The Metabolic Circuit -
A Simple and Effective Off-season Strength Program

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Coach Arthur is a Master Strength and Conditioning Coach and is regarded as one of the most knowledgeable strength coaches in the nation. Mike has been instrumental in developing the University of Nebraska into one of the premier collegiate strength and conditioning programs in the country for the past 33 years. He now coordinates the workout programs for student-athletes in all 22 Nebraska sports except football. His years at Nebraska directing the development of thousands of athletes have produced many advances in the strength programs used by athletes around the nation. His research helps Nebraska stay on the cutting edge and allows NU athletes to further develop their skills and talents. Among his many honors, Mike was named the 1995 National Collegiate Strength and Conditioning Coach of the Year and in 2003 the board of directors selected him for the USA Strength and Conditioning Coaches Hall of Fame. His vast experiences and unique “practical research role” at NU have allowed him to formulate this revolutionary approach to body mechanics and strength training.

The search for development of maximum performance has always been the mission of Husker Power. One of the programs developed by Husker Power to accomplish this mission was the Metabolic Circuit. Back in 1991 our research proved, with the help of Dr. Chris Eskridge, a UNL professor, football players who had the best improvements in speed, agility and power were the players who had the greatest increases in muscle mass. Since muscle mass correlated with increases in speed we started to look for the best way to increase muscle mass during winter conditioning and make that our main objective.

A call was made to Dr. William Kraemer, one of the top exercise scientists in the United States, for his recommendations on how to best put on muscle mass. He recalled the time he had stopped by to visit Husker Power back in 1979, on his way to Wyoming to work on his Doctorate degree. He said, at that time we were experimenting with different circuit training protocols. The lineman trained in the North Fieldhouse weight room utilizing a heavy lifting program. The objective was to get strong and at the same time put on bulk. The skilled positions trained in the South Stadium, because of the restricted size of the North Fieldhouse weight room, employing a circuit program. The idea, at that time, was that circuit training would make the players stronger without putting on a lot of bulk. The circuit consisted of a series of lifting stations, mostly machines, arranged in a consecutive order. Each station focused on a different muscle group so that the entire body was exercised. The players would move from station to station to the next, utilizing a timer. The timer was set so that the players had 20 seconds to do 10 repetitions, 10 seconds to rest before the next set or exercise. This method of training was quick, efficient and required a minimum space for exercise equipment. Dr. William Kraemer recalled we had put him through what we called the survivor circuit, because it tested your physical and mental toughness. It had put him on his back sucking desperately for oxygen. He felt that we were on to something, so he decided to study the effects of circuit training for his doctorate studies.

His research examined the release of anabolic hormones in response to heavy resistance using different training protocols. He found by manipulating the acute program variables (choice of exercises, exercise order, exercise load and rest between sets) had
an effect on the neuroendocrine responses and metabolic adaptations, hence the title of metabolic circuit.

Program Notes
- This program was originally designed for football but it can be used as an off-season program for cycling.
- For BMX-Track-Mountain/Cyclo-Cross to develop muscle mass which increases potential for power, and pedel speed improvement.
- This program is suitable for master level cyclist by maintaining/increasing muscle mass thus retarding the downward spiral of the aging process.
- Gender considerations: women will not get the exact same response as the male athlete due to the diminished amount of testosterone. But this program is very applicable to the female athlete and will greatly benefit from doing it.
- The squat exercise is the key to program, the coach can substitute other exercises based on equipment availability, personal preference and choice of cycling-specific exercises.

Principle Outcomes of Research
1. Greater testosterone release when using large muscle group exercises (e.g. the squat, leg press) with heavy resistance.
2. Greater serum growth hormone release when doing 3 X 10 as compared to 3 X 5.
3. Greater serum growth hormone release when utilizing a 1 minute rest as compared to 3 minute rest between sets.

Exercise Order
The metabolic circuit consists of the following stations. You can substitute other exercises; the idea is to incorporate large muscle group exercises early in the circuit and try to include all the major muscles groups utilizing single jointed exercises to finish the circuit. The key is to start with the squat or you won’t get the desired hormone releases. The leg press can be used in place of the squat. Sometimes the squat technique can breakdown because of fatigue. It may be wise to use the leg press if the athlete’s technique is questionable.
1. Squat or Leg Press – Complex movement for leg and core muscles.
2. Bench Press (narrow grip, back flat on bench) – Complex movement for upper body pushing muscles.
3. Low Pull – Complex movement for upper body pulling muscles.
4. Walking Lunges – Glutes
5. Shoulder Raises – Deltoids
6. Bent-over Rows – Back
7. Leg Curls – Hamstrings
8. Triceps Pulldowns – Triceps
9. Biceps curls – Biceps

Time and Load
It takes 4 minutes for each station (3 sets X 10 repetitions). Twenty seconds for each set and sixty seconds rest between sets. The squat may be the only exception where it may take more than twenty seconds to complete a set. That is a total of 80 seconds for each set times three (sets) allot four minutes for each exercise. That is a total of 36 minutes to complete the entire circuit (9 stations). Note each station should be completed before rotating to the next station. Start off at 50% of an athlete’s squat 1RM (see chart to determine 1 repetition maximum) for the first workout, if they can squat 300 pounds start at 150 pounds. Start light and gradually build up. The circuit will be tough enough and the intensity can be increased as you adapt to the workload. The time to complete the circuit stays about the same from workout to workout, but the poundage lifted should increases each week.

It is also good to incorporate a light and a heavy circuit day, especially with the squat. On the light day use a weight where each set can be completed within twenty seconds or a rep every two seconds. On the heavy day each set should take about forty seconds or a rep every four seconds.

Split Routine
The metabolic circuit also prompted us to change our split routine. The split routine is a very efficient and widely used concept to stimulate maximum gains in strength. It simply means the program is split so that you work half of the body parts one set of days and the other half on the remaining days. Dividing the body-parts and working them on separate days allows the athlete to have short intense workouts as opposed to long drawn-out workouts when working all the body parts in one day. The old split routine was done by doing upper body exercises on Monday and Thursday while doing lower body exercises on Tuesday and Friday (cleans and squats). Since the metabolic circuit worked all the body parts in one workout, we had to make changes. What we did was on Mondays and Thursdays we focused on explosive lifts and the metabolic circuit was integrated into the weekly schedule on Tuesdays and Fridays. It worked out great.

Note: All nine exercises should be done on Tuesdays and Fridays as a metabolic circuit. On Mondays and Thursdays the athlete can do a routine of explosive lifts.

Lifting Experience
We only allowed the players who had been in the program for two years to do the metabolic circuit, for a couple of different reasons. First of all, Dr. Kraemer’s research showed that the best responses were with those who had two years lifting experience. The second reason was, when the younger athletes saw the older players doing the circuit they wanted to do it. By restricting the
young lifters from doing circuit motivated them. After two years of seeing the older players making gains doing the circuit, when it came time for the younger players to do the circuit it was done with maximum effort. We were apprehensive that if a player did the metabolic circuit four years in a row he would gradually lose motivation and not derive the benefits from it.

From 1992, when we started the Metabolic Circuit, to 1996, the last five years of Tom Osborne’s coaching career, the Huskers had 60 victories with only 3 defeats.

The Squat - The Key Component of the Metabolic Circuit

The Key Exercise in the metabolic circuit is the squat. It sets the off the hormonal release, essential to the success of the program. The leg press is presented as an alternative, presenting a “safer” method to the squat. But for those who don’t have access to a leg press machine or would like to achieve the joint, tendon and ligament strength gain benefit the squat offers the squat might well be the only choice. If so it’s imperative that the squat be done with correct technique.

“One of the most basic of exercises, the squat, is often the cause of many back problems. This is because proper mechanics are not used when performing the squat. Most coaches tell athletes to keep their backs tight and chest up. The intention is good—to prevent back injuries—but it is the very cause of back problems. When an athlete hears the words “keep your back tight or chest up,” what muscle group do you suppose he contracts? In picture (1) the hip flexors are turned on in an attempt to keep the back straight. Notice how the lower back arches. It is impossible to squat into a deep position with the back arched. The hip and spinal joints lock up and doesn’t allow mobility.”

Notice how the lower back is arched (a gap between the lower back and straight edge) when a straight edge is placed on the back.

“In picture (2), the lifter is able to keep an upright position and get deep. Notice how the back is in a flat position. This is an example of greater hip and spinal mobility when the pelvis is in the correct position. In the second picture, the athlete was told to keep his abs in a static position (distance between ribs and pelvis maintained), especially as he gets deeper. Now the hamstrings can keep the pelvis level as the squat is performed. The abs stabilize the spine and allow maximum mobility at the hip joints. The back muscles react by lengthening to control the forward lean, keeping the center of gravity over the feet, similar to cables on the shaft of a crane.”

Notice the straight edge is flat against the back leaving no gap.

Compare the two pictures. Notice the gap between the bar held against the lifter’s back and his back in picture (1). In picture (2) the gap is gone and the back is in a neutral position. Which is more “athletic” and functional to sport movement? What position do you want your athletes’ in? Let’s look at the wrong and right way of teaching the squat using the correct coaching cues to your athletes.

Carefully compare the two methods and adapt the right way that’s best for your athletes.

Teaching the Squat to Athletes the Wrong Way

Note: The wrong coaching cues are stricken out.

Start

• Use rack, with supports at mid-chest level.
• Be sure spotters are in position.
• Grasp the barbell palms down, slightly wider than shoulder width.
• Step under bar, feet parallel and shoulder-width apart.
• Place the center of the bar on the upper back so it is balanced, resting securely across back of shoulders.
• Elbows pointed back, eyes straight ahead, chest up, squeeze shoulder blades together.
• Straighten legs to lift the barbell off rack and step backward, feet slightly wider than shoulder-width and toes pointed out slightly with slight arch in lower back and tight.

Movement

• Under control bend hips backwards, bend knees and ankles.
• Keep bar over middle of foot to heels, feet flat on the floor.
• Inhaling, descend slowly until tops of thighs are parallel to floor; pause.
• Do not let knees come together on descent.
• Keep back straight and chest up.
• Exhale as you straighten hips and knees to return upright under control.
• Keep hips under bar, eyes focused straight ahead.
• Back as flat as possible.
• Knees over ankles.

Tips

• Do not bounce at bottom position.
• Do not bring knees together coming up.
• Do not speed bar up at the top.
• Stay tight throughout movement.

Teaching the Squat to Athletes the Right Way

Note: The new, right coaching cues are underlined.

Start
• Use rack, with supports at mid-chest level.
• Be sure spotters are in position.
• Grasp the barbell palms down, slightly wider than shoulder-width.
• Step under bar, feet parallel and shoulder-width apart.
• Place center of the bar on the upper back so it is balanced, resting securely across back of shoulders.
• Elbows pointed down, eyes straight ahead.
• Straighten legs to lift barbell off the rack and step backward, feet slightly wider than shoulder-width and toes pointed out slightly.
• Fill lungs with air (the creation of intra thoracic pressure) and hold.
• Attempt to exhale forcefully but close nose and mouth air passages so that air is not allowed to escape (the creation of intra abdominal pressure, Valsalva maneuver).

Movement
• Under control, squat down as if sitting down on a chair.
• Descend under control until tops of thighs are parallel to floor.
• Keep feet flat on the floor and knees in alignment with feet.
• Important: maintain the intra thoracic/intra abdominal pressure created at the start. Try to keep back relaxed the back will take care of itself.
• Upon start of the ascent, exhale forcefully using the abdominal muscles to return to the upright position.
• Keep eyes focused straight ahead.

Tips
• Control, do not bounce at bottom position.
• Knees together coming up. The thigh adductors are hip extensors in the low position and help get you through the sticking point.
• Do not speed bar up at the top.
• Keep abs tight Stay tight on the descent and ascent using abdominal pressure and not the tightening of the lower back. Avoid the shifting of weight predominately to one leg. This indicates a muscle imbalance.

(Squat technique information provided by Ken Kontor, editor).

Husker Power Predicted Maximum Chart

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About predicted maximums: The predicted maximum method is suggested so that the athlete does not have to lift as much weight as s/he can one time. This, it is believed, may cause injury. Rather, a number of continuous repetitions are performed until the athlete can no longer continue. When using this method for an athlete have the athlete warm-up with a light weight, making sure that each repetition is performed with perfect technique. Select a weight that you feel s/he can handle for at least one rep but not more than 10. Once the lift can no longer be performed in this manner the athlete should stop immediately. The total number of repetitions correctly performed should be recorded and the predicted maximum formula used. (Ed.)

Example the athlete does 5 reps with 200 pounds in the squat. The % formula for 5 reps is 1.15 so multiply 200 weight used by 1.15 the % formula will yield a predicted 1RM of 230 pounds.