Sport Science

Many factors contribute to skill development and to the success of your athletes. Keeping up with current research in sport science is sometimes overlooked by coaches. The following pages provide important information in the areas of physiology, flexibility, psychology and nutrition.

Physiology

Exercise and sport physiology evolved from anatomy and physiology. Anatomy focuses on the basic structure of various body parts and physiology focuses on how the body functions. Exercise physiology focuses on how the body's functions are altered when exposed to exercise. A term used more and more, sport physiology, applies the concepts of exercise physiology to enhancing sport performance. Sport physiology also focuses on training athletes to compete at their optimum level. When studying exercise and sport physiology it is important to understand concepts associated with two exercise patterns. First, exercise physiologists study how the body responds to an individual bout of exercises. Second, exercise physiologists are interested in how the body responds over time to the stress of repeated exercise.

Acute exercise – An individual bout of exercise such as skating or lifting weights for an hour

Chronic adaptation or training effects – How the body responds over time to the stress of repeated bouts of exercise (over days or weeks)

Fatigue

Many coaches and athletes believe that the main cause of fatigue while training is lactic acid. This is a common misconception and oversimplification. Fatigue is actually very complex. Current research points to the following underlying causes of fatigue:

- Decreased rate of energy delivery (ATP-PCr, anaerobic glycolysis and oxidative metabolism)
- Accumulation of metabolic by-products, such as lactate and H+
- Failure of the muscle fibers contractile mechanism

- Alterations in neural control of muscle contraction

At any given time, depending on the intensity and type of exercise an athlete is doing, several of the above causes may be working together to bring about fatigue. Fatigue is very rarely caused by a single factor.

PCr Depletion

PCr is used under anaerobic conditions to rebuild ATP as it is used. Although ATP is directly responsible for the energy used, it is depleted slower than PCr during exercise. To delay the rate of fatigue an athlete must control their rate of effort through pacing. Through training, you and your athletes will learn to determine the pace that will permit the most efficient use of ATP and PCr for their events.

Principles of Exercise Training

Key Terms:

Strength – The maximal force that a muscle or group of muscles can generate.

1-Repetition Maximum (1RM) – The maximum weight an individual can lift with one single effort

Power – The product of force and velocity (the rate of performing work)

Maximal-Muscular Power – The product of strength and speed movement

Muscular Endurance – The capacity to perform repeated muscle contractions or sustain a muscle contraction over time.

Aerobic Power – The rate of energy release by cellular metabolic process that depends on the availability and involvement of oxygen

Anaerobic Power – The rate of energy release by cellular metabolic processes that function without the involvement of oxygen

Energy

Three systems supply energy to working muscles. The energy system that is used varies depending on the athlete's training intensity.

Three Energy Systems

- **Phosphate**
- **Oxygen**
- **Lactate**

Phosphate System

The phosphate system is extremely important for the starts of sprinters and for any activity that is explosive and rapid. The phosphate system directly supplies energy and does not need oxygen and does not produce lactic acid. At a maximum effort this system is exhausted in 10 seconds and it supplies energy for only six to eight seconds. Adenosine triphosphate (ATP) in the muscle and the breakdown of creatine phosphate (CP) make the supply of energy possible. ATP is a high-energy chemical substance that enables the muscles to contract. ATP is broken down to adenosine diphosphate (ADP) during muscular activity. ADP supplies the muscle with direct energy. CP is an important aiding system in the process of resynthesizing ATP from the ADP that is produced. The store of CP is also very limited, but it is capable of resynthesizing ATP from ADP very quickly. The store of ATP plus CP is replenished within a few minutes after the activity ends.

The phosphate system can be trained so that ATP is broken down much faster and the energy is released more quickly. This is accomplished through sprint training consisting of short, explosive training with periods of rest in between. ATP and CP stores can also be increased by consistent endurance training. An increase in ATP and CP stores will help athletes in activities that last up to 10 seconds.

ATP: The store of ATP is exhausted within 4 seconds of maximum effort.

CP: The store of CP is exhausted within 8 to 10 seconds of maximum effort.

should only last six to eight seconds. If you are using submaximal sprint training, the interval can be 20 to 30 seconds long. To train the phosphate system, the rest period should be long enough to resynthesize ATP and CP and will vary for each individual athlete. If the rest period is not long enough to resynthesize ATP and CP, you are training the lactate system.

Oxygen System (Aerobic System)

The oxygen system is a system that burns nutrients consisting mostly of carbohydrates and fats. The nutrients that are burned vary widely and depend on the athlete's level of conditioning and activity level; well-trained athletes have a higher ability to use fat as a fuel source. Generally speaking, fats are burned during lower-intensity exercises and as the intensity increases carbohydrates stored in the form of glycogen becomes more important. Glycogen stores vary among athletes, but in most circumstances an athlete should have enough glycogen stores for 60 to 90 minutes of submaximal training. A consistent aerobic training program can increase an athlete's aerobic capacity. Endurance training is best for training your oxygen system and can be done at different intensity levels.

While there is virtually an unlimited amount of fat stored for energy, carbohydrates remain as the most important fuel source for high-intensity aerobic training. The burning of fats requires more oxygen than the burning of carbohydrates; therefore, once the supply of carbohydrates is gone and the athlete begins burning fats, the intensity of the training will go down.

Lactate System

When the body reaches a level during high intensity training where the body can't keep up anymore, the anaerobic or lactate system begins to produce lactic acid. The accumulation of lactic acid in the muscles is known as acidosis. Once acidosis occurs, the athlete is not able to maintain the same level of exercise. Those athletes that can delay acidosis the longest typically have the highest success rates. The lactate system also supplies the energy during increases of pace that surpass the aerobic level or also in a field sprint at the end of a longer race.

High lactate values cause acidosis in the muscle. After acidosis damage, it may take days for the system to recover sufficiently and regain full capacity. When training is repeatedly too intensive

without enough recovery, aerobic endurance capacity decreases considerably. If a coach doesn't recognize the need for recovery during this time period, overtraining may result.

The lactate system, like the phosphate system, can be trained through interval training. The intervals are longer and the recovery is shorter.

Aerobic: Using oxygen

Anaerobic: Without using oxygen

Muscle Fibers

Muscles contain different types of fibers that differ in function.

Red Muscle Fibers (also called Type I or slow-twitch fibers)

White Muscle Fibers (also called Type II or fast-twitch fibers)

Red Muscle Fibers

Red muscle fibers have a mostly aerobic energy supply. These fibers are incredibly important in endurance activities as they do not fatigue easily and are able to work for long time periods.

White Muscle Fibers

White muscle fibers have a mostly anaerobic capacity. These fibers are important for sprinting and explosiveness.

Heart Rate

A lower resting heart rate generally implies good cardiovascular fitness and efficient heart function. Measuring the heart rate of athletes has many training benefits.

Heart Rate

- **Intensity of workouts can be monitored through heart rate.**
- **Overtraining can be avoided by carefully tracking the morning pulse of athletes.**
- **Viral infections such as cold and flu can be traced in early stages by monitoring morning pulse.**
- **As endurance capacity increases, an athlete's resting heart rate decreases.**
- **The resting heart rate in women is generally 10 beats higher than in men of the same age.**
- **For most athletes, the morning resting heart rate is about 10 beats lower**

Factors that can influence heart rate:

- **Age**
- **Overtraining**
- **Illness**
- **Nutrition**
- **Altitude**
- **Medication**
- **Jet Lag**
- **Mental Stress**
- **Temperature (both the environment and body)**
- **Activity Level**
- **Fitness Level**

Age

With age, an individual's maximum heart rate decreases. Although the maximum heart rate decreases with age, this decrease does not correlate with the athlete's conditioning level.

Overtraining

If an athlete is overtrained, he or she may not be able to reach maximum heart rate during training. Overtrained athletes may have a very high resting heart rate in the morning or they may have an extremely low resting heart rate. Generally, overtrained athletes will show inconsistency in their heart rate pattern. When the athlete is fully rested, their heart rate levels

will remain fairly consistent. Sudden changes in this consistency can indicate overtraining, illness, etc.

Altitude

Initially after arriving at higher altitudes, an athlete's resting heart rate decreases. Once the first few hours pass, the resting heart rate increases by about 10% at 2,000 meters above what the athlete's heart rate would be at sea level. The resting heart rate can be a good indicator of the athlete's degree of acclimatization.

Calculating Heart Rate Without the use of a Heart Rate Monitor

The heart rate can be counted at the wrist, neck, temple or left side of chest.

15-Beat Method

The athlete should find his or her heartbeat in the wrist, neck, temple or left side of chest. Once the heartbeat is established, a stopwatch is started directly on a heartbeat. The heartbeat that the watch is started on is 0; the next heartbeat is 1 and so on. The athlete continues to count heartbeats until the athlete reaches 15. On the 15^{th} heartbeat, the athlete should stop the stopwatch. To find the number of heart beats per minute take 15 divided by the number of seconds it took to reach 15 heartbeats and then divide that by 60.

Example: Suppose it took 24. 8 seconds to reach 15 heartbeats.

(15 ÷ 17.2) × 60 = 52 beats per minute (bpm)

10-Beat Method

This is the same as the 15-beat method, but instead of using 15 seconds as time period, use 10 seconds. This method is best used after exercise as heartbeat decreases rapidly once exercise has stopped. Because of the rapid decrease in heart rate after the exercise has stopped, the heart rate obtained through this method will be slightly lower than the actual heart rate was during the exercise.

15-Second Counting Method

This method is easier to perform than the 15-beat method, but is not as accurate. The athlete should count the number of heartbeats during a 15-second period and then multiply that number by four to get the number of heart beats per minute.

Example: Suppose the athlete counts 14 heartbeats in a 15-second time period.

14 × 4 = 56 bpm

- This method is also commonly done using six seconds and then multiplying the number of heartbeats in six seconds by 10.

Calculating Maximum Heart Rate

It is very difficult to establish an accurate maximum heart rate without the use of a heart rate monitor or electrocardiograph (EKG or ECG). It is impossible to count heart rate during maximum effort and waiting until the exercise is complete will produce an inaccurate result as the athlete's heart rate starts to decrease immediately after the training has stopped.

You can calculate a rough estimate of maximum heart rate based on age, but the age-based estimation is not always accurate.

Age-Based Heart Rate Max (HRmax) Calculation

- **220 – age = HRmax**

Using a heart rate monitor to determine an athlete's maximum heart rate should be done only when the athlete is fully recovered. The maximum heart rate should be established by on several recordings that take place over a few-week time period. Several methods can be used to establish maximum heart rate.

Example: Using a Heart Rate Monitor to Determine HRmax

- **Make sure the athlete is fully recovered.**
- **Have the athlete warm up prior to the test.**
- **Have the athlete skate pretty intensely for four to five minutes with the last 20 to 30 seconds being an all-out sprint.**
- **Immediately read the heart rate using a heart rate monitor.**

General Training Intensities Based on HRmax

- **Recovery workout: 68-73 percent of HRmax**
- **Light aerobic workout: 73-80 percent of HRmax**
- **Intensive aerobic workout: 80-87 percent of HRmax**
- **Anaerobic workout: 87-93 percent of HRmax**
- **Maximum effort in races: 93-100 percent of HRmax**

Recovery is an essential part of training that is often overlooked by athletes and coaches. Finding the perfect balance between workload and recovery can be a very difficult task. The required recovery period for an athlete does not always remain constant. Training loads vary and so does the amount of time it takes to recover from training session. There are many factors that can contribute to the time that an athlete takes to recover; some of these include: workload, mental fatigue, illness, jet lag, change of climate and nutrition. As long as workouts are reduced immediately and drastically at the first signs of overtraining, improvement can be obtained within a few weeks. A training diary can be a tremendous help in being able to recognize the early symptoms of overtraining.

Symptoms that may Indicate Overtraining

- **Poor recovery of heart rate after exercise**
- **Higher heart rate at rest**
- **Decreased appetite and weight loss**
- **Heart palpitations**
- **Poor sport performance**
- **Emotional instability**
- **Troubled sleep**
- **Loss of concentration**

Steps to take if an Athlete has Overtrained

- **Get plenty of rest.**
- **Eat food rich in vitamins and minerals.**
- **Do not race until the symptoms of overtraining have gone away.**
- **Make sure the workouts are not intense (generally, no higher than 75% of maximum HR).**
- **When symptoms are gone, increase training volume first and then increase intensity.**

Athletes do not all have the same ability to respond to acute exercise and not all athletes have the same capacity to adapt to exercise training.

Flexibility

Flexibility is often one of the overlooked components of a successful training program. The results from stretching are often times less noticeable to the eye than the results of strength or cardiovascular training. When athletes are running short on time, stretching is not usually perceived as the most productive use of the time that they do have. Therefore, stretching, if done at all, may be done ineffectively. Science has advanced passed the old-school techniques of basic static stretching. While static stretching still has its place, it isn't the only type of stretching that should be added to an athlete's training program.

USA Roller Sports currently teaches the following dynamic flexibility warm ups at the Colorado and Florida Banked Track Clinics:

DYNAMIC FLEXIBILITY WARM UP

OFF SKATES

These warm-up exercises can be used for those skaters who take more time than the two to five minutes allowed for the typical warm up. You should always wear well-fitted shoes that are tied and offer support.

The time that you spend on each exercise, the distance traveled, and which exercises you do, will depend on how much additional warm up is needed. Each individual is different. Typically it can range from 10 minutes to 30 minutes prior to competition or practice.

1. **Walk on heels only (this stretches the calf muscles).**
2. **Walk on toes only (this stretches the shin muscles).**
3. **A-March—Over exaggerated high knees and high arms/elbows. Opposite elbow touches opposite knee, while pulling the toe up and pushing the heel down (continues to stretch calves and shins, starts using hamstrings and upper body – mild twist at waist).**

4. **Butt-kicks: movement at knee, with the heel touching the butt (stretches quad muscles).**

5. **Carioca High Hip: turn sideways – stay in lower position – start by going to the left, low on the left leg, lift right leg up and over – step out with the left leg and return to the lower position, repeat. Return by stepping out onto the right leg in the lower position and lifting the left leg up and over. Continue until you are covering the same distance on the right and the left.**

6. **Run backwards: push off toes while reaching back and pointing toes upward.**

7. **Low walk: knee to heel of front foot – do not raise up to switch feet.**

8. **A-Skip: skip while exaggerating coming off the toe, drive the knees up and forward.**

9. **Skip Kicks: at the end of each skip, bring the toe up approximately shoulder height, and touch the opposite hand.**

ON SKATES

1. **High hips on wall: face wall, lift leg up with knee close to the wall, then turn the left leg open (stretching the groin and working the hip flexors) bring back and set down. Repeat several times before switching to other leg. Eventually this should become a fluid movement. Repeat movement 10 times on each leg.**

2. **Opposite high hips: same drill as above except you will lift the leg up in the "open" position first, turn knee towards wall and set down. Repeat 10 times on each leg, once again becoming fluid.**

3. **Side to side leg swings: face wall and swing leg from side to side, pendulum style, trying to allow the hip to open as much as possible, causing the leg to swing high. Usually repeat 10-20 times on each leg.**

4. **Front to back leg swings: same as side to side except turn sideways to the wall, and swing outside leg forward as high as possible.**

5. **Wall kicks: face wall and simulate starts, feet in "V" position with body out away from wall and at an angle, head up, drive knee up and forward to the wall, switching back and forth. First a slow count and then a fast count, causing the skater to hop or switch feet quickly.**

6. **Core: face wall, lean onto wall with forearms and hands gripping if possible, let both feet roll back on toes, using stomach muscles to roll skates back and butt/stomach muscles to roll feet back in. Do not bend at waist – good for upper body as well.**

7. **Balance Hawk Change: beginner skaters hang on to wall – stand on toe wheel on back foot and heel wheel on the front foot – switch feet, try to switch faster and allow your feet separate a little further each time.**

8. **Bear in the Woods: separate feet underneath shoulders, into a "V" position – squat down and put each hand behind each skate – you should be in a squat position, stretching groin area.**

9. **Side-to-Side with Arms Up: start in skating position, step to the side with feet pointing forward – as the skater steps out, both arms raise up, lifting from the shoulders, into a bird like position – continue in one direction, return back to your starting place by starting with the other foot.**

10. **Moving Crosses**

11. **Feet on Floor: shuffle, short and fast with arms.**

12. **Swing arms in a circle at the shoulder and across the body.**

13. **Duck walk into trots.**

14. **Stretch groin side-to-side.**

15. **Roll – Run approximately 20 meters, fast short feet.**

Factors Affecting Flexibility

- **Physical**
- **Mental and Emotional**

Physical Factors

There are several physical factors that can contribute to poor flexibility. We are going to focus on three general contributors: poor posture, compensating for injuries and repeated use in roller speed skating.

Good posture is attained easiest when all structures of the body are in balanced alignment with regard to gravity and each other. You can achieve balance, once you attain it, by performing activities that balance each other out. For example, in speed skating, most of the turns are to the left. This may increase tightness in the body due to the repeated repetition in the same direction. You can help to minimize this tightness by balancing out your left-hand turns with some right-hand turns. It is well-understood that due to the nature of the sport, it would be very difficult to be completely balanced. However, a focus on balancing the muscle groups will help with overall flexibility and strength. When the structures of the body are not balanced, stress and strain created by myofascial compression and tension develop and begin to change your alignment.

Too much activity (overtraining) is not the only way that stress and strain are developed. Too little activity (undertraining) can also contribute to tension in the body. Over time these forces are chronically present in the body and the body accommodates these forces by depositing more collagen (scar tissue) for support. The extra collagen in the area upsets to balance of elastin, water and other elements and a decrease in flexibility is the result.

Often times athletes mistakenly think that past injuries haven't healed yet due to the tightness they feel in the area that was injured. Past injuries can cause pain and tightness that make it difficult for athletes to stretch; however, most often, the tightness and pain is not due to the injury not being healed, but rather due to the patterns the body has formed to compensate for

the injury. Over time, these compensations accumulate and create an uncomfortable cycle of stress, strain and tightness.

Repeated use without good recovery and stretching techniques can also contribute to inflexibility in athletes. Over time an athlete will again compensate for the feelings of tightness they are experiencing and these compensations can lead to decreased power, speed and strength.

Mental and Emotional Factors

Different people handle day-to-day stress differently. It is a good idea for athletes to get to know how their bodies react to mental or emotional stress so that it can be addressed on a physical level. When athletes have this understanding of their own body, they can work to minimize the negative effects of stress. Using techniques to manage mental and emotional stress can help to conserve energy, decrease compensatory movements from unnecessary myofascial tension and decrease the risk of injury due to poor concentration.

Three Common Structural Factors

Three common structural factors that can indicate a problem with flexibility are:

- **Hypomobile joint capsules**
- **Scar tissue in the myofascia**
- **Trigger points in the myofascia**

Hypomobile Joints

When you focus movement on a hypomobile joint, you will usually feel an abrupt block to the movement. An example of this can be seen when lifting weights. If you cannot get down into a full squat position, your hip-joint capsules and your psoas muscle may be blocking your attempts. The hypomobile joint limits your range of motion and can also have an impact on your strength.

Scar Tissue

Collagen in the form of scar tissue in muscle and fascia is very common. Extra collagen in the form of scar tissue slows you down as tissue with extra collagen loses some elasticity. This is where stretching becomes extremely important. Stretching will help you to recover and maintain elasticity.

Trigger Points

Trigger points can be caused by several factors and are a major cause of myofascial pain and dysfunction. Trigger points can exist in connective tissue, fascia, muscles, ligaments, bones and fat. Trigger points can cause a reduction in power, speed and agility by tightening and weakening the muscles.

These structural factors that contribute to tightness can all be reduced or eliminated by treating them before they develop further.

Self-Myofascial Release

Self-myofascial release (sMFR) is an excellent method, if used properly, to reduce the presence of trigger points and other areas of tension in your body. It is suggested that you begin the stretching routine with two to five minutes of aerobic activity to get the blood circulating and to warm the tissues before you begin sMFR.

There are a number of tools that you can use for sMFR (foam rollers, trigger point therapy balls, tennis balls, golf balls, racquet balls, Theracane and so on).

Sport Psychology

One challenge that competitive inline speed skaters and their coaches face is being able to produce consistent results. Understanding and applying sport psychology principles can help to enhance the performance of the athlete and the coach. Just like any other type of sport training, there isn't one single method that will work for everyone. It takes practice to determine which strategy will work best. One of the great aspects about sport psychology principles is that they will not only help you and your athlete in sport, but can be applied to many other areas throughout one's life.

While sport psychology principles are not new, they are often overlooked. Those that believe heavily in sport psychology as a component of athletic performance tend to agree that psychological readiness is one of the main determining factors, along with physical conditioning and skill level, in an athlete's success. Even though psychological readiness is something that can be practiced almost anywhere, it is the element that athletes devote the least amount of time to and that coaches place the least amount of emphasis on.

Three Components of Athlete Performance

- **Physical conditioning**
- **Skill**
- **Psychological readiness**

Motivation

Motivation describes the powerful inner force that activates coaches and athletes to direct behavior in certain ways. Motivation is a key element in an athlete's success as without motivation being present, it is impossible to achieve competition readiness. Motivation levels differ among individuals and also differ in each individual depending on several factors. While there are some examples that indicate individuals are motivated in several different areas, current research indicates that individuals are generally motivated to perform in specific domains. You may have an athlete that is extremely motivated to perform at nationals when the crowd is watching, but you can hardly get them off the bench at practice. Your sprinters may be very motivated during sprint-specific drills, while your endurance athletes shine in the long-distance drills. You may also have that rare individual that is motivated for everything you throw at them. The person that is motivated across a wide-range of contexts often succeeds in several aspects of life, not just in sport.

Intrinsic and Extrinsic Motivation

Motivation can come from external sources such as winning medals, attracting attention from outside sources such as the media or gaining financial rewards. Motivation that comes from external sources is knows as extrinsic motivation. Athletes that are motivated internally find

the sport interesting, fun and enjoyable and are not concerned with external rewards or benefits. This type of internal motivation is known as intrinsic motivation. Athletes that are motivated intrinsically typically participate because they enjoy the process. It is possible to be both extrinsically motivated and intrinsically motivated and often times those athletes that possess both types of motivation perform the best.

Two Types of Motivation

- **Intrinsic**
- **Extrinsic**

Competition Outcome: Influence on Motivation

After any competition it is natural to experience an immediate emotional response. That emotional response is usually based on whether the athlete won or lost. Often, athletes claim credit for their successes while transferring blame for their losses. It is important for coaches to help athletes evaluate how much of a loss was actually in the athlete's control. Doing this will hopefully have a positive impact on the athlete's future motivation. When failure can be viewed as a result of some temporary factor, it is easier to keep your athletes motivated. If they constantly feel that there isn't anything that they can do about their losses, they may lose hope and their motivation levels will decline. For an athlete that does not have a lot of wins or medals it is important to capitalize on personal successes so they have a reason to stay motivated. Personal successes are very individual and if a coach learns to capitalize on athlete's personal successes, they can often get more than they expected from the athlete.

Maximizing Motivation

Goal Setting

Setting goals is the process of defining clear objectives. In sport and in life, goal setting can greatly assist individuals in achieving success. There are some basic principles that can help goals to be more effective.

Goal-Setting Principles

- **Specific**
- **Challenging and Controllable**
- **Attainable**
- **Measurable**

Specific: Make your goals as specific as possible. Have a plan for reaching your goal and also a plan for measuring your improvement. The more specific you are with your goal, the better.

Specific Goal Example:

Goal: I want to improve my 300 meter time trial. (This is OK, but needs to be more specific.)

Specific Goal: I want to improve my 300 meter time trial by ½ second by the time I compete at outdoor nationals. I am going to spend time at least two times per week working on my start and my transition into the corner. I am going to measure my progress by taking times consistently throughout the process. I will

Challenging and controllable: Research has shown that challenging goals produce better results than goals that are too easy. It is important to challenge yourself when setting your goals, while still making sure the goals remain possible. One mistake that athletes make is setting goals with outcomes that are not within their control. Making a goal to win is great; however, if the goal is only evaluated based on winning vs. losing the athlete may end up being discouraged. There are a lot of factors involved in winning that may be out of the athlete's control.

Attainable: Goals should relate to where you are now. If your goals prove to be unrealistic, reassess your goals while still making them challenging.

Measurable: Motivation is enhanced when progress can be seen. It is important to have a plan that includes measuring progress towards goals on a regular basis.

Personal: Make sure you think through your goals when you are setting them to ensure they are actually your goals and not the goals of someone else. You will be more motivated and achieve your goals quicker if they are actually *your* goals.

Self-Confidence

Confidence plays a critical role in sports. A positive mental attitude is extremely important in achieving success. A loss in confidence resulting in a poor attitude can be extremely damaging for athletes. Many athletes possess confidence simply as part of their personality while others may need to work at it. Often times, an athlete's confidence is directly related to their performance. It is important for athletes to learn how to manage these dips in confidence as dwelling in a negative state for too long can greatly affect motivation and performance. Confident athletes are more persistent and more intense in their training. A coach can help to build an athlete's confidence in several different ways. Each athlete is unique in what makes them feel confident and perform at their peak. Once a coach learns the athletes' characteristics, they can implement confidence-building strategies to make sure the athlete performs at his or her optimum level.

Confidence Building: Athletes may respond to one or many different confidence-building techniques. Here are some basic aspects of an athlete's confidence level.

- **Mastery: Mastery is achieved when an athlete performs well or reaches their specific goals. When this happens, coaches can capitalize on these performances by using them to boost confidence.**
- **Social Support: Many athletes feel most confident when they have the support of their family, friends and coach.**
- **Coach's Leadership: This refers to the athlete's perception of the coach's ability to lead effectively. Some athletes are more confident and perform better when they believe 100% that their coach has the ability to make the best decisions (related to sport) for them.**
- **Vicarious Experience: Athletes that build confidence through vicarious experience do so by watching a friend or teammate perform successfully.**
- **Situational Favorableness: This relates to the perceived conditions of the competition. If the athlete feels the floor is in excellent condition and that they are well prepared, they will be more confident.**
- **Environmental Comfort: This refers to the athlete being in surroundings that are comfortable for them. An athlete that requires environmental comfort to perform at their best will want to make sure they surround themselves with those they feel comfortable with. Environmental comfort can also refer to the athlete's comfort with the competition venue.**

Anxiety

High anxiety can cause athletes to perform well below their abilities and expectations. We all know the really good practice skater that tends to freeze or "choke" under pressure. The root cause of this is often competition anxiety. Anxiety often develops due to an athletes' perceived imbalance between their skills and the competition demands. Sport produces a wide variety of stressors.

Stressor: A stressor is a situation, event or demand that has the potential to upset your equilibrium; it often triggers a reaction known as the stress response.

When we are stressed we often experience elevated heart rate, increased muscle tension and a release of adrenaline. Some athletes thrive under these conditions while others freeze up. The stress itself is not damaging to performance; it only becomes damaging when the athlete views the stress as a negative. A negative view on competition stress can result in anxiety. These negative views can come from worrying about the outcome, from a strong disbelief in ability, from a fear of safety, from concern of what others may think and from many other factors. Since the presence of anxiety depends on each athlete's perceptions at any given moment it is very unpredictable. Anxiety in athletes can be recognized on three levels: behavioral, cognitive and somatic.

Behavioral: This can be recognized by specific patterns of behavior such biting nails, skating safe, incessant talking, uncharacteristic introversion or extroversion.

Cognitive: This refers to thought processes such as fear, loss of confidence and poor concentration.

Somatic: This is recognized by physical responses such as increased blood pressure, butterflies in stomach, sweating and sleeplessness.

Managing Anxiety

Relaxing place: This technique is a visualization technique that when performed properly can take you from a stressful situation to a place that you associate with feelings of relaxation.

Relaxing Place Exercise:

- **Close your eyes and take a few deep breaths (inhaling through your nose and exhaling slowly through your mouth).**
- **You may want to put on relaxing music or you may prefer silence.**
- **Concentrate on the sounds around you and then begin concentrating on your breathing.**
- **Allow your eyes to relax and then begin imagining your favorite place for relaxation (a beach, the mountains, a specific room at home). Try to visualize your place as clearly as possible (sights, sounds, smells).**
- **Begin to count down from 10 to 1 and with each number become more and more relaxed. It may help to visualize yourself on a stair case and with each number that you count see yourself taking a step down the stairs.**
- **While you are in your relaxed state, give yourself some positive-performance suggestions.**
- **After you feel completely relaxed, slowly come back to your actual**

The Five-Breath Technique: This technique involves focusing your attention exclusively on your breathing.

The Five-Breath Technique:

- **1st breath: Take a deep breath allowing your face and neck to relax as you breathe out.**
- **2nd breath: Allow your shoulders and arms to relax as you breathe out.**
- **3rd breath: Allow your chest, stomach and back to relax as you breathe out.**
- **4th breath: Allow your legs and feet to relax as you breathe out.**
- **5th breath: Allow your whole body to relax as you breathe out.**
- **Continue to breathe deeply and each time you breathe out focus on relaxing.**

Keep Winning in Perspective: Of course athletes want to win and their coaches want them to win. However, when the athlete places their self-worth on winning and losing, negative anxiety is often a result. Coaches can help to alleviate this type of negative anxiety by helping the athlete keep things in perspective.

Controlling Aspects that can be Controlled: Athletes experience unnecessary anxiety when they are preoccupied with things that are beyond their control: the floor conditions, their competition, the weather, etc. We all know that the floor surface is the same for everyone, the thing that is different is the individual's attitude toward the conditions. Getting the athlete to focus on the things that are within their control will help to eliminate some of the anxiety created by obsessing over uncontrollable factors.

Visualization

"Before the Olympic trials I was doing a lot of visualization. And I think that helped me to get a feel of what it was going to be like when I got there."

Michael Phelps
14-time Olympic gold medalist swimmer

Visualization is one technique that can be used to help athletes use their imagination to increase success. By recreating images from information stored in an athlete's long-term memory, he or she can mentally rehearse races and improve skills. Visualization is a form of meditation and while visualization is more widely accepted now than it was years ago, some athletes are still hesitant to practice visualization techniques for fear of what their peers will think.

"The first time we practiced meditation, Michael Jordan thought I was joking. Midway through the session, he cocked one eye open and took a glance around the room to see if any of his teammates were actually doing it. To his surprise, many of them were." Phil Jackson: Winner of 11 NBA championships as a coach.

Based on Phil Jackson's statement above, Michael Jordan was a little hesitant himself at first. Michael later went on to realize the benefits of Jackson's teachings and has been quoted as saying, "I visualized where I wanted to be, what kind of player I wanted to become. I knew exactly where I wanted to go, and I focused on getting there." Jordan also stated, "The mental part is the hardest part (when comparing mental to physical) and I think that's the part that separates the good players from the great players."

Visualization Perspectives

When we visualize we use our creative right side of our brain to produce images without the need for words. There are different perspectives you can use to visualize. While research indicates that visual-internal imagery is the most natural form of visualization as it represents how we normally see the world, it isn't the only perspective and may not be the best one. Selecting which visualization technique to use is extremely individual and it is OK to use more than one perspective.

Visualization Perspectives

Visual-Internal:

- **A form of imagery that involves reviewing what is going on as though you were actually there performing it.**

Visual-External

- **A form of imagery that is like watching yourself through a camera.**

Kinesthetic

- **A form of imagery that involves recreating the physical feeling of performance.**

Visual-Internal Kinesthetic

- **A form of imagery that involves experiencing a performance through your own eyes while at the same time recreating the physical feeling of performance.**

Visual-External Kinesthetic

- **A form of imagery where you see your performance from the outside while**

Practicing Visualization: Introduction

If you or your athlete hasn't tried visualization before, it may best to start by practicing by visualizing general sounds, feels, tastes, sights and smells. Start your practice by getting comfortable. Once you are comfortable, close your eyes and breathe slowly while releasing tension. Once you are completely relaxed, begin to create mental images.

Sounds:

- **The sound of the starting gun as it fires**
- **The crunch of a crisp apple as you bite into it**
- **The sound of waves crashing**

Feels:

- **The roughness of sandpaper**
- **The stickiness of a freshly-coated floor**
- **The coolness of a metal weight in the gym**

Tastes:

- **The sweetness of sugar**
- **The tartness of a lemon**
- **The bitterness of dark chocolate**

Sights:

- **All the colors of the rainbow, one after another**
- **Smooth asphalt that goes on for miles**
- **Rain pounding on your car window**

Smells:

- **The smell of fresh Roll-on**
- **The aroma of freshly-ground coffee**

After you complete the introductory visualization exercise, make notes on which senses were really clear and which ones were more difficult to create images for. Once you are comfortable creating images by using one sense at a time, move on to creating images using all five senses. If you are new to this technique, it is best to start by visualizing a simple activity such as making and drinking a cup of hot chocolate. Once you get the basics down, begin moving into sport-specific visualizations.

Sports Nutrition

Nutrition supports good health and helps to optimize training. In order to maximize a nutrition program, a coach should carefully evaluate the goals and objectives of his or her athletes. The nutritional needs for a skater that focuses mainly on marathons will be different from a sprint-specific skater.

Carbohydrates

The average athlete can store approximately 1,700 calories from carbohydrate. Consuming carbohydrates stimulates the storage of glycogen and oxidation (glucose). Carbohydrates that are rich in vitamins and minerals should be the athlete's first choice. Excellent sources of vitamin and mineral-rich carbohydrates include: fruits, vegetables and whole grains. These types of carbohydrates contain antioxidants which help to repair damage done while training or competing. Refined and processed carbohydrates such as cakes, cookies, high-sugar cereals, white breads and candy are not very nutritious and while it is still OK to consume these types of carbohydrates in moderation, they should not be looked at as a main source of carbohydrates.

Carbohydrates are typically broken down into two categories: complex and simple. It was once thought that all simple sugars were bad for you and shouldn't be consumed. Current research indicates that this is not necessarily the case. The glycemic response of both simple and complex carbohydrates can vary greatly in individuals based on the person's metabolism.

Because of the glycemic response research, it is best for athletes to evaluate the carbohydrate based on nutritional value rather than basing their decision on which carbohydrate is simple and which carbohydrate is complex.

Glycemic response is a measure of the rate at which a food or meal will cause a rise in blood glucose.

- **A meal that contains high-response foods results in the rapid conversion of a food into glucose.**
- **A meal containing low-response foods results in a slower conversion of the food into glucose.**

Protein

Proteins contain a lot of amino acids (essential and non-essential amino acids). Essential acids must be consumed in the diet; non-essential amino acids don't have to be consumed as they can be made by the body. While protein has been shown to facilitate training adaptations and possibly assist in weight loss, there is a lot of information readily available from a sales standpoint about the amount of protein that athletes "need" in order to increase muscle mass. Coaches should carefully evaluate this information and make sure that the information that they are receiving is credible and not simply based on a desire to sell products.

The amino acids in protein build and repair body tissues, maintain fluid and electrolyte balance, promote a healthy immune system, help transport other nutrients within the blood and serve as a source of energy for training and recovering.

Proteins derived from meat, dairy and whole grains are considered to be complete proteins. These proteins are classified as complete proteins as they contain all of the essential amino acids. Plant proteins are often times considered incomplete proteins as there isn't a single plant-based food that contains all of the essential amino acids.

In addition to proteins being classified as complete and incomplete, they are also classified as fast and slow proteins. Proteins that are classified as fast proteins, such as whey, are often used as supplements. These proteins are absorbed by the body very quickly and are easy to digest. Since whey proteins digest so quickly, they can provide large increases of amino acids in the

body. This increase is very short in duration, but with good timing, the short increase in amino acids can provide a temporary increase in muscle synthesis.

Casein is considered a slow protein as it takes longer to digest. Approximately 80 percent of whole milk's protein is casein protein. The slower digestion of casein protein results in a steady release of amino acids into circulation. This steady supply of amino acids may help to prevent protein breakdown over a longer period resulting in the body maintaining a more positive protein balance.

Amino acids are the building blocks from which proteins are constructed.

- **Proteins that are derived from meat, dairy and whole grains contain all of the essential amino acids and are considered complete proteins.**
- **Proteins that are derived from plants do not contain all of the essential amino acids and are considered incomplete proteins.**

Fat

If you have ever watched a show dedicated to health, it probably didn't take long for you to hear that fat is a major problem in the United States. Fat receives so much criticism and while a lot of that criticism is justified, it really isn't the whole story. There are many types of fats and eating the right kinds of fats in the ideal quantity can be a huge benefit to athletes.

Fats are classified as saturated and unsaturated. Unsaturated fats have three subgroups: monounsaturated, polyunsaturated and trans fats.

Saturated Fats

Saturated fats are usually solid at room temperature and should be used sparingly. The fatty acids in saturated fats are saturated with hydrogen which has been shown to have a negative impact on heart health. Saturated fats are found in fatty meats, butter, whole milk, creams and full-fat cheese.

Unsaturated Fats

Trans Fats: Trans fats have been hardened by hydrogenation which can be worse for health than saturated fats. Trans fats are found in fried foods, doughnuts, cookies, processed foods and crackers. Athletes should pay careful attention to limit the amount of trans fats they consume. If the food label lists partially hydrogenated oil in the ingredients list, this indicates that the product contains trans fats.

Trans Fats

- **Can cause an increase in the levels of "bad" cholesterol or LDLs (low-density lipoproteins).**
- **Can lower the levels of "good" cholesterol or HDLs (high-density lipoproteins)**

Monounsaturated Fats: Generally, monounsaturated fats are beneficial to health. Monounsaturated fats have been shown to lower levels of low-density lipoproteins and raise the level of high-density lipoproteins. Many food sources of monounsaturated fats also contain vitamin E, an antioxidant that has many health benefits.

Food Sources of Monounsaturated Fats:

- **Olives, avocados, salmon, trout, walnuts, macadamia nuts, hazelnuts and oils such as olive, canola, safflower, sunflower, corn and soybean.**

Polyunsaturated Fats: Polyunsaturated fats, which include omega-3 and omega-6 fatty acids, are not produced by the body's cells and must be obtained through diet.

Omega-6 Fatty Acids

- **Are converted to arachadonic acid in the body.**
- **Are commonly obtained in the diet through vegetable oil.**
- **Help stimulate skin and hair growth.**
- **Maintain bone health.**
- **Regulate metabolism.**

Omega-3 Fatty Acids

- **Are converted to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).**
- **Assist in decreasing inflammation in the body.**
- **Help to regulate blood pressure and cholesterol**
- **Assist with a healthy immune system.**
- **Can improve oxygen delivery to the body**

Consuming the right amount of omega-6 and omega-3 fatty acids is very important and ideally should be consumed in a ratio of 3:1. Typically, Americans consume far more omega-6 fatty acids than omega-3 fatty acids. If an athlete's diet is imbalanced in the area of omega-6 and omega-3 fatty acids, an emphasis should be placed on consuming more omega-3 fatty acids.

Foods That Contain Omega-3 Fatty Acids:

- **Flax seeds, salmon, tofu, navy beans, kidney bean, pumpkin seeds, canola oil, trout, walnuts, soybeans, scallops, shrimp, winter squash.**

Pre-exercise Fueling

It is important to note that nutrition plans are very specific to each individual and the information in this section serves as a guideline and not an absolute. The athlete will get the best performance if they choose foods that they know work well for them.

When selecting pre-exercise meals or snacks, athletes should choose foods that are easily digestible. It is also beneficial to choose foods that will provide a steady rate of glucose into the bloodstream. If there is more than two hours before the athlete begins exercising, he or she should choose foods that contain both carbohydrate and protein and minimize foods that are high in fiber and fat. The goal is to choose meals that are moderate to low in their glycemic response to minimize any sharp rises in insulin (this will help to eliminate the "spike/crash"

pattern). If there is one hour or less before the exercise begins, it is recommended that the athlete choose carbohydrate based meals and snacks that are rapidly absorbed by the body.

Examples of pre-exercise meals and snacks if you have more than two hours (2-4 hours):

- **Cold or hot cereal with non-fat or low-fat milk, fruit or fruit juice**
- **Breakfast burrito (scrambled eggs, low-fat cheese, flour tortilla), fruit juice**
- **Bagel or English muffin with peanut butter, banana, fruit juice**
- **Baked or grilled chicken or lean beef or fish, steamed rice, green beans, dinner role and fruit juice**

Examples of pre-exercise, carbohydrate based snacks if you have less than one hour:

- **Fruit smoothie made with low-fat or fat-free yogurt**
- **Fresh fruit**
- **Fruit juice**
- **Fat-free frozen yogurt**

Fueling During Exercise

The goal during exercise is to sustain energy so that the training intensity can remain high. It is not necessary to eat carbohydrates during exercise unless the training session is 60 minutes or higher of high intensity training. While it isn't necessary to eat carbohydrates during the training session, you should continue to remind your athletes to hydrate. Hydration during exercise is essential to maintain high training levels. Athletes should avoid losing more than two percent of their body weight in any training session. Drinking 3-8 ounces of water or sports drink every 15-20 minutes is enough for the typical athlete to stay hydrated while training. With hydration, again, athlete's needs vary (3-8 ounces every 15-20 minutes is only a guideline). It is

recommended that the athlete evaluate his or her sweat rate and then hydrate accordingly. There will be more detailed information on hydration in a later section of this manual.

Post-exercise Fueling

Proper nutrition during the recovery period is essential for replenishing nutrient stores depleted during training. Your athletes will recover at a much higher level if they adequately replenish fluid, carbohydrates, proteins, vitamins and minerals after they train. A more efficient recovery time period will lead to a higher level of performance at the next training session. This recovery starts the moment that the athlete stops exercising. It is recommended that athletes begin re-fueling within 30 minutes of exercise. While current research varies in reference to the perfect protein to carbohydrate ratio for optimizing recovery, one point remains consistent; a combination of carbohydrate and protein is best for quickly restoring muscle glycogen. Since the first window of opportunity is within 30 minutes, athletes may need to have snacks readily available in their skate bag.

Examples of post-exercise (recovery) snacks:

- **Low-fat or fat-free chocolate milk**
- **String cheese with crackers**
- **Fresh or canned fruit smoothies made with low-fat or fat-free yogurt**
- **Peanut butter and jelly sandwiches**

Hydration

Water is the body's most important nutrient. Athletes should remain well hydrated for optimal performance and health. While there is a lot of debate as to how much body weight one must lose due to dehydration before performance is affected, it still remains that if you are performing in a dehydrated state, you are not performing at your optimal level.

General Hydration Guideline for Optimal Performance

- **Do not lose more than 2% of your body weight due to fluid loss.**
- **During exercise, drink 3 to 8 ounces of fluid every 15 to 20 minutes.**
- **After exercise, drink 24 ounces per pound of body weight lost.**

Pre-exercise Hydration

Athletes should begin each training session in a euhydrated state. A euhydrated state is best achieved when the athlete follows good hydration practices throughout the day. Athletes can stay hydrated throughout the day by consuming water and eating fruits and vegetables with a high water content. Often times, when an athlete realizes they have not consumed enough water throughout the day, they will try to hydrate really quickly by consuming large amounts of water prior to their workout. This practice is not advised as large amounts of water in a short period of time can act as a diuretic and could dilute the sodium levels in the body. If the sodium levels in the body become too low, the athlete is at risk for hyponatremia.

Euhydrated: Having an adequate amount of water to meet the body's physiological demands.

Hyponatremia: Having a low concentration of sodium in the blood.

Hydration During Exercise

Fluid replacement strategies and the amount of fluid loss that occurs during exercise is very individualized. The goal during exercise should be to consume enough fluids so that excess dehydration is prevented. Drink before you get thirsty; generally, two to three percent of fluid is lost before an athlete feels thirsty. Fluid replacement during exercise also helps maintain electrolyte balance and therefore, decreases the risk of hyponatremia. Current research indicates that fluid replacement during exercise is only necessary when the exercise lasts more than 60 minutes.

The general guideline is to consume between 3 and 8 ounces of a carbohydrate-electrolyte fluid every 15 to 20 minutes. This guideline is advised for optimal performance; however, depending on the type of training being done, this is not always a viable option. In situations where

consuming the recommended amount of fluids is not a viable option, it is extremely important to follow the pre-exercise hydration guidelines very closely.

Post-exercise Hydration

Often times when training is over, athletes drink just enough to satisfy their thirst; this may not always be enough. The goal should be fully replace any fluids and electrolytes lost through the training session. It is recommended that athletes drink 24 ounces of fluids for every pound lost during exercise. Plain water is OK as a rehydrator, but depending on how much sodium you lose while training, water may not be not ideal. If the athlete tends to lose a lot of sodium while training, combining water with higher sodium foods post workout can be helpful. Sodium is one of the key nutrients that should be consumed after training as it helps athletes to retain fluids and it also stimulates thirst.

Nutrition Periodization

Traditionally, periodization separates training programs into specific cycles. The largest cycle is the macrocycle. Within the macrocycle are smaller cycles or mesocycles. Within mesocycles, there are even smaller cycles or microcycles. The length of each cycle will vary depending on the athlete's goals and competition schedule.

Periodization: A process of structuring training into specific cycles over a year or several years.

Macrocycle: A period of training that typically lasts from one to four years.

Mesocycle: A period of training that typically lasts between 2 and 12 weeks.

Microcycle: A period of training that typically lasts from several days to a week.

Nutrition programs vary based on individual needs and goals. It is important to have a clear understanding of what your goals are and what your athlete's goals are prior to determining a nutrition-periodization strategy. Energy expenditure in each training session, frequency and focus of each training session and athlete-specific needs are items that should be considered when developing a plan.

Pre-season Nutrition

A typical pre-season goal is to create a base by improving strength and endurance while also focusing on sport-specific technical skills. Nutritional intake during this time period, if your athlete is not trying to gain or lose weight, should equal the athlete's energy expenditure.

General Pre-season Macronutrient Guidelines

Carbohydrates:

- **3-7 grams per kg of body weight (training 1-3 hours per day)**
- **7-10 grams per kg of body weight (3-4 hours per day)**
- **10 or more grams per kg of body weight (4 plus hours of training per day)**

Protein:

- **1.2-2.0 grams per kg of body weight (endurance training)**
- **1.6-3.0 grams per kg of body weight (strength and power training)**

Fat:

- **.8-1.3 grams per kg of body weight**

In-Season

Nutrient timing is extremely important during the competitive season. Athletes experience higher levels of stress, often time higher levels of training and unfortunately, not always enough sleep. Recovering from training and competition is extremely important during the season and nutrition can play a large part in that recovery process.

As the intensity of exercise increases, the body's ability to digest foods decreases. Because of the slower digestion rate (among other factors such as location, availability of food, etc.), it is important to test competition nutrition during practice. There are several factors that can make it difficult to eat the same while at competition as at home. However, for optimal results, it is important to try to mimic competition day in practice often enough that you know what types of food will work best in intense situations.

Athletes are typically focusing on sport-specific strength, power, force and speed during this timeframe. More calories are typically burned in-season compared to the pre-season and nutrient intake should be adjusted to fit the athlete's needs.

Carbohydrate, protein and fat intake can remain similar during the season, but since intensity is higher, the athlete should consume the amounts listed per kilogram of body weight that fall on the higher end of the range.

Off-Season

The off-season is often a time for recovery, rehabilitation and re-focusing. Training frequency and intensity usually slows down during the off-season and the athlete will not need as much fuel during this time. It can be very difficult to change the eating behavior patterns from the in-season timeframe and often times athletes find themselves gaining weight during the off-season.

In order to keep from adding extra weight the athlete should focus on being able to control the amount of energy that he or she consumes. The range of macronutrients needed is lower during this time since the workouts are not as intense.

General Off-Season Macronutrient Guidelines

Carbohydrates

- **3-4 grams per kg of body weight**

Protein

- **1.5-2.3 grams per kg of body weight**

Fat

- **1.0-1.2 grams per kg of body weight**