ability to contract properly, causing inefficient movements and risk of injury. Without flexibility, the body's movement becomes limited, and good results are difficult to achieve.

How to choose what program fits the person

As a trainer, you will meet many different people. Some are serious and very competitive while others are just recreational athletes or average people who just want to exercise for health and stress relief. It is important to recognize some of general qualities associated with different individuals, because you need to address both the physical and mental needs of your clients in your program design. Below are some basic guidelines and suggestions to help you get started. Program design is complicated and takes practice. This manual only focuses on basic principles only; advanced principles are offered in our other manuals.

The Serious Athlete: Needs strict attention and exercise selection must be precise. Programs must be well thought out and every detail accommodated. Very competitive by nature, so workouts must be challenging and specific to the sport. Super sets, dynamic core training, plyometrics, and heavy training (when

appropriate) should be a big part of your program. This person will do whatever program you give them and will follow it even when you are not there. Incorporate weight-training as much as their sport will allow. Don't overlook the "small stuff"; athletes compensate very well and need to be told when they are doing something wrong. Show them how flawed they are at the easy postural and core exercises that many trainers forget about. You need to be very confident and have a strong background to train this individual correctly and successfully.

The Recreational Athlete: Requires strict attention and workouts need to be functional with some general weight lifting exercises. Loves their sport and enjoys exercise in general. Usually has some gym experience and will want to do non-functional exercises for enjoyment but will do all sport-specific exercises you teach them. Super sets, dynamic core training, light plyometrics, and semi-heavy training (when appropriate) should be a good part of your program. Progression is important – these individuals want to be challenged and exposing their weaknesses will only fuel their determination. They will do most of what you tell them on their own but will be more inclined to play or practice their sport than work out in the gym. Optimally, they should train with weights 3x per week, but 2x per week is what they will normally deliver.

Exercise Enthusiast: This person lives to exercise and will stop at nothing to get into shape. Most of the time this person does all the wrong things and it's your job to change their mind. Exercises should be functional and geared towards toning and muscle building. Target areas they complain about and pay careful attention to progression. These clients are posing in the mirror alone at night, so make sure they see results. They will follow whatever you give them if they believe you. Program design should include 4-5 days, or they will be unhappy and go to the gym on off days and do whatever they want. Be certain to design a program that doesn't over train them but keeps them in the gym and happy.

Weight Loss: This person wants to get in shape and feel better. This individual usually doesn't play sports but may have in the past. He/she also doesn't love exercise but understands it's the only remedy for permanent weight loss. Workouts should be focused on getting them to sweat and raising and lowering heart rate. Exercises should relate to everyday activities and gross movements for maximal calorie burning. Circuit training is a good routine for these participants. Exercise prescription should be geared toward 3x week, but these people love cardio and compliance is usually difficult. They will strength train with you and perform cardio on their own, despite your recommendations.

The Gym Hater: This person hates exercise and anything related to health. There are a few reasons they come in:

- You are a great salesman and convinced them it was in their best interest;
- Their doctor told them they need to exercise for health reasons;
- A family member forced them;
- They feel terrible and want to do something to stop feeling guilty.
- They usually don't play any sports and have been out of shape a long time.

These clients will not do anything unless they see you. It's your job to keep them moving but comfortable. They do not want a hard workout and anything beyond simple exercises makes them upset. The best routine is circuit training and when you see them getting tired, slow the pace and do some really easy exercises. Try and keep it fun and do the best you can to keep them motivated. You are helping them even if you feel your workouts are not the model of efficiency. With these folks, doing something is the name of the game!

When considering program design for beginners, a general suggestion is to design it for an initial 12-week period: four, three-week cycles with gradual progression assuming the client is reaching desired/assigned targets. The first stage is geared towards correcting postural issues, teaching form, defining exercise boundaries, and addressing balance & faulty motor patterns. Repetition ranges will vary from 6 to 10 at slow tempos and low intensity. The second stage is almost the same with less static exercises and increasingly difficult exercises at a faster tempo and slightly more intensity. Repetition ranges can be higher with 10 to 15 repetitions. The third stage should have more dynamic movements at a moderate intensity and include super-setting and challenging environments. The fourth stage should be difficult, full-body, multi-joint and proprioceptive exercises. Intensity is based on goals.

We want to state that the guidelines suggested here are simple in theory and presented as a starting point basis. This is not an all-inclusive approach to program design; in fact, our intent is to offer the fitness professional a foundation upon which to build. We offer more comprehensive, in-depth program design courses and provide suggestion reading/educational materials on our website.

Athlete program design guidelines

When designing a conditioning program for athletes, it is important to take into consideration the time of year it is for the athlete. Periods to take into account include off-season, pre-season, in-season, and post-season, with cycles or phases

incorporated within each period. Workouts must accommodate the primary sport(s) in order to avoid over-training. Program design for athletes is similar to that for other individuals in that initial and on-going evaluations will determine the structure of the workouts and adjustments must be made accordingly.

Despite such similarities, all sports have different demands and training programs must take into account the dominant energy system utilized. Frequently coaches have athletes running long distances, which in many cases is counterproductive. Instructing a squash player to run five miles makes little sense when you consider the no squash course covers that distance! Cardio work should be done in intervals related to the sports demands and rest periods. Sport-specific drills should be a big part of the program and be based on athletic movements during game play. Below is a sample program for squash players who are new to weight training:

Off-season
Rep ranges: 6-10
Tempos: 4/0/1 and 3/0/x
Rest periods:60-120 sec
How many days in the weight room per week? 4-5

Phase1: Concentrate on gross movements and form with slower tempo.
Duration: 3-4 weeks

Phase 2: Gross movements at an explosive tempo – the focus is on power and explosion. Exercises should increase in difficulty as time progresses. Duration: Until pre-season

Pre-season
Rep ranges: 6-8
Tempos: 3/1/1
Rest periods: 45-60 sec
How many days in the weight room per week? 3-4

Phase1: Focus on power and building endurance strength. Variety can be implemented with incorporation of bi-sets.
Duration: 3-4 weeks

Pre-season (Cont'd)

Phase 2: Perfecting and getting ready to play. Drills will increase in intensity; heavy lifting will still be involved, but changes will be incorporated. Higher reps will be used with the power exercises, e.g., one gross exercise performed slightly heavy for 6 repetitions, followed by a 15-repetition, easier exercise.

Duration: 2 weeks
Rep ranges: 8-10
Tempos: 3/0/1
Rest periods: 60-90 sec
How many days in the weight room per week? 3

In-season
Rep ranges: 6-8
Tempos: 3/0/x or 3/0/1
Rest periods: 10- 45 sec
How many days in the weight room per week? 3 or from whatever the athlete can recover.

Phase1: Adjusting to playing and training together. Continue explosive lifts but decrease frequency and avoid high risk exercises. Keep workouts a bit shorter and avoid a lot of aerobic activity.

Duration: 4-6 weeks

Phase 2: Continue explosive lifts but further decrease frequency. Incorporate more flexibility and recovery exercises.

Duration: Until post season.

Phase 3: Usually occurs around crunch time (those making it to postseason play). Everyone is different. As a general rule, it is prudent to keep the workouts to a moderate intensity and eliminate explosive weight training. Focus more on drills and explosive, on-court movements. Increase time passively stretching the athlete.

Duration: until end of season

Post-season
Rep ranges: 12-20

Tempos: 5/0/1
Rest periods: 30-120 sec depending on weaknesses
How many days in the gym per week? 3-4

Phase1: Higher reps for recovery. Don't overdo it the athlete is playing their hardest at this point.

Duration: until the end of the season. After their final match give the athlete a week or two to recover. Don't do any weights; just stretches and basic, simple movements.

Circuit Training

Circuit training involves performing a series of exercises with little or no rest at the end between each exercise. The series can be as few as three exercises or as many as five or six exercises performed consecutively. Once the series of exercises has been completed, a rest period of one to three minutes is allowed before commencement of the next circuit. Circuit training routines are typically best for weight loss or rehabilitative situations, but they can easily be designed and/or modified to suit the needs of any individual – from a beginning novice to a well-conditioned athlete.

Circuit design will vary depending on the needs of the individual, but the exercises should be structured in a fashion which incorporates use of alternate muscle groups to facilitate recovery. Exercise selection should be geared toward functional-type movements because circuit training is often used as a method for building foundational strength. Well-chosen functional exercises will not only develop the prime movers but help to condition core musculature -- a key consideration in any exercise program. The overall goal of circuit training is to allow for anatomical adaptation in a structured manner with less risk of overload to the client due to alternating muscle groups.

You can easily control the intensity of a circuit routine by speeding up the exercises, super-setting or increasing or decreasing rest periods. Circuits for novice athletes should be designed to address as many muscle groups as possible because you are trying to create a strong foundational base upon which they can build in the future. Therefore, beginning circuits will result in the use of more stations and ultimately longer circuits. Design for experienced athletes however, can include a reduced number of stations but a change in pattern between circuits.

General training parameters for circuit training will vary on the level of the participant, and it is from this level that you can use to design the circuit workouts. For example, a recommended frequency for training for novice clients is 2-3 days per week and for experienced athletes, 3-4 days per week. Some sessions can involve full-body training while others can focus on specific muscle groups. If the participant is training three times per week with one day of rest between training sessions, their workouts can be structured as follows: Day One: Full-body, focusing on large muscle groups; Day Two: Core and balance exercises; and Day Three: Full-body focusing on the smaller muscles. If the participant is training on two consecutive days, you can design each circuit to focus on alternating muscle groups on the upper body on day one, and the lower body on day two. You can do different rep ranges and tempos for different body parts in the same workout to add variety. It is important to remember that the total physical demand for each client must be increased progressively with the individual in mind in order to maximize anatomical adaptation. Therefore, a novice participant will require approximately 8-10 weeks for such an adaptation, while an experienced exerciser will require programming change after a maximum of five weeks.

Don't Fear the Weight Room

Some women still fear the weight room. The existing myth is that women who lift weight will end up with big, bulky muscles and look too manly. Ideas like this are giving resistance training a bad name.

We, as trainers, must remember that men and women are physiologically different and the increased muscle mass that is acquired by men is due to testosterone. Yes, women secrete and deliver testosterone just like men do, but at much lower rates and volumes. This allows women to tone and build lean muscle and to increase metabolism to enhance weight loss.

Frequently, women start an exercise program to lose weight and look better. However, resistance training has so many more benefits to help women's health, both now and in the future. Looking great is always a plus, but resistance training may also decrease day to day stresses from our fast-paced lifestyles.

Stress may lead to decreased motivation and eventually increase body fat storage. Studies have shown that proper exercise can reduce stress dramatically. Another important factor for women is bone mineral density (BMD). Because of a higher level of estrogen, women are at a higher risk for low bone mineral density than men. A consistent moderate resistance program can increase BMD in women and

dramatically reduce the possibility of osteopenia and/or osteoporosis. The proper resistance training program can also increase posture, balance, flexibility, and stability for all ages.

What is Metabolism?

Sure, running on the treadmill will help women lose weight but so will every other daily activity we are engaged in. Whether it's walking, eating, or even sleeping, our bodies are using calories to function properly. Losing weight depends on the intensity and duration of what we are doing each day. As mentioned, running on a treadmill will help us lose weight more than walking, and walking will help more than sleeping, but if there were an easier way, we would do it…right? Luckily there is. It's all about our metabolic rate.

Our metabolic rate (or basal metabolic rate BMR) is closely related to resting metabolic rate (RMR) and it measures the total amount of energy expanded while at rest or sleep. The term thermogenesis refers to the measure of total energy exhausted as heat disposal. As we age we generally lose muscle mass which decreases BMR. New scientific research has shown that aerobic exercise alone doesn't correlate with an increase in BMR, but anaerobic does due to maintaining lean body mass.

Cardio vs. Weight Training

When you do cardio, your intensity will determine how your body produces energy, aerobic or anaerobic. To keep it simple, aerobic is with the presence of oxygen and anaerobic is without oxygen. Even though anaerobic exercise (resistance training) may contribute to an increase of metabolism, aerobic exercise (cardio) is also important. Aerobic training is very important for the cardiovascular system ("heart health"). There are optimal times for both kinds of exercises depending on your goals. Additionally, cardio and resistance training can also be combined together. If the goal is to increase power and strength, then including cardio exercises can be detrimental. This is due to an increase the muscle capillary density, increased number of mitochondria (both help in oxygen consumption to keep the muscle going), and a possible change in fiber type (type IIx to type IIa to type I). However, if the goal is increase aerobic power, both cardio workouts and resistance training can be combined. This will allow for an increase in aerobic power due to an increase in VO^2 Max. VO^2 Max is the amount of oxygen exchange that occurs within a muscle to adequately supply and keep the muscle cells functioning properly (contributing factor may also be stroke

volume SV). For the best results to achieve weight management, both types of exercise should be combined via circuit training. Circuit training will allow a trainee to increase aerobic and anaerobic power by incorporating moderate to high intensity (keeping the heart rate up) exercises with resistance training.

Frequency of Weight Loss

Weight loss can vary depending on the individual and the diet and exercise routine. Some people go on extreme crash diets and lose 8, 10, or even 12 pounds a week. This is extremely unhealthy and will almost certainly result in the weight being regained in the future. Furthermore, some people may be able to safely and effectively lose 4 pounds a week, while another may only be able to lose 1 to2 pounds a week. This all depends on the trainee's starting weight. A good rule to follow is the "1% rule" (1% loss of starting body weight per week). For example, if a trainee's starting weight is 150 pounds, then a maximal weight per week should not exceed 1.5 pounds a week. Whereas, someone with a starting weight of 300 hundred pounds may effectively lose 3 pounds per week. The 1% rule can adequately allow for safe weight loss without creating macronutrient deficits. Macronutrients are the three essential nutrients that consist of carbohydrates, proteins, and lipids (fats). When people attempt some of these "fad" crash diets, they ultimately fall short in the proper percentages of one of the three essential nutrients. This may put the body in a particular nutrient deficiency that may change the body's physiological chemistry, and negatively impact metabolism.

Women's Resistance Training Program Design

A proper program design should be specific to the person being trained. Since each trainee will begin at a different level based on their condition, a tailored exercise program with the adequate amount of progressions is crucial for optimal results. Each exercise program should begin with some sort of active/dynamic warm-up to help promote proper muscle activation for the following workout. To circuit train effectively, three to four multi-muscle functional workouts can be grouped together to optimize increased heart rate and aerobic and anaerobic power output. Between 2 to 4 sets and 10 to 15 reps of approximately 3 or 4 exercises should be performed in a continuous cycle with little rest (30seconds to 1 minute after completing each cycle of the 3 to 4 exercises). Each group of three to four exercises may primarily target different areas of the body. After the warm-up, the first group of exercises may focus on legs. The second group may focus on the upper body, and the third may focus on the core muscles. This exercise structure can help save time and effort with a busy schedule and may also maximize overall

fitness results. Ending each workout with a form of static stretching may also be a good idea. Static stretching AFTER exercise can keep the joints from getting too tight.

Strength Training for Children and Adolescents

Many parents focus on helping their child reach their full academic potential with tutoring, homework, and structure. Children have an athletic potential as well that is often overlooked or assumed that team sports alone will help them reach it. While the importance of learning teamwork is not discredited, team sports alone will not help a child reach that potential. If they excel at a sport or sports, getting them involved early in strength and conditioning training can mean the difference between playing at the varsity level, a possible college scholarship, or even reaching the dream of professional sports.

For some parents, strength training may seem risky and unnecessary for their child. As a kid I was always told, "You play sports so you're already in shape" or one of my personal favorites "if you want to get stronger just go do pushups and sit ups." These commonly heard statements are absurd and could contradict the sport specific goals of nearly all sports. One thing that trainers, coaches, and parents should know is that children and adolescents are not just small adults and need a training routine specifically designed for them. Children and adolescents are physiologically different from adults, but this doesn't mean that with the PROPER training that they cannot benefit greatly from strength training. With the aid of resistance training, boys and girls are capable of significantly increasing muscular strength in addition to their natural growth and maturation during development. Studies have shown that with the proper intensity and volume, children as young as 6 years old have benefit from resistance training. Like sports, there is no minimal age requirement to participate in strength training.

How can strength training affect children and adolescents?

Early/late childhood: boys age range from 1-10 and girls age range from 1-8
Adolescents: boys age range from 10-22 and girls age range from 8-19

First and foremost, for children and adolescents, trainers must find a way to make training FUN as well as beneficial. The concept of training can be intimidating. Some children and adolescents look at strength training as work and that's exactly what it is. Making up games/competition to incorporate into exercise programs can help keep the trainee engaged and excited to work hard. So therefore, training children and adolescents has an added dynamic that requires some extra attention and focus by the trainer to ensure maximum gains/improvements and to inhibit

frustration/boredom. Another important aspect of training children and adolescents is language and communication. Using appropriate words and tone can help encourage a trainee and maintain self-esteem; inversely, using too harsh a tone or using too strong or negative language can damage self-esteem. If a child has low self-esteem and gets frustrated with exercise the odds of them working at 100% is low. A trainer should ensure that there is not a negative correlation between exercise and satisfaction &self-worth. Educating children and adolescents on the benefits of strength training and how it can make them feel better, live better, and be happier will only help promote healthy living.

In adolescents, puberty is when we see a substantial increase in muscle mass (hypertrophy). For most people, this increase in muscle size is associated with an increase in strength and signifies the turning point at which training can begin. Although this could be one view, neurological adaptation (nervous system development) is the main contributor for pre-pubescent children. This helps with motor development and coordinated movements, which illustrates how our athletic development begins even younger. For example, throwing a baseball or catching a football requires an extremely high level of coordination and motor skills. It should be looked at as a fundamental foundation to help aid in proper athletic movements later in life.

The main concern of training a child or adolescent is not only making significant gains, but also ensuring the safety of the trainee. Whether it's a trainer, coach, or parent that is working with a child or adolescent trainee supervision is very important. Form and posture mistakes can be most detrimental to a new trainee of all ages and can ultimately lead to poor mechanics and/or injuries. The proper biomechanics of an exercise can greatly benefit children and adolescents. Taking the time to advise proper form and movements should be the first priority to any new exercise. Sometimes it is easier to master the technique of an exercise with little or no weight added. This will ensure that the proper movement patterns can be instilled with the program.

Pain Related to Daily Activities?

Our daily activities can cause muscle imbalances. No matter what your line of work, you probably have some type of routine consisting of repetitive activities. This can overwork some muscles and under-work others. This is one reason why many people often say, "I do not know how this happened – one day I felt pain, but I've never had an injury." The body is a balanced system of levers and disrupting that balance can put joints at a mechanical disadvantage, causing unnatural and inefficient movements. The muscles that work harder tighten while the opposite weaker muscles lengthen, causing impingement of joint spaces and other joint irregularities. This extra wear on the joints and ligaments can also cause arthritis, bulging disks and even tiny fractures in the spine. For example, an office worker who sits incorrectly all day with chin forward, shoulders rounded and leaning over toward the computer will likely have anterior shoulder, low back and neck pain. Think about the amount of times you get up and down in one day. If you are doing so incorrectly, the force on your spine eventually will cause some type of break down. This postural distortion can cause all sorts of problems such as pain, poor sleep, scar tissue build-up and muscle atrophy, just to name a few. Simply taking medication for pain is not enough and routine, impersonal, everyday exercises do not work.

Unfortunately, medication can often be a mask that only exaggerates the problem and introduces new side effects. A general exercise routine doesn't fit every person because people have varying lifestyles and do different things. One person may have back pain due to a hip dysfunction, while another may have a thoracic issue. Therefore, exercises need to be tailored to the individual. An effective exercise prescription needs to, not only consider your job, but your daily activities and workout routine. Did you know that stretching alone can alleviate many basic everyday complaints? Exercise and stretching related to daily activities can benefit any person because if you feel better at work, you will perform better. If a job is stressful, it can cause tension in the neck and back and pain from tight muscles can trigger stress and thus, the start of a cycle.

A functional program that considers these issues can greatly help your client. Take into consideration what they do all d ay and include exercises to offset those repetitive motions or positions. It is not all about big muscles. Help your clients to feel better and they will value your service.

Frequently Asked Questions

Q) Should I do slow or fast repetitions?

A) The speed of the repetitions should be based on the speed of the required activity. The body needs to be trained at the same or higher velocity during exercise to

benefit a particular activity. A sprinter doesn't jog to increase their speed. Slow training is good for form training, rehabilitation and hypertrophy.

Q) My friend works out at the local gym and mostly uses machines. He has been doing the same routine forever and has had good results. Is this program good for me?

A) NO! If you stick to it, any exercise program will produce results whether it is done right or wrong. Unfortunately, when exercise is done incorrectly, the harmful effects may not be noticed until the damage is done. By exercising functionally, you will systematically attain your goals and insure that your time in the gym is spent safely and efficiently. Just because someone looks good does not mean they are an expert.

Q) Can functional training benefit anyone?
A) Yes. Functional workouts are beneficial for any athletic level or age group. When you train in this fashion, you will see drastic improvement in overall health and performance not just appearance.

Q) Shouldn't I do cardio and lose weight before I start a functional program?
A) NO! You should have a functional training program that concentrates on raising and lowering your heart rate. The program should first use body weight exercises then advance to free weights. This promotes lean muscle mass, skeletal integrity, and healthy cardiac function. Muscle mass accelerates fat loss.

Q) My friend tells me to do three to five sets of 10-12 repetitions to failure, with one-minute rest intervals. Is this the correct method?
A) This is what everyone who thinks of the gym envisions. This is not a good program unless you are a bodybuilder. If you train in a functional fashion, you burn more calories and get more benefit from your sessions outside of the gym.

Q) Aren't aerobic classes and the treadmill enough?
A) NO! A weight training program that includes balance, core stability strength and cardiac conditioning will build lean muscle mass. When you build lean muscle, you burn more calories at rest and during your daily activities. Therefore, by adding resistance to your program, you will actually burn more calories doing the same aerobics class or distance on the treadmill.

Q) Should I stretch before or after exercise or an event?
A) Evidence suggests that static stretching before an activity is not beneficial to prevent injury. If you want to avoid injury, you need to be flexible by doing regular stretching – not just before activity. Active and dynamic stretches with a short warm-up mimicking the activity before, with PNF and static stretching at the end, help remove waste from the muscles.

Q) Why have none of my doctors told me to stretch and exercise to alleviate pain?
A) Unfortunately, we live in a society where some doctors prescribe medications for everything imaginable. Everyone wants immediate gratification (a pill) not a long-term solution (exercise). The fact is that most people ignore the doctors' requests to stretch and exercise. Most minor health problems can be eliminated by moderate exercising, but people choose to take medications because it is easier.

Q) I injured my knee and my doctor told me to rest it for a while. Do I?
A) So long as the joint is stable, this is the worst thing you can do. Pampering a stable injury for extended periods causes muscle atrophy and decreased blood flow. All injuries should be functionally rehabilitated under careful supervision by a health professional. There are doctors that base their whole practice on movement therapies for injuries, find them. Keep in mind there are injuries that rest is the only answer.

Q) Should I cut carbohydrates out of my diet?
A) NO! Only cut out high glycemic carbohydrates. Carbohydrates are essential for cellular function. Eating carbohydrates that do not spike insulin levels is healthy and effective for weight loss.

Q) My doctor told me to walk to get some exercise for my aches. Is walking enough?
A) NO WAY! If walking were enough, everyone would be healthy as we all walk. If you have pain, chances are there is a biomechanical issue. My first suggestion would be to stretch. More walking may further aggravate the issue; you need to correct the imbalance first, not just walk more. I suggest seeing a Physical Therapist for this situation if stretching doesn't help.

Avoiding injuries

A person that is training at any age has some potential of injury. Proper training significantly decreases the risk of injury but cannot guarantee an athlete won't get injured, just as an athlete could be injured in the heat of competition with any sport. However, what proper training does guarantee is that the injury potential in competition will reduce dramatically. Functional sport specific training will allow for identification of weaknesses and subsequent increase in balance, flexibility, strength, and coordination in vulnerable positions and movements. This leads to an overall increase in strength and ability to perform in the athletic arena. Regardless of the individual, when introducing resistance training it is always important to underestimate ones' physical abilities regardless of how big or strong the child or adolescent may seem. For most children and adolescents, resistance training will be a new experience. Pushing &exceeding their abilities too soon may put them at a greater risk of injury. Starting slowly and cautiously to complete an evaluation and moving up when the foundation is established is the safest approach.

Should trainers worry about growth plate injuries in children and adolescents?

Growth plates are areas of bone that is still in development. The growth plates are cartilage tissue at the ends of long bones and are important to normalize the length and shape of mature bone. Growth plate fractures can be classified depending on the degree of damage to the plate itself. All children that are still growing are at risk and the injury rates increase into adolescents. Growth plate fractures occur twice as often in boys then in girls. This could be due to boys having higher involvement in high impact sports. 1/3 of growth plate injuries occur in competitive sports, such as basketball, football, and gymnastics. 1/5 of growth plate injuries are due to recreational activities, such as skateboarding, skiing, biking, and sledding. There are five different classifications of growth plate fractures:

- A type I fracture is a break in the bone that separates the bone end from its shaft; this type may require surgery which involves pins.
- A type II fracture is when the bone breaks partially through the growth plate and partially through the cortical bone itself. This is the most common type of fracture.
- Type III fracture is a break off a portion of the growth plate and piece of the end bone. This type is more common in older children adolescents.
- Type IV is a break through the bone shaft, growth plate, and end of the bone. These fractures commonly stop bone growth and are treated with surgery.
- Type V is when the growth plate is compressed due to a crush impact. This type will almost always disturb bone growth but is very rare.

There are two major reasons for these types of injuries. First, in children and adolescents, bones and muscles develop at a different speed, so the bone may be weaker than the ligament tissue that it is connected by. The second reason for these injuries can be attributed to high impact movements on the bone such as; falls, contact sports, or high rates of joint stress. For trainers there has been an increasing concern for these injuries, especially with plyometric workout programs. Plyometric workouts can be best defined as exercises that involve rapid stretching and contracting of muscles to gain an increase muscle power. Even though there are limited studies on plyometric workouts in regards to children and these exercises, there's an increase concern focused on the high intensity impacts with plyometric exercises. The major concern within plyometric workouts has focused on the intensity of depth jumps. The depth jump is rated as the highest intensity of all plyometric workouts because of the amount of stress it puts on the lower extremities. The proper mechanics of a basic depth jump consists of jumping forward off of a box on the ground with both feet. Then rapidly descending into a squat position and exploding in the upward direction with a

powerful jump. The height of the box that is descended from will determine the amount of impact within the exercise.

Signs of growth plate injuries

A child that has experienced a growth plate injury may have some visible deformity. Another telltale sign of a growth plate injury is consistent or severe pain at the joint. If the child is unable to move or put any degree of pressure without experiencing pain, there could be a growth plate issue. If any of these signs are apparent while training a child, the trainer should immediately stop the session and should inform both the parent and child to get an examination by a licensed physician (trainers are not licensed physicians and should never diagnose a trainee).

BMD and BMC

Bone mineral density (BMD) and bone mineral content (BMC) are very important in a maturing body. Bone mineral content refers to the amount of bone mineral in grams. Whereas, bone mineral density refers to the grams per centimeter squared (g/cm^2). Children are considered "moving targets" and bone mineral content may not apply to them the same way it does to an adult (heavier bone may not reflect stronger bone). The age at which bone mineral content will most likely reflect bone density is post-adolescents. Bone mineral density is most advantageous to the strength of children and adolescents bone make-up. The most crucial time for development and strengthening are between the ages of 10-15 (for most this is adolescents). Bone mineral density can be developed by performing weight bearing activities. The more vigorous the activity or exercise is the greater the increase in bone strength (BMD). This may seem to contradict the theory on growth plates, and it does. This is why children and adolescents are not miniature adults. There is an overlap in performing more intense exercise as children and adolescents because of the risk of growth plate injuries. Keeping the trainee in a healthy intensity range will help benefit the child without injury. Medium to high intensity plyometric workouts can be safe for a child to maximize healthy bone strength.

Make training children and adolescents simple

There seems to be a simple solution to this concern with children and adolescents. This is to avoid this particular plyometric exercise or any workout that can put a high level of stress on joints. There are plenty of resistance training exercises, including plyometric exercises, that children and adolescents can do without over stressing their joints. These include most power lifts, most strength training lifts, repetitive jumps, bounds, different throwing exercises, etc. Sometimes as trainers,

we focus more on what we can't or shouldn't do in regards to training children and adolescents and inadvertently forget what we can do. There are far more exercises that are safe for children and adolescents then ones that are not. Some other important factors to keep in mind for training children and adolescents are nutrition, proper recovery times, and educating youth sport coaches about the benefits of strength and conditioning training.

CHAPTER VIII

Charts and evaluations

Name_____ **Today's date**:_____
Phone (h)_____(w)_____
Address_____ **Email**_____
Medical Information:

When was your last complete physical examination? What were the results?

List any medications *you* are currently taking or have taken in the past 6 months.
Provide the reason they were prescribed.

List any operations that *you* have had (include date):

Are *you* on a special diet?

Have any member of *your* immediate family (mother, father, sister, brother) had:
Heart disease/ Hypertension/ High Cholesterol / Heart Attack/ Diabetes / Stroke / Obesity

Indicate any of the following which currently or have existed in the past, and note when:
Anemia___ Arthritis___ Asthma ___ Back pain/injury___
Bursitis___ Cancer___ Diabetes___ Dizziness___
Epilepsy___ Headaches___ Heart problems___ Hernia___
Hypoglycemia____ Joint problems____ Kidney problems___Liver disease___
Lung disease____ Shortness of breath__Ulcer ____ Weight problems____
Chest Pains____ High blood pressure__Thyroid problems_ High cholesterol___
Osteoporosis_____ Neurological Disorder_____ Other_____

***Do you* currently smoke? ____ Have *you* ever smoked? _____**
Age: ____
Are you pregnant or trying to become pregnant?_____
***BLOOD PRESSURE:*____**
Explain your current eating habits How many times do you eat per day?___
Do you take any
supplements?_____
_____
_____
_____

How do you spend your day at work? Hours of sleep do you get each night?_____

Sitting at a desk walking/ active highly active Hours per week_____

How would you rate your daily stress level?_____ Rate your daily energy level?____
Do you enjoy exercising?____ How often do you perform resistance training?_____
How often do you perform moderate exercise?___ Vigorous exercise? ___

How would you rate your current fitness level?

Poor Below Avg. Moderate Above Avg. Excellent Competitive Athlete

List any other factors which might affect your safe participation in a fitness program?
Weight _____ Height____ Body Fat___ Measurements: Waist___ Thigh___ Chest___ Arms___
Lowest weight_____ Highest weight_____ Favorite weight_____
Personal Goals: (circle all that apply)
Weight loss lbs._____ Improve strength General Fitness
Reduce risk of disease Improve Flexibility Improve Cardio Vascular Health
Improve posture Tone and firm Injury Rehabilitation _____
Strengthen Bones Exercise Regularly Balance and Stability
Other _____
Please list anything else that will help provide a better Fitness Program
Rest HR____ Max HR_____ Recovery HR_____

NOTES: _

EVALUATION

Name: _____ Date:

Health History:

Prior Surgery: _____

Bursitis:_____ Stenosis: _____ Fusion:_____Herniation:_____

SQUAT

Heel Raise ☐_
Toe Raise ☐_
Knee Knocking ☐_
Rounded Back ☐_
Pronation☐_____
Hip Flexion/Forward Lean ☐_
Notes:_____

WALL SLIDE

Pain ☐
Can't Keep Shoulders Flat ☐
Can't Keep Spine Neutral ☐
Hands Move ☐
Notes:_____

ONE LEG STAND

Time Left: _____ Right_ Pelvic Shift ☐_____
Knee Shaking ☐_____
Eyes Closed Time: Lt_____Rt____
Notes:_____

TOE TOUCH

Rounds back ☐_____
Maintains neutral spine ☐ Notes:___
Pain ☐_____
Notes: _____

LUNGES

Heel Raise L☐ R ☐_
Pronation ☐_
Torso Lean☐_
Knee Shaking L☐ R☐_
Pain ☐_____
Notes: _____

PLANKS

Low Back Pain ☐_____
Pelvis Drop ☐_____
Thoracic Flexion ☐_____
Time: _____

PUSH UPS

Reps: _____
Shoulder Elevation ☐_____
Lumbar Extension☐_
Scapula Winging ☐_
Scapula Retraction ☐_____
Pain ☐_____
Notes:_____

SUPINE FOAM ROLLER

Shaking Core ☐_____
APT/PPT ☐_____
Can't Stay on Roller ☐_
Knee ☐_
Notes:_____

Progress Tracker

Date:______________

Weight:__________________BMI______________Body Fat_________________

Measurements:

Waist_______ Hip_________ Bicep_______ Quad_______Calf_________ Chest_______

One Mile Treadmill Test:

Starting HR:__________________ Pre-Cool Down HR:

Ending HR:________________ Recovery HR (1 minute):

Time:_____________

Date:______________

Weight:__________________BMI______________Body Fat_________________

Measurements:

Waist_______ Hip________ Bicep______ Quad_______Calf________ Chest_______

One Mile Treadmill Test:

Starting HR:__________________ Pre-Cool Down HR:

Ending HR:________________ Recovery HR (1 minute):

Time:_____________

Date:______________

Weight:__________________BMI______________Body Fat_________________

Measurements:

Waist_______ Hip________ Bicep______ Quad_______Calf________ Chest_______

One Mile Treadmill Test:

Starting HR:__________________ Pre-Cool Down HR:

Ending HR:________________ Recovery HR (1 minute):

Time:_____________

CHAPTER IX
General Sports Training Principles

This chapter is meant as an introduction to the basics. Sports training is complex and must be specific to each athlete.

Tennis/Squash Program

Training tennis and squash players requires a multidimensional approach that includes strength and conditioning training, as well as the sound principles of injury prevention. Tennis is a sport that requires a lot of repetitive movements and full range of motion in every joint. The goal of this program is to discuss proper biomechanics, the importance of flexibility, and outline proper training techniques and how nutrition affects performance.

Biomechanical Evaluation

It is important to evaluate the body as a whole to detect weakness and any joint dysfunction. To avoid overuse injuries, screening for muscle imbalances is an extremely important part of any training program. The rationale behind it is that there are detectable and correctable abnormalities of muscle strength and length. These imbalances can affect basic movement patterns such as running or swinging a racket and lead to unexplained musculoskeletal pain and dysfunction. Once detected, a specific functional rehabilitation program can be implemented. This can include but is not limited to soft tissue release, corrective exercises, core strengthening through tri-planar movements, and balance and flexibility training. The focus is on restoring function and stability by correcting irregular muscle patterns and treating the body as a whole.

Flexibility

Flexibility and balance are the two most important concepts to build a solid foundation. Moving incorrectly will hinder the body's ability to create maximal force. This will undoubtedly affect your game and workout. Repetitive incorrect movements actually shut muscles off and create synergistic dominance, reciprocal inhibition, and altered neurological pathways, which greatly inhibits your form. Tight muscles cause compensation patterns that will disrupt proper movement and hitting mechanics. Proprioceptive neuromuscular facilitation (PNF) active and dynamic stretching should be part of your program. We find that most athletes move incorrectly due to poor flexibility and balance. Most tennis players have very tight hips, shoulders and pecs. You need to stretch just about every day especially after a match or practice. If you do not stretch, you will have a short-lived career riddled with injuries.

Core Training

Core training needs to be specific to tennis and should include balance and exercises that improve proprioception. Sit ups, bicycles, and leg raises should be eliminated totally from a tennis program. According to research, these types of

exercises further tighten the hips which are already prone to tightness. These floor exercises also put tremendous torque on the spine irritating disks and do not recruit as many abdominal muscles as you might think. Athletes do not play tennis lying down on their back, so it doesn't make sense to train that way.

Training should include core stabilization and tri-planar exercises that mimic movements that are specific to tennis. Training with medicine balls and using chopping motions with balance devices are a good idea. The core is the center of all movement, so it should be trained in a way that is optimal for each individual. Building a strong core creates a solid base for supporting your body through specific movements. A weak core will increase the risk of injury and can lead to loss of power on the court. You need to set up the training environment that challenges balance and proprioception specific for tennis players. Implementing cuing exercises will improve motor skills and promote proper movement patterns. Poor balance and flexibility create wasted movements and will inhibit the body's ability to decelerate properly and change direction explosively.

Strength and Power Training

This is the most overlooked aspect. All athletes can benefit from strength training and should do at least 2 days a week, even in season. The exercises should relate directly to tennis and incorporate full body movements targeting weak links. You should be training using multi-sets that mix resistance training with endurance training. It is crucial to train at a high velocity, since tennis is a fast sport.

You need to establish core strength and proper movement patterns before moving onto plyometrics and explosive exercises. Plyometrics should be added only after a full body movement analysis is performed. Often times, athletes do plyos without being able to move or absorb force properly.

Endurance training

Most of your cardio and endurance training should be on court, since that is where you perform. Running 5 miles has little benefit to a tennis player since the court is only **78x28 ft.** and squash is **32x21 ft.** Interval training should be the staple of your program. For example, set up cones on a tennis court or measured area and have athletes run to the cones and explosively change direction while rotating. It would not be a bad idea to do a 30-40 min weight session and then play a practice game. This method can be effective for endurance strength because in a real game you are never doing prior weight training. This method is called pre-exhaustion. Riding the bike doesn't make you better on court either. It is ok for a cool down or an infrequent change of pace but should by no means be substituted for court work.

You stand during tennis so why sit when you train? You should not even sit between points.

You should be training according to time. The average 3-set men's match is about 2 hours but a 5-set match can be up to 5 hours. There are short rests of 10-15 sec between points and about 120 secs between sets. An average point is about 15 secs but can go longer.
Juniors have a 1-hour minimum rest but their average match lasts about 45 minutes.
It is important to train in the same time frames that the game demands.
Running and most cardio is aerobic so training that way limits carryover greatly.
Research proves that too much aerobic activity is actually detrimental to sports training.

Nutrition
This is the absolute most important aspect to any training program. Poor nutrition will hinder performance no matter what sport you play.

Water
Calcium/Potassium/Magnesium
Pre-workout carb loading facts
Pre-game carb loading facts
Restoring glycogen stores after a match or workout
Importance of multiple meals
Use of supplements
Use of BCAAs during long matches

Recovery between multiple games
During the time in-between multiple games, you need to stretch and rehydrate with carbs to replenish glycogen stores and some protein (BCAA). Gatorade in any form is not recommended. Drink something with natural electrolytes and carbs. Zico makes coconut water, which has more potassium than 10 Gatorades. An organic protein bar or some type of easily digested form and fruit is also good idea for long days.

Rest
It is necessary to rest. Working out is not good for you every day regardless of how it is done. The body needs to recover; more is not always better. Overdoing things leads to injury and only hinders results.

At The Arena, we believe that restoring optimal function is the most important concept in eliminating pain and preventing injury. With the combination of our evaluation, treatments and structured program, tennis players will find improved performance and playing satisfaction.

Improving Your Golf Performance

Golf Analysis
Your golf swing is all about proper body mechanics. A good golf swing requires full rotational capacity of nearly every joint involved and must be done - efficiently - easily - explosively - repeatedly. Many swing faults are directly attributable to poor joint mobility, resulting from soft-tissue restrictions.

At The Arena, we provide you with a means to enhance your golf performance by identifying and releasing restrictions that reduce performance and cause injuries.

During our **Golf Analysis** we:

- Determine which structures are affected along the Golfers kinetic chain. We focus on more than just the chief area of restriction.
- Identify the antagonistic structures (opposing muscle groups) to those that have been identified as the primary structures causing the imbalance. Since function and performance is based upon balance and coordination, an opposing soft-tissue structure is *always* affected by restrictions in the primary structure.
- Then treat each soft-tissue dysfunction with the appropriate technique to restore full function to the affected structures.
- The result is almost most always an improvement in Golf performance. Using this process has helped hundreds of Golfers achieve their goals and prevent numerous injuries from occurring.

Common Swing Faults

Common swing faults occur due to tight shoulder, tightness in the hip joint, spinal injuries, and repetitive strain injuries. When shoulder rotation is restricted, the body compensates with excessive spinal rotation. This can result in back injury because most people already lack flexibility in the spine. In addition, golfers will notice that they have difficulties in:

- Keeping their eyes on the ball
- Maintaining an optimal swing plane

- This results in fat or thin shots. When the golfer attempts to compensate at the shoulder joint, the chances of a hook or slice increases.
- Tightness in the hip joint rotational muscles places additional strain on the rotational requirements of the shoulder or spine. Often a golfer will compensate by lifting up during the back swing and then chop down on the ball resulting in a fat shot.
- Wrist and elbow injuries often occur when the body does not have the capacity to effectively compensate at either the shoulder or spine. The wrists are then over-used to drive as well as decelerate the golf club.
- These swing faults are often easily corrected by addressing the physical restriction the golfer has in their body.

Stretching is often not enough to release these restrictions

Even individuals such as professional golfers who are constantly stretching find it difficult to release soft-tissue adhesions. This is why so many professional and amateur golfers are turning to Active Release Technique (ART), Graston, Acupuncture, and stretching to release and remove these restrictions. Often muscle groups will literally adhere to each other, preventing the sliding necessary for full mobility. During normal stretching, the first tissue that elongates may not be the scar tissue, but rather the normal healthy tissue. After the restriction has been removed, an effective program of stretching will often be enough to stop the restrictions from returning.

Applying Soft tissue techniques to golf related injuries

In order to effectively balance your muscles and remove joint restrictions, we must first identify your unique pattern of muscle imbalances. By utilizing a series of muscle balance and swing analysis tests, we can identify the exact type, extent, and location of muscle restriction. We then use ART treatments and follow-up stretches to remove and resolve these restrictions and then strengthen the muscles with weight training to prevent re-injury.

We don't tell you how to golf, we just help your body perform the way it should.

Core Stability

The core is where the most of the body's power is derived. It provides the foundation for all movements of the arm s and legs. It must be strong, have dynamic flexibility and function synergistically in its movements in order to achieve maximum performance. Motion of the human body is not isolated to one muscle or tissue moving in one specific direction. Rather, it is a complex event involving agonists and antagonist structures that work together to create changes in position and/or location, and to stabilize the body in all planes of motion. Regardless of what sport one p lays, it is essential to have core strength and trunk stability to maximize performance and prevent injury.

What Makes Up the Core

The foundation of the core is much more than the abdominal muscles. It includes muscles deep within the torso, from the pelvis up to the neck and shoulders as well as the following structures:

- **Multifidus** – deep spinal muscles that run segmentally from the neck (C2) to the sacrum. They produce extension, and to a lesser degree, rotation and lateral flexion forces that provide stability to joints at individual levels of the spine.
- **Interspinales, Intertransversarii, Rotatores** – deep structures that directly attach to the spinal column. These are very important for rotatory motion and lateral stability.
- **External Obliques** – abdominal muscles that attach at the lower ribs, pelvis, and abdominal fascia.
- **Internal Obliques** – abdominal muscles that attach at the lower ribs, rectus sheath, pelvis and thoracolumbar fascia.
- **Transversus Abdominis –** abdominal muscles that attach at the lower ribs, pelvis, thoracolumbar fascia, and rectus sheath.

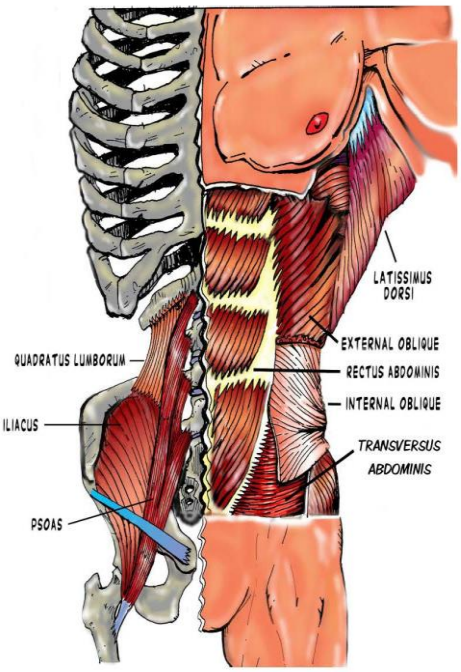
These abdominal muscles work together to transmit a compressive force, and act to increase intra-abdominal pressure to stabilize the lumbar spine. They also work individually to perform trunk rotation, while the internal and external obliques on the same side can work together, or synergistically, to laterally flex the spine.

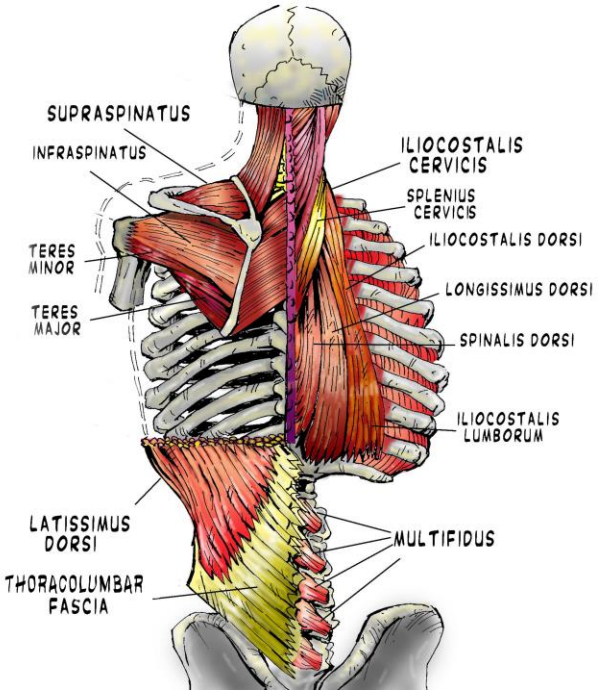
- **Rectus abdominis** – abdominal muscle that attaches at the fifth through seventh ribs, the lower sternum and the front of the pubic bone. This muscle flexes the spine, com presses the internal organs of the abdomen and transmits forces laterally from the obliques. It is a common fallacy that the upper and lower rectus' are isolated differently. One exercise can train the rectus.

- **Erector Spinae** – helps to counterbalance all the forces involved in spinal flexion. They begin as the sacrospinalis tendon that attaches at the sacrum and ilium. This tendon then gives rise to different muscles that run up the spine and obliquely attach at lateral parts of

the vertebrae and the ribs. In the cervical region, these muscles attach at the base of the skull.

- **Quadratus Lumborum** – attaches at the 12th rib and the upper four lumbar vertebrae and the pelvis. It stabilizes the lumbar spine in all planes of motion, the 12th rib, and the attachment of the diaphragm during respiration. It also laterally flexes the trunk.
- **Latissimus Dorsi** – this is the largest spinal stabilizer. It attaches via the thoracolumbar fascia to the lumbar vertebrae, sacrum and pelvis, and runs upward to the humerus. It assists in lumbar extension and stabilization and performs pulling motions through the arms.
- **Thoracolumbar Fascia –** connects the latissimus dorsi, gluteal muscles, internal obliques and transverse abdominis, supplies tensile support to the lumbar spine, and is used for load transfer throughout the lumbar and thoracic regions.
- **Abdominal Fascia** – connects to the obliques and rectus abdominis, and to the pectoralis major. Fascial connections, that cross the midline, transmit forces to the muscles of the opposite side of the body.





Training the Core

The common myth is that training the core simply involves sit ups, leg raises and low back hyperextensions. Research has proven that most of the old school core exercises are not only harmful but, in most cases, don't even work the core muscles you are targeting. In fact, many of these old school exercises place a tremendous amount of shearing force on the spine which will lead to soft tissue injury over time.

An efficient core routine consists of multiplanar movements – training in all planes of motion while maintaining a neutral spine. As the body moves, the center of gravity changes, and forces exerted by, and on, the body's tissues are constantly changing. Dynamic stabilization must be included to increase proprioception and stability in the trunk, as well as in the rest of the body. This allows the parts of the body to react efficiently to external forces and stresses, such as gravity, changes in terrain, and carrying loads, as well as the internal forces exerted by other muscles. Doing a series of floor exercises is inefficient and for the most part have no carry over because most of life's activities are multi-dimensional and don't relate to single plane exercises on the floor.

Dynamic stability is best achieved through training in functionally practical positions that mimic activities, or movements in one's particular sport, or in life as a whole. With this in mind, one can conclude that most core training that is done while sitting or lying down and limiting pelvic movement has little functional value.

Medicine balls, balance boards and stability balls are great tools for core training and should be integrated into every program. Core exercises should include strengthening, as well as challenges, such as standing one-legged and/or two-legged on stable and unstable surfaces, reacting to external forces, such as a partner's light push, the catching and throwing of a medicine ball, and moving the joints of the body through all planes of motion.

The goal of functional core training is to develop a system of efficient automatic responses to work as a stable base from which to generate optimal force and motion.

Postural Distortion and Biomechanical Dysfunction

Consider how the chronic shortening of just one muscle, which happens to be a core muscle, can impede performance and cause imbalances that lead to injuries.

The rectus abdominis is a good example of an overworked muscle. As this muscle is overworked, the other core muscles are often ignored. Crunches, leg raises and exercises using abdominal machines all work in the sagittal plane only, therefore limiting "benefit" to muscles that produce hip and trunk flexion. (Note that repetitive trunk flexion places increased injury – causing stress on the intervertebral discs of the lumbar spine). It is imperative to train the core in a multi-planar fashion, especially the transverse plane, in order to create stabilization in the trunk, and in effect, more optimal posture, strength and motion in the entire body. The following is a common example of the result of overworking the rectus abdominis.

A flexion force in the trunk is caused by a tight rectus abdominis, when it creates tension, or pull on its upper and lower attachments, including the anterior pelvis, anterior ribs and inferior sternum. This has consequences beyond the immediate structures affected.

These consequences include a chain of effects that begins with shortening and tightening of the pectoral muscles. These muscles will exert an inferior tension on the clavicle, superior ribs, and the anterior scapula, and will assist in internally rotating the humerus.

The force of gravity also contributes to the internal rotation of the glenohumeral, or shoulder joint, as the trunk flexes forward. Internal rotation of the humerus tensions and lengthens the external rotators of the shoulder. This, in combination with the tension exerted on the anterior scapula by the pectorals will bring the scapula into protraction, lengthening and weakening the middle and lower trapezius, and rhomboid muscles. (Note that a tight latissimus dorsi can also be a primary contributor to internal rotation of the humerus.) The internally rotated humerus and protracted scapula will place the rotator cuff muscles at a biomechanical disadvantage by dynamically stabilizing the glenohumeral joint. The cuff will not function effectively, increasing the risk of injury.

The reaction of the cervical spine is two-fold. The lower segments of the cervical spine follow the forward and downward movement of the trunk, and they themselves flex, causing lengthening and weakening of the deep cervical flexor muscles. (This can also stress the outer layer of the intervertebral discs, which over time, may lead to injury.)

Naturally, if the lower cervical spine flexes forward, the head will follow, and if this force is not countered, gravity will cause the head to fall forward. In order to prevent this from happening, tension will develop in the cervical extensors, including the upper trapezius, splenius, semispinalis, spinalis and sub-occipital groups, which attach to the base of the skull. The upper cervical segments, including the base of the skull, are extended, shortening the sub-occipital muscles. This extension will allow the skull to remain somewhat level as it rests on the atlas, or the uppermost cervical vertebra.

The overworking of the upper trapezius muscle and lengthening and weakening of the middle and lower trapezius and the rhomboids will also contribute to early elevation of the scapula with shoulder motion. This will worsen the position of the glenohumeral joint and further stress the rotator cuff.

This example has been limited to the rectus abdominis. It is important to understand that single muscles are rarely isolated culprits in postural distortions and biomechanical dysfunction. (An exception would be an acute specific muscle injury that has not healed correctly and has caused compensatory overloading in other areas.) Because muscles act synergistically and as agonists and antagonists, there is usually more than one contributor. There are also connections between muscles through tough fascial connective tissue, which help to transmit forces between tissues. These cases of dysfunction can be rooted in other parts of the body, as the musculoskeletal system functions as a whole.

These faulty positions and compensatory biomechanics will not only cause an athlete to move inefficiently. Overtime, they may lead to degenerative processes in the soft tissues and joints, leading to further injury and impairment.

The neurological system also adapts to these changes, applying muscle memory as it controls the musculature. Training this system is essential in developing healthy neurological pathways and muscle firing patterns. This is achieved through methods already mentioned: medicine balls, balance boards and stability balls, and challenging the neuromuscular system.

Any of the aforementioned muscles may be the source of dysfunctional patterns, but it will most likely be a combination of them that will be the cause. It is important to follow the entire kinetic chain when assessing and treating these conditions.

Cycling

Most cyclists focus on their hamstrings, quadriceps and gluteal muscles, and forget about the importance of core stability.

Consider how many hours the cyclist spends bent over in a flexed position on the aero bars, with no rotational or side bending motions. A strong core is needed to counter-balance these forces. With a focus on the core, a cyclist can generate more power and sustain a higher level of intensity for longer periods. A stronger core also means less stress on the primary muscle movers and a delay in the build-up of lactic acid.

Even minor changes such as brake position can affect core stability.

If the brake handle position is too low, the cyclist is forced to reach too far forward with their forearms.

- This reaching position forces the cyclist to raise their head, forcing the pelvic girdle posterior. This position can cause a restriction in several key muscles in the core, thus reducing performance.
- The ideal position is to have the elbows bent and the forearms flattened out. Here, the cyclist's head drops into a more comfortable, aerodynamic position, and the pelvis tilts forward; the cyclist is able to use all the core muscles with improved efficiency.

Running

Now consider how a shortened rectus abdominis affects a tri-athlete's performance during running. Although opinions about the 'ideal running form' vary greatly, most authorities will agree that the less energy that is expended, the more effective and efficient the running style will be. Table 1 explains common running recommendations, as well as how having a shortened rectus abdominal can affect your running.

Table 1. Common running recommendations, together with how having a shortened rectus abdominis can affect your running

Common running recommendations (RunnersWorldOnline)	**How a shortened rectus abdominis affects your running**
Run upright. Your back should be straight, roughly at a 90-degree angle to the ground.	A shortened rectus abdominis will pull the runners posture forward. This causes a braking action that reduces running economy.
Look straight ahead. Your eyes should be focused straight down the road on a point moving about 10m in front of you. This helps to keep you in a straight line.	As the rectus is shortened, it pulls the chest forward, allowing gravity to pull the head down. In order to look straight ahead as instructed, the athlete wastes a considerable amount of force in trying to overcome the contracted rectus abdominis.
Swing your arms naturally. The angle at the elbow between your upper and lower arms should be about 90 degrees. Your hands should be loosely cupped, about belly level.	As the shoulders move forward, a shortened rectus abdominis causes the arms to rotate internally. This makes keeping your arms relaxed at the recommended 90-degree angle much more difficult, reducing running economy.

When performing a biomechanical analysis, it is very common to see numerous imbalances of which the athlete is completely unaware. By videoing them during their activity, the practitioner can show and explain what is happening, and then it can be corrected.

When analyzing a runner, some of the most common biomechanical faults looked for are:

- Over-pronation (rolling in as the arches collapse) in the feet – this can cause a series of biomechanical imbalances from the foot up to the cervical spine.
- Excessive hip adduction – this is due to tight hip adductors and can cause increased load in the lateral tissues, such as the iliotibial band, tensor fascia lata and gluteus medius.
- Lack of trunk rotation – due to restrictions in trunk rotators or shoulder extensors. This can cause overload in the hip musculature, spinal joints, and other trunk rotators.
- Lack of hip extension – caused by tight hip flexors restricting extension, and weak gluteal muscles. This causes the extensors and rotators of the lumbar spine to become overloaded in order to compensate for the lack of hip extension.

- Lack of shoulder extension – caused by restrictions in anterior shoulder muscles or poor trunk rotation.

Educating yourself on how the core works will help to avoid injury, improve your athletic performance and increase training efficiency. Far too often people read the most popular book or take advice from someone who they think knows more than they do.

This cookie cutter approach does not take into account the person's specific needs and goals. In my opinion, anyone who participates in any sport or activity should have a professional evaluate them for any weaknesses or poor movement patterns. I can't tell you how many patients have told me "It just started hurting. I never did anything to it." A simple evaluation can save you from repetitive stress injuries.

Athletic Development for Basketball:

Introduction

"Most people have the will to win; few have the will to *prepare* to win."
—Bobby Knight[1]

THE ARENA is committed to providing the best, most comprehensive and scientifically validated programs in the industry. This manual is an overview of how we apply that philosophy to the speed, power, agility and conditioning demands of our basketball athletes. While built most closely around the demands of elite high school players, it is also intended for and may be used—with rights and permissions—by trainers, coaches and athletes of any age or ability level, from youth league to collegiate and professional development.

THE ARENA is unique because its partners Fit and Functional and Next Level Speed run a school for personal trainers and for strength and conditioning professionals. This program was created by THE ARENA and Next Level Speed. To learn more about THE ARENA and its partners see

Athletic Development that Takes Your Game to the Next Level
Nearly 30 million Americans play organized competitive basketball. This popularity combined with the extremely sports-specific demands of the game makes the American basketball court one of the most competitive places on earth: those who have better skills and can apply them with faster movements and higher jumps advance to play better, more selective basketball. Those who fail to make progress languish or fall behind their peers. Our program is designed to help players make it to their next level through scientific athletic development. If you have the drive and commitment we will show you how to become faster, stronger, quicker, more agile and explosive athlete. We will show you how to maximize your athletic potential.

Do I Train by Myself?
If you are really determined to run your own conditioning program without the aid of a trainer or coach this manual can serve as an invaluable, extremely sports specific guide. But understand that we use it to train both our coaches and our clients and that you will get far more out of our manual if you use it in conjunction with professional coaching. You don't need to find a basketball specialist or a collegiate strength coach. But a generic personal trainer won't do either. If you can't work with one of our coaches, find a trainer or coach who specializes in training athletes and has some sports specific training like a degree in exercise physiology, U.S.A. Weightlifting coaching certification, USA Track and Field coaching certification, the National Strength and Conditioning Association's 'CSCS' credential or the like. Such athletic specialists don't usually cost more than generic trainers but are well worth seeking out as they have the specialized knowledge and skill to safely train you in the sport-specific modalities that are critical to the advanced basketball conditioning program laid out in this manual.

General Training Philosophy and How to Use this Manual

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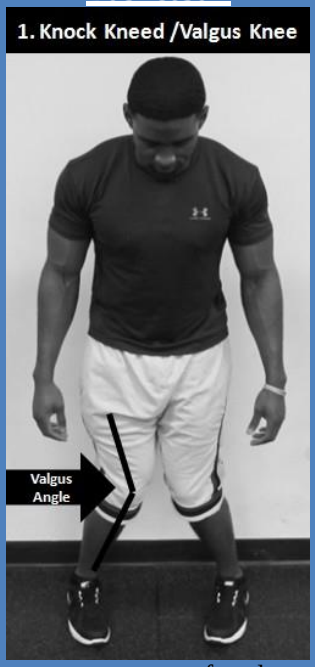
[1]Kasakove, Evan (13 April 2011). "ThelegacyofBobKnight". *The Muhlenberg Weekly*. 1.2498342#.T5qe87NumWg. Retrieved 27 April 2012.

Many schools and camps send out a detailed and extremely specific workout plans to all of their athletes. We don't. We don't do it that way because no single plan can meet the training needs and real world realities of a diverse group of individuals. That said, we have a very clear understanding of the relevant research and extensive experience working with players at all levels from youth and high school to elite college and professional players. It is a skill base that informs one basic assumption: Most basketball players over-train in ways and in modalities that limit their athletic potential and that predispose them to injury.

From which we derive the following pillars of our program:

1. Basketball Specific Periodization: Basketball players need to play and practice all year long, but the intensity of that practice must be calibrated to the individual and allow for periods when speed and power are the primary focus. If you are constantly competing, when are you preparing to compete? Some players think that simply running the court and jumping under the boards during games will maximize their speed and jumping ability. It won't. To be as blunt as possible: Players who reduce the volume and intensity of off-season basketball to recover and train specifically for speed, strength, and better movement will run, jump, and play better than players who simply play all the time. That's why colleges and professional franchises all hire people like us to train their basketball players. The effect may seem small over the course of one given year, but over the course of four, five, even ten years the discrepancy between those who simply play and those who train and play in a planned, or periodized way, is incalculable. Maybe you are one of those very rare individuals that are blessed with such natural physical abilities that you can make it to your goal—Varsity, D2, D1 pro —without specialized conditioning but why play those odds when you can maximize your potential, and maybe even exceed your goals through modern, periodized training. Figure 1 is a graphic representation of how such a prioritized program might work for a high school aged player. This is only an example of one possible training plan: Remember that every player is different. Don't let your coach or STACK magazine tell you 'this is exactly what you need to do because it worked for Dwayne Wade' or some other nonsense. The volume and intensity that is best for one athlete is probably too much or too little for his or her teammate. Nor can you simply build one 'perfect program' and stick with it. Training needs to change and evolve with the athlete. So, your training plan needs to be specific to your needs, your level of commitment and it will have to be continually revised and modified. But that's not an excuse to fly by the seat of your pants. If you fail to plan, you

'The Dirty Five': The Five Most Rampant Injuries & Postural Problems in Basketball



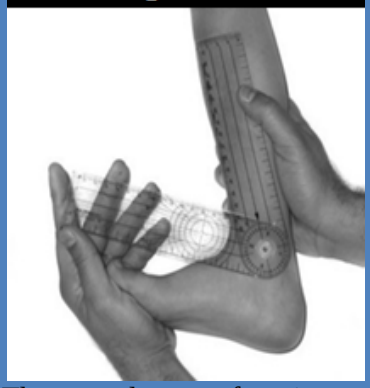
More common among females (because the greater width of the hips creates a larger Q-angle) but also commonly seen among male basketball players. If it occurs during running, jumping, landing or cutting movements, it greatly increases the risk of knee injury, especially ACL ruptures for which it is considered a prime culprit. Among the prehabilitiative strategies we employ are band resisted squats which force athletes to recruit abductor muscles of the hip and, on a more basic but ultimately more effective level, continuous and rigorous variations of *well coached* squat exercises. This continuous repetition of high quality squat movements 'grooves' or reteaches the skill until it is a fully autonomous skill. Note, that with this goal in mind we don't let athletes use the mirror or film to correct themselves: they need to

are planning to fail. If you want to be your best as a player you need to have a yearly plan, one that outlines what you are trying to achieve and where your training emphasis will be in every month of the year. If you are one of our clients, we will help you do that. If you are working with another coach or by yourself make the best plan you can and be especially sensitive to modifications you need to make along the way.

2. Quad Dominance

Quad dominance is a habit, pattern or need to squat, jump, run, land, change direction, etc. with excessive knee flexion and minimal hip flexion. It is common in the general population but even more common among basketball players where it decreases speed and performance and predisposes players to ankle, low back and especially knee injuries (ACL ruptures, meniscal tears, patellofemoral syndrome, etc.). Sometimes good and frequent coaching/cueing of the squat and squat exercises is enough to correct and retrain an athlete. But frequently more aggressive strategies are necessary. This is particularly so as many athletes lack the ankle and hip mobility to squat and require extensive static and dynamic flexibility work to increase their hip and ankle mobility before they can relearn the skill.

3. Tight Calves



The normal range of motion should allow for 20 degrees of dorsiflexion (where the goniometer or measurement tool is set) but the subject in this picture only has about 8-9% dorsiflexion. This is caused by hypertonic or tight calf muscles. It's common in the general population but positively epidemic among basketball players who typically spend thousands of hours per year jumping and sprinting on the court but rarely spend more than a few minutes stretching their overworked calf muscles. Tight calves are a serious problem that limit performance (all muscles are stronger when held in their optimal resting length and the calf muscles are particularly powerful during jump and sprint activities when they are over-stretched in a dorsiflexed landing) but also pre-dispose an athlete to knee and ankle injury.

4. Pulling (v. Push) Slide

Most novice basketball players learn how to slide the wrong way: they 'pull' their body along the floor with the adductor/inner-thigh) muscles of their lead leg because that is a less taxing way to move laterally. But the right way—that is the more taxing but faster, safer and defensively better way to move—is to drive by powerfully triple extending (extending the ankle, knee and hip completely)the trail leg. This is often avoided, even by more experienced players when fatigue sets in. Every good basketball coach tells his or her players how to slide and knows it when they see it but few know how or bother to correct it. At NLS we use random but frequent practice—e.g. squat push lateral drill—to ensure that when players get on the court they only know one way to slide, the safe and effective way, pushing.

5. Foot & Ankle Dysfunc.

Foot & ankle injuries can't be eliminated from basketball but effective rest/recovery through periodized training, good functional mobility (e.g. an overly tight calf muscle will cause foot landing in a plantar-flexed/toes-down position that invites ankle sprains) and leg strengthening exercises, especially in single leg squat can reduce their incidence & severity. Balance training exercise can also help but need to be dynamic not static (single leg hoping tag instead of the wobble board). We don't advocate barefoot running, which is a high-risk activity, but do use other less stressful barefoot activities that increase the neural control/efficiency of the foot & ankle.

2. Assessment and Corrective Training: How to Perform at Your Best and Keep Performing. Basketball is a rough, explosive game played on a hard, unforgiving surface. Not surprisingly it produces high rates of injury. A study of collegiate athletics in *The Journal of Athletic Training* found that rate of time loss injury per 1,000 exposures was, at 6.1 for female basketball players, the second highest among eleven women's sports and, for men, at 6.1, just a bit less dangerous than football (9.8), wrestling (9.0) and soccer (6.4).[2]More troubling still, basketball players suffer disproportionately high rates of serious ankle and especially Anterior Cruciate Ligament tears which, for year around participants, may occur at a rate of 1.5% per year among year-around male players and an astounding 5.5% per year for year-around female players.[3]This manual cannot and will not attempt to give medical advice for how to treat these injuries. It cannot even serve as a comprehensive guide to injury training. It is, however, a major focus of this manual and our practice to engage our athletes in assessments and individualized exercise programs that: address gross postural/movement errors; counter and prepare athletes for the repetitive stresses of their sport with 'pre-habilitative' exercise; and generally apply the best practices in the field of strength and conditioning as these apply to the cooperative goals of athletic performance and decreased incidence of injury.

3. Leg Strength: Pick the Low Hanging Fruit First. We teach and use—this manual includes—all manner of explosive power exercises from plyometrics and Olympic lifts to Vertimax, medicine ball throws and over-speed sprinting. The consensus in the field of strength and conditioning is that power development is maximized through a 'mixed' approach wherein athletes train across the force velocity curve from high force/low velocity exercises like barbell squats, through moderate force/moderate velocity exercises like the power clean, and low force/high velocity exercises like over-speed sprint training.

The simple, safest and most sport specific exercise we know and emphasize is the squat. We want all of our athletes, male or female, to have the ability to do 3 full single leg squats (aka 'pistols') and to have a maximum or estimated maximum barbell back squat that is 1.5 times their body weight (e.g. if you weigh 200 lbs. you should be able to max squat at least 300 lbs.). Exercise science (and our own personal experience) has shown that this kind of strength is one of the most important ingredients in all ground-based power sports. The National Strength and Conditioning Association will not prescribe some power training modalities like depth jumps until an athlete can back squat at least 1.5 times their body weight. We believe that not only strength is important but muscular coordination. Some super strong athletes have poor coordination while other athletes have great coordination but may not be as strong. Coordination and joint integrity are crucial when prescribing these exercises. There are circumstances where the stronger athlete isn't ready for plyometrics but the coordinated athlete even though they are weaker can start plyometric training. We include a variety of training modalities even in our youth clients. But until an athlete has the kind of leg strength to squat 1.5 times their body weight we advise caution in exercise intensity and an extreme prioritization of basic leg strength and hypertrophy in an athlete's conditioning program.

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[2] Note that a "time loss injury" is defined as an injury that results in a medical restriction from participation; "exposure" as a coach directed practice or game. Powell J W, Dompier TP. Analysis of injury rates and treatment patterns for time-loss and non-time loss injuries among collegiate student-athletes. Journal of Athletic Training, 2004, 39:1, 56-70.

[3]Prodromos CC, Han Y, Rogowski J, Joyce B, Shi K. A meta-analysis of the incidence of anterior cruciate ligament tears as a function of gender, sport, and a knee injury-reduction regiment. Arthroscopy. 2007 2 3 (12): 1320-1325.e6. See also: Hewett T E, Myer GD, Ford KR, et al. Biomechanical measures of neuromuscular control and valgus loading of the knee predict anterior cruciate ligament injury risk in female athletes. American Journal of Sports Medicine.2005;33:492-501.

4. Sprint and Agility Training - Loren Seagrave, the father of modern speed coaching, has taught us that "speed is a skill that can be taught" to be sure there are individuals who possess greater or lesser neuromuscular potential for speed and power (proportions of fast twitch muscle fibers, neuromuscular plasticity, etc.)There are those who naturally, through luck or some combination of motor learning adaptability, 'pick-up' better, more efficient motor programs in childhood (e.g. the child who just 'looks like a sprinter' because without formal training they bring their knee to thigh-block, keep their foot dorsi-flexed, etc.). The absolute reality is that every athlete—no matter how fast or how slow—has a great ability to improve their speed and agility through coached performance training. To be blunt, if you or your players don't train regularly to improve the quality of movement or to train for speed and agility, you are falling short of their potential and you are slower and less effective on the court than you should be. Of course, this tends to be a very technical aspect of conditioning and we strongly suggest working with one of our coaches or at least another trained specialist in the field whenever you can. That said, we know that some basketball coaches and individual athletes will be working on their own and we assure you that if you use this manual as a starting point. If you aim to teach yourself good movement mechanics and train these regularly and rigorously, your investment will be well compensated on the court. We wish to emphasize that the most important thing to improving movement speed for basketball is that the 'teachable' skill of speed be taught in ways that carry-over to the court.

There are plenty of camps and speed schools that advertise and will get you to 'shave a ¼ second off your 40' but what you need is speed when you play. Sure, it's nice to know that you'll be faster if you get to a combine but you aren't likely to get invited to the combine if you don't have speed on the court. Instead of learning to be fast at a drill or test, we suggest that you learn to be fast in both the tests and on the court. Research in motor learning—and our experience—clearly shows that for motor skill learning to be retained and transferred to novel situations with high contextual interference and significant inter-trial variability (e.g. games) the skill must be: over-learned (e.g. learned so well that it can be consistently performed in practice with little cognitive effort even after a prolonged break between practice sessions); practiced on a randomized schedule where-in athletes don't know which skill they will be asked to perform next; and practiced in environments that mimic the context of performance. What does this mean for how we conduct speed training?

When we work with a coach or team, we send our performance coach to team practices. The Arena coach attends as many on court practices as possible. At these sessions The Arena coach teaches warm-ups and drills *with* the basketball coaching staff (so that the coaches learn basic speed coaching principals and so that athletes see that the coaches view speed mechanics as an essential part of their game). These initial drills are normally taught at the beginning of a practice but our coaches always stay for the rest of the practice and encourage the coach to stop at 'teachable moments' for quick reviews and rehearsals of movement mechanics as these apply to the game-like situations in the practice. So, for example, if we see players pulling with their lead leg (instead of properly pushing with the trail leg) during defensive drills or play we might encourage a coach to stop and remediate the "Squat Push Lateral" for 30-90 seconds before resuming the drill. Or we might pull aside an athlete that is landing with a pronounced valgus angle and give them 30 seconds of cueing and band work to improve their movement before sending them back into the practice. The same kind of mid-practice remediation can be done

once or twice a practice with whatever movement errors are most important to correct that day from failing to hit thigh block on a lay-up to plantar flexed sprinting. Of course, when we work with individual athletes or if you are working on your own it may not be possible to include this type of training directly into your team practices. We encourage you to apply the same principals whenever and however you can. Try doing our 'Basketball Specific Dynamic Warm-up' and a few agility drills before practice, do your own agility training on days and mixed in with your on-court skills practice, visualize and even film your practice and basketball play to make sure that you are applying your movement practice, etc. Remember, your goal is to become as fast and powerful a player as possible and that means learning the best, most efficient motor patterns until you can perform and modify them competently and with unconscious mental effort in every game or game like situation!

5. Don't Jump into Injury: Work Across the Force Velocity Curve—Effective speed and power training requires a mixture of training methods. You won't reach your sprinting or jumping potential simply by sprinting any more than you would by a regimen of simply squatting. The mix is vital, as can be seen in Figure 2 which represents the consensus view of the continuum of modalities needed for optimal increases in speed and power:

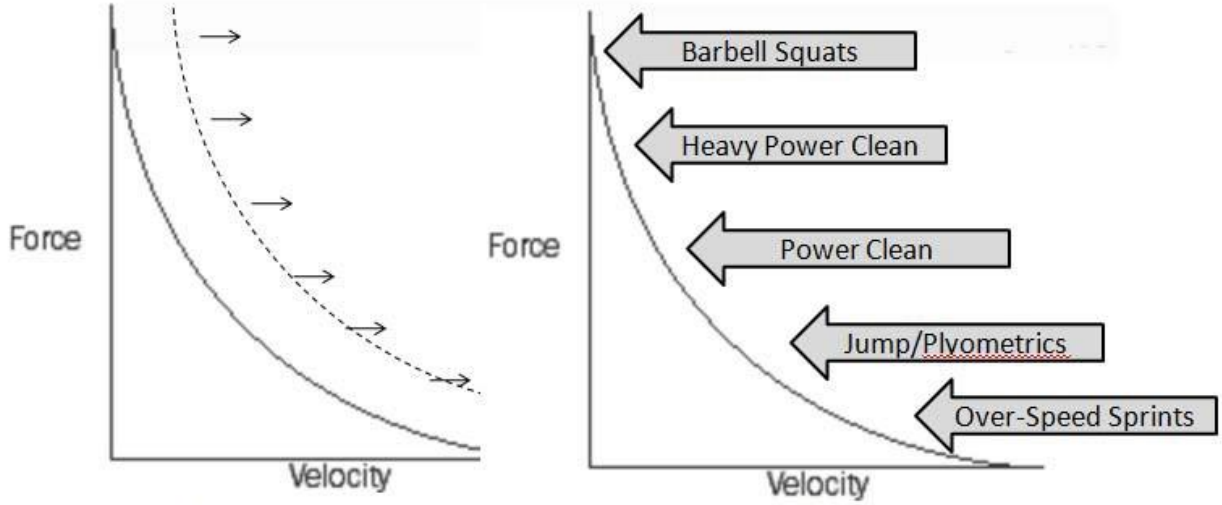

Fig. 2. The Force Velocity Curve. A-Depicts the result of effective speed-power training which moves the entire curve to the right. B-Depicts the spectrum of training modalities—from hi-force/low velocity to low force/high velocity—needed to produce such an overall change.

This concept is particularly important to impress upon basketball players and coaches who tend to gravitate towards and over use jump and plyometric exercises in their conditioning programs. We understand the appeal of exercises like the "Depth Jump with Stuff"—wherein an athlete, holding a basketball in both hands, steps off a 12-30" box and immediately upon landing executes a jump and stuff basket. Such exercises seem to be so sport specific and cutting edge as to be almost irresistible to basketball heads. And such exercises do have their place and are covered in our program/manual—at least for athletes with the basic strength and sound movement mechanics to execute them safely. We encourage you to use them sparingly, to use them like strong medicine and remember that this type of force-velocity training/medicine is

very similar to the force velocity demands placed on basketball players every time they play or scrimmage (e.g. lots of explosive jumps from sprints, etc.).

A Few Final Words for those Working Without a Conditioning Coach:
-Do an inventory assessment based on the tests and performance criteria we've provided you.

-Use the data from your inventory assessment to PLAN A YEAR LONG TRAINING PLAN with specific prioritized goals/emphasis for each block and then PLAN AND MAP OUT WHICH DAYS YOU'LL TRAIN AND WHAT YOU'LL TRAIN IN EACH SESSION. This will ensure that you are putting your effort into the right kind of training and, if you put them into your calendar, you'll be making 'appointments' to train that you can commit to. Remember, 'failing to plan is planning to fail.'

-Be conservative. We want you to make gains. But don't over-do-it. The best policy is to take a serious but long-term approach to getting progressively stronger, faster and more agile year over year. That's what we expect from our Division I players and its what you should expect from yourself. If you are in poor condition in all six assessments, try to improve in all areas and, if you can try to pull yourself up to the next standard of performance in a few if you can. Then next year, work to pull yourself up a category in all six. Slow and steady wins the race.

-In practice we expect that most of you should be doing **3 to 4 conditioning workouts a week** and that each of these sessions will last between **1.5-2 hours per session** (a good alternative for those with more flexible schedules is to split the workouts into shorter AM and PM sessions) or a total **of 4.5-6 hours per week**. If you look at our example workouts, we expect that some of this time will be devoted to practicing and playing ball. But again, remember that during your off season we want and expect your focus (e.g. circa 65-75% of your training time) to be on your athletic training.

The remainder of this handbook is devoted example workouts, exercise, and assessments, as well as basic descriptions about how to execute these correctly. Remember, that we strongly encourage you to seek the advice of a professional coach, particularly for the highly technical and potentially more dangerous aspects of training like Olympic lifts and multi-directional sprint training. Second, keep in mind that the examples and types of exercise presented here are meant to emphasize the importance of speed, power, agility and anaerobic endurance, as well as the types of exercises that are most effective at developing these core basketball abilities.

I. Mechanical and Physiological Analysis of Basketball

"Basketball happens in the air; flying, floating, elevated above the floor, levitating the way oppressed peoples of this earth imagine themselves in their dreams."
-John Edgar Wideman

Basketball is a court invasion sport characterized by highly specialized reactive and motor abilities in a context of high speed multi-directional movement. Players must be able to 'run the court,' execute explosive first moves in all directions, and perform maximal and near maximal jumps in rapid succession. The tempo and timing of the game demand that these skills and abilities be executed with limited recovery which fundamentally taxes the anaerobic –glycolytic

system. The physicality of the game makes strength and physical size an important asset but unlike football—which is fundamentally an ATP-CP sport that places an absolute premium on the mass of its players—the high glycolytic/anaerobic-endurance demands of the game mean that athletes must carefully balance their body mass against their ability to maintain speed endurance (e.g. an athlete that gets too big will lack speed, agility, quickness and jumping ability later in the game because excess body mass causes undue fatigue).

Of particular importance to the training and development of basketball players is the development of proper sprint, multi-directional sprint and jump mechanics. Common movement patterns errors that need to be corrected include:

- Poor ankle mobility
- Poor knee stability
- Poor hip movement
- Overactive lower back muscles due to hip dysfunction
- Distorted running mechanics
- Overactive trapezius muscles
- Internally rotated shoulders

Many of these issues can be corrected by simple exercises that can be easily integrated into your warm ups. You can see these exercises at www.purefitclub.comunder clinics just click basketball and then choose Red Wings. Coaches will usually discard these types of exercises because they think they are not "basketball specific" and a waste of time. This is the very reason athletes get injured and sometimes never reach their full potential. They may not seem basketball specific, but you cannot properly perform basketball movements if you cannot master these exercises. If an athlete can eliminate their dysfunction, training can be more intense and technical. Coaches often say they have a hard time getting kids into an athletic position. This is an example of why athletes need proper flexibility and efficient movement patterns. In many circumstances kids are just forced into positions their body cannot naturally achieve. Doing these exercise forces the body to compensate in other areas and the chain of dysfunction begins. Poor posture can inhibit breathing patterns and diminish stamina.

Coaches and athletes must understand sports are about repetition and repetition means repetitive stress injuries like stress fractures, plantar fasciitis, tendonitis, etc. The importance of the fundamental exercises posted at www.purefitclub.com cannot be measured. Almost every injured young athlete our team has seen in 12 years has needed the basic stretches, recovery and fundamental exercises listed on our website. Obviously, we individualized private clients programs and there were many other custom exercises included but in most cases they had almost identical starting points. Doing the exercises regularly enabled them to far exceed pre-injury state and greatly reduced the reoccurrence of injury. It is just as important to train in a manner that undoes the damage and repetitive nature of your sport as it is to increase performance. Kids like most adults sit at a desk with poor posture for long parts of the day so it is important to focus on stretching and strengthening the posture muscles.

II. Assessment

In God we trust; all others must bring data.
—William Deming

You can't improve what can't measure.
—Anonymous

How Do I Measure My Level of Conditioning?
Our basketball assessment collects data in four broad categories: physical and athletic history, anthropomorphic measurements, postural analysis (dynamic and static), and six athletic performance tests (Vertical Jump, Max Vert, Standing Long Jump, Pro-Agility, Lane Agility, 25 Yard Sprint, 300 Yard Shuttle Run).

We use this battery of tests with the athletes and teams that we train, usually giving the entire battery twice a year, at the start and end of the off-season training cycle (e.g. once in April and

How to Evaluate a Personal Trainer

When seeking a personal trainer, it is necessary for the public to educate themselves on how to interview the right person for the job. While there are many certified personal trainers out there, only a select few of them are truly competent. You should always ask and verify where their certification is from and what their credentials are. There are different types and levels of training certifications, only a handful of them are good. Most tests are multiple choice questions that are moderately difficult and some others require some essay or program design but are usually easy. A few of the certifications allow the trainer to take the test at home unsupervised. You should also not be fooled by a college degree. There are colleges out there teaching old cookie cutter information. More times than not, these college programs do not create an environment that requires the trainer to demonstrate text book principles in an actual real life situation. What you need to look at is the continuing education courses the trainers have taken and how often they attend seminars. It is the seminars and practical workshops that make a trainer more knowledgeable.

It is difficult for the public to decipher a good trainer from a bad one. In many cases, even the worst trainer knows more about physical fitness than the average person. Below are some fundamental questions that should be asked before making your choice. They are designed to save you from choosing a bad apple.

Questions:

- What certifications or degrees do they hold?
- Do they attend workshops and seminars? Which ones?
- How long have they been a trainer and where have they worked?
- How thorough was your evaluation? Did they do a medical history and test flexibility, balance, core strength, proprioception, muscle strength and endurance?
- Are they familiar with functional training (training according to daily activities or a specific goal)?
- Have they explained the importance of flexibility?
- Do they stress how important it is to properly brace the core and preserve the lumbar spine?
- Do they know what P.N.F(Proprioceptive Neuromuscular Facilitation) stretching is?
- Have they explained that function is more important than vanity?
- Can they explain what they are going to do in the routine and how it benefits you?
- Did they explain that cardio alone is an inefficient workout?
- Do they have a basic understanding of nutrition?

If you already have a trainer you can evaluate them:

- Does your trainer understand that a core routine is not a series of floor exercises?
- Do they understand current research that proves traditional sit ups, leg raises and many of the common exercises that flex the spine can actually be harmful, even for healthy people?
- Are you doing more free weights and medicine balls than machines?

- Do they ever take notes?
- Are you being properly warmed up at the beginning and being stretched at the end?
- Does your trainer change the routine periodically?
- Does you trainer incorporate balance boards, swiss balls, single leg exercises and other challenged environments?
- When training the core (midsection) does your trainer explain how important it is to do dynamic multi-plantar movements as well as isometric exercises and the importance of low back exercises?
- Does your trainer target weak areas?
- If you feel pain in places that you should not like your knees, low back and neck does your trainer change or modify the exercise to a pain free range?
- Do you truly understand what you are doing while you train?
- Are you really getting results?
- Do you do more back exercises than chest and abs?
- Are you setting goals?
- Are you talking about you and your needs?
- Are you getting undivided attention?

If you answered no to any of these questions, then your trainer may be lacking key knowledge that is necessary for you to reach your fitness goals. More importantly, your trainer may be doing you more harm than good. It is simple for a trainer to deceive an unsuspecting client into believing they are knowledgeable. This is due to the general public not being educated about the fitness industry and trusting a gym will provide them with a competent trainer. In most cases, gyms are not always concerned with the quality of the people they are hiring. If a gym thinks a trainer possesses strong sales skills, they will hire them as long as they have some type of certification. A qualified fitness professional will understand at the very least everything listed above. Remember when hiring a trainer to make sure they are a full time professional. Part time does not cut it when it comes to your health. Would you go to a part time medical doctor?

Be aware of trainers that are charging low rates. The going rate for a high-level trainer in a gym like Equinox or New York Sports Club is around $85-$90/hr. Even their entry level trainers are
$65-$70/hr and they are newly certified if that and have little or no experience. There are other gyms that charge way more than the rates just mentioned. In-homes for a high level professional trainer charge around $125 and can be more. You may be able to get a really good trainer for
$90-$100 depending on travel time. Trainers charging much less are either just starting out, not very good, or a close friend of management. You get what you pay for. It is important to research the trainers' certification and check to make sure they are currently certified by multiple accredited agencies.

It is important to understand that certifications and degrees are important but do not mean everything. You want to know about their clinical experience and the workshops they attend. Ask who they work with and get at least three references to call from current clients. See if they work with any local doctors, all the good trainers work with at least one doctor. Also, see if they have written any articles. A bad trainer can hurt you, do your research, and make sure they are experienced.

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