Unit 5 – SPORTS NUTRITION

Nutrition Lecture Notes

I. Introduction
   A. Proper nutrition is a vital consideration for athletes who seek to maximize their performance.
   B. Just as using the proper gasoline, oil, or radiator fluid, is important for your vehicle, eating the proper food will directly affect how the body “machine” operates!
   C. A proper diet will provide the necessary raw material to allow a good training program to build and run the human machine
      1. It will provide the proper nutrients and energy for athletic performance, training and healing.
   D. Many factors affect nutrient needs and nutrient availability including the athletes’:
      1. physical condition
      2. nutritional status
      3. age
      4. genetic background
   E. These factors make it essential that the diet be individualized.

II. Purpose of Nutrition
   A. Good nutrition promotes a healthier mind and body.
   B. Aids in resistance to illnesses.
   C. Provides energy
   D. The right foods help the athlete to:
      1. Feel better
      2. Sleep better
      3. Speed the healing process.

III. Sports Nutrition Goals are to Ensure:
   A. Adequate energy intake to meet the energy demands of training
   B. Adequate replenishment of muscle and liver glycogen with dietary carbohydrates
   C. Adequate protein intake for growth and repair of tissue, particularly muscle
   D. Adequate overall diet to maintain a healthy immune system
   E. Adequate hydration
   F. Consumption of food and beverages to delay fatigue during training and competition
   G. Minimization of dehydration during exercise
   H. Utilization of dietary strategies known to be beneficial for performance including:
      1. Pre-competition meals
      2. Carbohydrate loading
IV. The Food Pyramid

A. Components of the Pyramid

1. Find Your Balance Between Food and Physical Activity
   a. Represented by the steps and the person climbing them, as a reminder of the importance of daily physical activity
   b. Be physically active for 30 Minutes most days of the week
   c. Children and teen agers should be physically active for 60 minutes every day or most days of the week.

2. Moderation
   a. Represented by the narrowing of the each food group from bottom to top.
   b. Wider base stands for food with little or no solid fats or added sugars
      i. These should be selected more often
   c. Narrow top stands for foods containing more added sugars and solid fats
      i. The more active you are, the more of these foods can fit into your diet

3. Personalization
   a. Represented by the person on the step, the slogan, and the URL.
   b. MyPyramid.gov is interactive and designed to give each individual a more customized approach to nutrition
   c. The link MyPyramid.gov/professionals/food_tracking_wksht.html gives 12 different worksheets that best match an individual’s caloric needs

4. Proportionality
   a. Represented by the different widths of the food group bands.
      i. Suggest how much food a person should choose from each group.
   b. Variety
      i. Represented by the 6 color bands for the 5 food groups and oils.
      ii. Illustrates that foods from all groups are needed each day for good health
5. Gradual Improvement  
   a. Represented by the slogan.  
      i. Suggests that individuals can benefit from taking small steps to improve their diet and lifestyle each day

B. The Groups of the Pyramid  
1. Grains (The orange color)  
   a. Eat 6 oz every day  
   b. Grains include bread, cereal, pasta, crackers, rice or pasta  
      i. Look for “whole” before the grain name on the list of ingredients.  
      ii. At least 3 oz should come from whole grains  
      iii. Examples of 1oz grains:  
         A. 1 slice of bread  
         B. 5 whole wheat crackers  
         C. ½ cup cooked oatmeal  
         D. 1 pancake
2. Vegetables (The Green Color)  
   a. Eat 2 ½ to 3 cups per day  
   b. Eat more dark green vegetables  
   c. Eat more orange vegetables  
   d. Eat more dry beans and peas
3. Fruits (The Red Color)  
   a. Eat about 2 cups per day  
   b. Eat a variety of fruits  
   c. Choose fresh, frozen, canned, or dried fruit  
   d. Go easy on fruit juices  
      i. They don’t contain fiber
4. Oils (The White Color)  
   a. Make most of your fat sources from fish, nuts, and vegetable oils  
   b. Limit solid fats like, lard, stick margarine, shortening, and butter.
5. Milk (The Blue Color)  
   a. Drink 3 cups per day  
   b. Go low fat or fat free  
   c. If milk cannot be consumed, choose lactose free products or other calcium sources
6. Meats and Beans (The Purple Color)  
   a. Eat about 6oz each day  
   b. Choose low fat or lean meats and poultry  
   c. Bake it, broil it, or grill it  
   d. Vary your choices – with more fish, beans, peas, nuts, and seeds.

V. Basic Nutrients
A. Nutrients are chemical substances in food that provide energy, act as building blocks in forming new body components, or assist in the functioning of various body processes.

B. The six classes of nutrients are:

1. Carbohydrates
   a. One of the 3 nutrients that provide energy
   b. Yields approximately 4kcals/gram
      i. Carbohydrates are the basic source of energy for the body
   c. Common carbohydrates are sugars, starches, and fiber found in fruits, vegetables, and grains.
   d. The body converts sugars and starches to glucose for energy or to glycogen for energy storage in the liver and muscles.
      i. When glycogen stores are full, excess carbohydrates are converted to fat.
   e. Carbohydrates tend to be high in fiber
      i. Fiber is a type of carbohydrate that the body cannot absorb but is essential for gastrointestinal functioning
      ii. While a high-carbohydrate diet is essential to good health in all individuals, it is especially important to the athlete
      iii. 50-60% of the athlete’s caloric intake should be from carbohydrates to keep the glycogen stores filled.
      iv. Athlete recommendation is 5 to 10 grams of carbohydrate per kilogram of body weight per day
         A. Varies depending on sport, gender, etc
      v. Carbohydrate loading (discussed below) is used to generate extra glycogen and requires a carbohydrate intake of 70-80%.
      vi. See handout for foods that are good sources of carbohydrates

2. Proteins
   a. Protein is critical to growth and development especially muscle and bones
      i. This important fact puts proteins above all other nutrients in the minds of some individuals. However, no one nutrient is more important than another to assure proper health
   b. General functions of protein
      i. Function as enzymes to catalyze chemical reactions in the body
      ii. Many hormones are proteins
      iii. Can be a source of energy
          A. Yields approximately 4kcals/gram
B. Occurs abnormally when carbohydrates and fats are not available  
   1. Such as in starvation  
C. Also occurs normally during prolonged endurance exercise  
c. Proteins are derived from animal foods – meat, milk, eggs, fish, cheese, and poultry.  
   i. Other sources are soybeans, dry beans, some nuts, and whole-grain products.  
   ii. See handout for extended list  
d. During the digestive process, proteins are broken down into different amino acids.  
   i. Eight of these amino acids are essential to build and repair body tissues.  
      A. The term “essential” means they must be provided in the diet; they cannot be manufactured in the body as the rest of them can.  
      B. The term “indispensable” is now being used to describe this type of amino acid  
e. As stated earlier proteins may be used by the body for cellular energy, but proteins are the body’s least efficient source of energy.  
f. The body cannot store protein; therefore, extra protein is converted to fat.  
g. Protein intake should be approximately 10-12% of caloric intake.  
h. The Dietary Reference Intake (DRI) for adults is .8g/kg body weight  
   i. Athlete recommendation is 1.2 to 1.7g of protein per kg body weight per day  
      A. Specifically, 1.2 – 1.4g/kg for endurance athletes and 1.6-1.7 for strength athletes  
3. Fats (Lipids)  
a. The third energy yielding nutrient  
   i. Yields 9kcals/g  
   ii. That’s over twice carbohydrates and proteins!  
b. Main sources include meats, eggs, milk, cheese, fried foods, butter, margarine, salad dressings, oils, and mayonnaise.  
c. Fats also carry vitamins A and D to cells, and are necessary for normal growth and development.  
d. Fats insulate the body from temperature extremes, protect the body from the impact of injuries, and shield the body’s organs  
e. Add flavor to our foods.
f. Fats are necessary, in fact important, in the diet. Yet many people consider fats to be a harmful nutrient.
   i. The problem is the fact that we often eat far more than the daily recommended amount of fats (30% of our caloric intake).
   ii. Most Americans eat a whopping 50% or more of their daily calories from fats.

g. Athlete recommendation is 1.0 to 2.0g of fat per kg of body weight per day

h. High-fat diets are associated with heart disease, hypertension, and cancers.

i. Fats are not digested as quickly as other nutrients.

j. Fats are a basic source of muscular energy, since fats are used when the carbohydrate sources are depleted.

4. Vitamins
   a. Vitamins do not provide energy!
   b. Vitamins are essential for maintaining good health.
   c. A lack of vitamins in the diet leads to deficiency conditions, which express themselves in a variety of ways.
   d. Most vitamins cannot be synthesized by the body and must be ingested via foods or pills.
   e. No single food or food group will supply all the vitamins needed by the body
      i. A good reason to eat a variety of different foods.
   f. Vitamins are usually identified as either fat soluble or water soluble.
      i. Fat soluble vitamins (vitamins A, D, E, and K) are emulsified and absorbed in the small intestines.
         A. These vitamins are stored in body cells, especially liver cells.
      ii. Water soluble vitamins (B complex and vitamin C) are absorbed along with water through the digestive tract and dissolve in body fluids.
         A. The body doesn’t store these vitamins well and excess quantities are excreted in urine.
   iii. Vitamin requirements do not increase during exercise.
      A. Available evidence does not justify supplementing the diet of the athlete with vitamins to improve physical performance unless a pre-existing vitamin deficiency exists.
      1. However, many athletes do not choose nutrient dense foods. In these cases, supplementation may be suggested.
5. Minerals
   a. *Minerals do not provide energy!*
   b. Minerals are inorganic substances and are known to have functions essential to life.
   c. Some examples of essential minerals include:
      i. Calcium – necessary for bone strength and muscle contractions.
      ii. Potassium – regulates cardiac rhythm.
      iii. Iron – assists hemoglobin in the delivery of oxygen to body tissues.
      iv. Sodium – essential in maintaining fluid balance.
      v. Phosphorus – needed for strong bones and teeth.
   d. Exercise does not seem to affect dietary needs of most minerals with the exception of the effects of sweating
      i. Heavy sweating may lead to excess losses of sodium, chloride, and potassium
      ii. Losses of these minerals may affect performance
      iii. It is recommended that athletes involved in prolonged activity, especially those who are considered “salty sweaters" consume more salt in their meals before and after activity
         A. Generally, this added salt can easily be gained through the salt added to foods and not through “salt pills”

6. Water
   a. Water is often considered the most important nutrient:
      i. Failure to consume other nutrients will show harmful effects on the body after several weeks or months but humans can only survive without water for a few days!
   b. Provides an aqueous medium for chemical reactions
   c. Provides a medium for transportation of oxygen, hormones, nutrients, etc. throughout the body (i.e. the blood)
   d. Facilitates thermoregulation for the body (i.e. sweet)
   e. Lubricates joints and cushions organs and tissues
   f. In saliva and gastric secretions, water helps digest food
   g. Note that a loss of fluid through exercise may have and effect on these functions; many of which will affect performance
   h. See the “Fluid Replacement” section for an in depth study of how water affects performance

VI. Fluid Replacement
   A. Exercise increases water loss
      1. During normal breathing, water is added to inspired air to protect delicate respiratory cells from drying out.
         a. Increased breathing during exercise increase this loss
2. Heat production is a byproduct of muscle contraction.
   a. Increased muscle contraction during exercise increases overall body heat forcing the body to compensate through sweating
   b. Athletes may loss up to 1 liter per hour!

B. Water loss affects performance
   1. Diminished water content in the blood causes:
      a. Diminished capacity to transport oxygen and nutrients to body cells
      b. Diminished capacity to get rid of excess heat from working muscles causing increased body temperature since heat is transported in the blood
         i. Body cells must have a consistence temperature to function properly (homeostasis)
   2. Loss of fluid causes cells to shrink (crenation) which affects their normal function
   3. These affects are summarized as follows:
      a. Decreased VO2max
      b. Decreased mental capacity
      c. Increased fatigue rate
      d. Increase susceptibility to heat illness

C. Sports drinks
   1. During heavy sweating water is not the only element lost
   2. Electrolytes including sodium, potassium, chloride, and traces of some others are also lost
      a. Of these, sodium is lost in the greatest abundance
   3. During exercise of 2 hours or less the body is able to reabsorb sodium loss
      a. There does not seem to be a performance or health issue with sodium loss during shorter exercise bouts
      b. During exercise lasting less than two hours, the athlete would need to pay more attention to fluid replacement to address water loss through sweating than to sodium replacement
      c. Water works well as a fluid replacement beverage under these conditions
   4. During exercise lasting over 2 hours, and in hot environments, sodium loss in sweat occurs too rapidly for reabsorption to occur
   5. Exercise lasting 2 hours or more may also significantly decrease glycogen stores (stored glucose)
   6. Sports drinks may be a good option for fluid replacement during exercise lasting over 2 hours and for exercising in the heat
      a. Sports drinks may help to replenish lost sodium and glycogen stores
b. Sodium replacement and maintaining hydration during exercise may help to reduce muscle cramping during exercise especially in salty and heavy sweaters.
   i. One cause of muscle cramping is an electrolyte imbalance caused from fluid and sodium loss from sweating.
   ii. It should be noted that another cause of muscle cramping is muscle fatigue
      A. It is vital to assure proper intensities during training that match intensities during competition to prevent fatigue that may lead to cramping

c. There are many types of sports drinks to choose from and choosing one over another is up to each individual
   i. However, there is a proper proportion of the chemicals in the drink in order to optimize performance and limit any detrimental affects
      A. 6-8% carbohydrate is recommended and is less likely to induce gastric distress due to slowed gastric emptying in most individuals
      B. Sodium content of 460-690mg/liter is recommended to replace sodium loss and encourage further drinking since sodium tend to induce thirst

d. Example of a sports drink recipe
   i. 1 quart or 1 liter water
   ii. 1/3 cup sugar
   iii. ¼ teaspoon table salt
   iv. Flavor to taste – use orange juice, lemon juice, etc
   v. Keep refrigerated

7. Monitoring hydration status
   a. The body’s thirst mechanism lags behind dehydration
      i. By the time you are thirsty, you are already dehydrated
      ii. Therefore, thirst is not a good indicator of hydration
   b. There are a number of very expensive and time consuming test to monitor hydration but this process can be accomplished with relative ease
   c. Urine color is a good indicator of hydration
      i. See Urine Color Chart
      ii. Diet, supplementation, or medications, may affect urine color but this method is easy and practical
d. Weight loss that occurs during a single bout of exercise is likely due to fluid loss
   i. Changes in body weight can be used as a marker for short term fluid loss
   ii. One liter of water weighs approximately 1 kg (2.2 lbs)
   iii. If an athlete completes a hard workout lasting approximately one hour and loses 2kg of body weight it can be assumed that approximately 2 liters of fluid have been lost
      A. Or simply drink until the pre-workout weight is reached
   iv. It must be cautioned that the need for frequent weighing may put undue stress on certain athletes who already have anxiety in regard to their weight
      A. In these instances an alternate method may be more appropriate

8. Fluid Replacement strategies
   a. Pre-hydration should begin at least 4 hours before competition
      i. Recommendation is 5-7ml/kg
      ii. Ex: a 50kg (110lb) female would drink 250-350ml (8-12 oz or 1-11/2 cups)
      iii. This recommendation assumes the athlete is in a hydrated state at the time
      iv. It should be noted that water is sufficient, however, sodium stimulates thirst and retention of body water so a beverage that contains sodium may be beneficial
      v. Pre-hydration should be determined on an individual basis and by trial and error to determine the appropriate amount for each individual
         A. Too little may lead to dehydration during completion and therefore, decreased performance
         B. Too much may leave the athlete feeling bloated and cause too frequent urine brakes that may interfere with pregame activities
   b. Hydration during activity
      i. It is generally recommended that an athlete drink 6-12oz of fluid every 15-20 minutes
         A. Small amounts taken frequently are tolerated best by most athletes and leads to more effective gastric emptying
      ii. Hydration needs during activity is highly individual and routines should be established well before competition to avoid introducing a “new” routine during competition.
iii. Cool beverages are tolerated best although studies do not show that temperature influences gastric emptying

c. Free access to water before, during, and after activity should be encouraged.

9. The thirst mechanism can be unreliable for athletes.
   a. Athletes should be encouraged to drink before they are thirsty.
   b. By the time the brain signals the thirst mechanism, the athlete may be well on the way to becoming dehydrated.
   c. This can significantly impair performance.

D. Hyponatremia
   1. A potentially serious medical complication that may occur in endurance athletes during prolonged exercise such as ultra-marathons or triathlons
      a. Events lasting 4 hours or more and is more common in heat and high humidity
   2. Occurs when plasma sodium concentration falls below normal
   3. Sodium plays a vital role in the body in maintaining normal fluid balanced throughout the body
      a. Low sodium level in the extracellular compartment causes fluid to move into cells causing them to swell
      b. This is particularly important in nerve cells which require sodium in proper proportions in order for nerve conduction to occur
   4. Cause: Excess loss of sodium due to heavy sweating accompanied by an overconsumption of hypotonic fluids, specifically water
      a. When dehydration is prevented with copious consumption of water, sodium loss is not replaced leading to an imbalance of sodium in the extracellular fluid.
   5. Signs & Symptoms
      a. Dizziness, confusion, seizure, coma, and death
   6. Prevention: during event lasting over 3 hours replace sodium loss through use of fluids containing sodium or eating salty foods.
      a. The recommendation is .5 to .7g of sodium per liter of fluid
      b. Athletes should be encouraged to consume enough fluid to match fluid loss and prevent dehydration while not exceeding the amount of fluid lost

VII. Energy Drinks
   A. Energy drinks are a $10 billion industry!
      1. Marketing tactics are similar to alcohol tactics and are generally directed at the youth.
   B. They contain ingredients that are not regulated by the FDA which allows the companies to make claims that are not based on scientific data
      1. Guarana is a fruit from Brazil. It is a natural form of caffeine
2. Ginseng has been associated with supporting the immune system.
3. Ginkgo is used to support memory
4. Taurine is a naturally occurring amino acid found in the body.
5. Many of these ingredients are “linked” to impressive claims but most are unsubstantiated and companies can include them in any quantity they choose and make claims that are attractive to the target audience
6. It should be noted that one of the main ingredients in energy drinks is caffeine.
   a. Content in most brands is more than in a cup of regular coffee
   b. See “ergogenic aids” for details on detrimental effects of performance of caffeine
7. Most contain a very high sugar content which causes an “insulin crash” which actually causes a low blood sugar content
8. See “Energy Drinks For Youth” PowerPoint for more detailed information

VIII. Pre Game Meals
   A. What is eaten before competition has four main functions:
      1. To help prevent hypoglycemia (low blood sugar), with its symptoms of light-headedness, needless fatigue, blurred vision, and indecisiveness – all of which can interfere with performance.
      2. To help settle the stomach, absorb some of the gastric juices, and decrease hunger.
      3. To fuel muscles, both with food eaten in advance that is stored as glycogen, and with food eaten within an hour.
      4. To pacify the mind with the knowledge that the body is well fueled.
   B. Sports nutrition for performance benefits must begin days in advance.
      1. Every day, eat adequate high-carbohydrate meals to fuel and refuel your muscles so they will be ready for action.
         a. Food eaten within an hour before exercise primarily decreases hungry and maintains blood sugar
            i. It doesn’t significantly replenish muscle glycogen stores.
      2. When exercising for more than 60-90 minutes, carbohydrates which slowly enter the bloodstream as they are digested (low glycemic index) such as rice, pasta, yogurt, oatmeal, bean soup, lentils, apples, or bananas should be eaten.
         a. When eaten an hour before exercise, these slow carbohydrates will be digested enough to be burned for fuel, and then will continue to provide sustained energy during the long workout.
3. When exercising for less than an hour, snacking on any tried-and-true foods that digest easily and settle comfortably is satisfactory.
   a. Bread, English muffins, bagels, crackers, and pasta are a few of the most popular high-carb, low-fat choices.
4. Limit high-fat proteins like cheese, steak, hamburgers, and peanut butter.
   a. These proteins take longer to empty from the stomach because the fat delays gastric emptying.
   b. Sluggishness and nausea can be a result of these foods.
5. Be cautious with sugary foods (such as soft drinks, jelly beans, and even lots of maple syrup or sports drinks) or carbohydrates which quickly enter the bloodstream as they are digested (potatoes, honey, or corn flakes).
   a. Many athletes who eat these foods within 15-120 minutes before hard exercise can experience a drop in blood sugar that leaves them feeling tired, light-headed, and needlessly fatigued.
   b. Experiment and learn how your body responds.
6. Allow adequate time for food to digest.
   a. Remember that high calorie meals take longer to leave the stomach than do lighter snacks.
   b. The general rule of thumb is to allow at least 3-4 hours for a large meal to digest, 2-3 hours for a smaller meal, 1-2 hours for a blended or liquid meal, and less than an hour for a small snack, according to your own tolerance.
   c. Some athletes can comfortably eat before they exercise, but others prefer to abstain. Both sorts perform well, and both have simply learned how to best fuel their bodies.
   d. It should be noted that exercise increases blood flow to working muscles and away from digestive organs
      i. This can cause stomach irritation if a large meal is eaten just prior to exercise
7. Always eat familiar foods before a competition.
   a. Don’t try anything new!
   b. New foods always carry the risk of settling poorly; causing intestinal discomfort, acid stomach, heartburn, or cramps.
8. Drink plenty of fluids.

IX. Carbohydrate Loading
A. The purpose of carbohydrate loading is to “super-compensate” for glycogen depletion in an effort to store the maximum amount of glycogen possible prior to an event
B. The athlete most likely to benefit from carbohydrate loading programs are endurance athletes whose events last for more than 90 continuous minutes
   1. Examples: Long-distance runners, swimmers, bicyclists, and cross-country skiers
C. Carbohydrate loading may also benefit athletes involved in sports that require prolonged movement of varying intensities:
   1. Examples: Soccer, lacrosse, and ice hockey, as well as tournament sports such as tennis.
D. The most accepted protocol is a 6 day cycle:
   1. Phase 1- The “Depletion Phase”
      a. The athlete participates in 3 days of high intensity training to deplete glycogen stores
      b. Carbohydrate intake during this phase should be 5g/kg/day
      c. This is the minimum amount recommended to athletes in training
      d. The first day should be 90 minutes of intense training (at 70% of VO2max)
      e. Followed by 2 days of 40 minutes of intense training
   2. Phase 2- The “Repletion Phase”
      a. Intensity of training is tapered over the next 3 days
      b. Carbohydrate intake increases to 10g/kg/day
      c. This is followed by 1 day of rest
E. Some side effects may occur
   1. During carbo-loading, the athlete’s weight should increase 1-3 pounds, since water is stored with glycogen.
      a. This may not be tolerated well by some athletes who may feel sluggish and heavy
   2. Eating too many carbohydrates can lead to intestinal distress
F. Choose wholesome, fiber-rich carbohydrates.
   1. These types of carbohydrates keep your system running smoothly.
   2. Pasta, rice, bran muffins, whole wheat bread, bran cereal, fruits, and vegetables are good choices.
X. Post Game Meals
A. What you eat after a hard workout or competition does affect your recovery.
B. Foods eaten after exercise or competition require the same careful selections as the meal before exercise.
C. Competitive athletes who are engaged in 2 or more workout per day must be especially concerned about recovery diet such as:
   1. Football player at training camp
   2. Competitive swimmers who compete in multiple events per meet
   3. Triathletes who train twice per day
   4. Aerobics instructors who teaches several classes daily
   5. Basketball players who needs to endure the entire season of intense training and competing.
D. Athletes commonly have reasons to eat inadequately after exercise, including that they don’t feel hungry and don’t have time.
E. Recovery Carbohydrates
   1. Recommendation is 1.5g/kg body weight
a. Ex: a 176lb athlete should consume approximately 120 g of carbohydrates.
   i. This could easily be achieved with a banana, 10oz of sports drink, and a bagel
   ii. Consumption of carbohydrate in smaller, more frequent meals appears to further aid the rate at which muscle glycogen is replaced in the hours after exercise
      A. With larger meals, blood glucose and insulin rise rapidly and then return to baseline relatively quickly
      B. Blood glucose levels can be sustained for a longer period of time with smaller meals
b. It is also recommended that .75 to 1.5g/kg body weight be consumed each of the next 3 hours

2. Ideally, carbohydrate-rich foods and beverages should be consumed within 15 minutes after a workout
   a. This is when the enzymes responsible for making glycogen are most active and will most rapidly replace the depleted glycogen stores.

3. Liquids and solid foods will refuel muscles equally well.
   i. Liquids should contain glucose rather than fructose
   ii. Studies show fructose does not result in glycogen synthesis rates that are as high as those with glucose
   iii. Solid foods should have a high glycemic index
      A. These are most effective in enhancing the resynthesis of glycogen
      B. Ex: white bread, corn flakes, baked potatoes, white rice, pancakes, bagels
      C. Many “energy bars” have a high glycemic index

4. See handout for a more complete list of carbohydrates with a high glycemic index

F. Recovery Protein
   1. Protein intake after exercise is important for muscle anabolism
   2. Recommendation is 6g immediately after exercise
      a. 0.1g/kg body weight
   3. Good examples of proteins are:
      a. Yogurt with fruit in the bottom
      b. Chocolate milk
      c. Turkey sandwich
   4. Some protein can actually enhance glycogen replacement in the initial hours after hard exercise.
   5. Protein eaten along with carbohydrates is recommended
G. Recovery Electrolytes
   1. Sweating not only causes water lose but also some minerals (electrolytes) such as potassium and sodium that help the body function normally.
   2. Electrolyte losses are primarily responsible for muscle cramping and intolerance to heat.
   3. Most athletes should be able to consume more than enough electrolytes from standard post-exercise foods.
      a. Salt tablets or special supplements are rarely needed

XI. Body Composition
    A. Body composition refers to all of the components that make up the body
    B. Body composition is usually divided into 2 main categories:
       1. Fat mass
       2. Fat-free or lean body mass
          a. Includes muscle, bone, fluids, and organs
       3. Most athletes are interested in the ratio of fat mass to total body mass which is commonly expressed as **percent body fat**.
    C. Essential fat is the minimum amount of fat necessary for proper physiological function
       1. Essential fat for males = 3% of body weight
       2. Essential fat for females = 12% of body weight
          a. Of this 12% approximately 9% is considered sex-specific fat
             i. This is fat needed for proper hormonal and reproductive functions
       3. Body composition that drops below these levels interferes with normal body function
    D. Body Fat norms are as follows:
       1. Females:  < 13 Caution, 14-18 Excellent, 19-23 Good, 24-29 Average, 30-36 Overfat, > 36 Obese
       2. Males:  <5 Caution, 6-11 Excellent, 12-16 Good, 17-23 Average, 24-29 Overfat, >29 Obese

XII. Measuring Body Fat
    A. Errors
       1. It should be noted that body fat cannot be directly measured except by chemical analysis of human cadavers
       2. All other methods “estimate” or “predict” body composition using data from the direct chemical analysis of relatively limited number of human cadavers
       3. All methods also have potential technical error in the assessment method itself
    B. There are five common methods to estimate percent body fat:
       1. Body Max Index (BMI)
a. BMI does not measure body composition but is a common method used to measure “fitness” associated with weight
b. BMI is used as a quick screening tool for physicians to screen for chronic disease risk associated with obesity
c. It assumes that adult height is stable and that any increase in scale weight is a result of an increase in body fat
d. This is not an accurate test to calculate body composition
   i. Athletes typically have more than average muscle mass which leads to inaccurate findings
e. Ex: an athlete whose’ height is 6’ 3” and weighs 240 lbs has a BMI of 30 and is classified as obese!
f. BMI is defines as a person’s height (measured in meters) divided by the square of the persons weight (measured in kilograms)
   i. This gives a unit of kg/m² but units are usually not included
g. BMI criteria are as follows:
   i. Underweight = 18.5
   ii. Healthy = 18.5-24.9
   iii. Overweight = 25-29.9
   iv. Obese = >30
h. See "Body Mass Index Table" for a quick way to calculate BMI

2. Hydrostatic (Underwater) Weighing
   a. Traditionally has been considered to be the most accurate method.
   b. The subject exhales all of the air in their lungs and is then weighed while submerged in a tank of water.
      i. This technique does not measure body fat, rather it measures body density.
      ii. This density measurement translates mathematically into percent body fat.
   c. Errors with underwater weighing include:
      i. Not completely exhaling all of the air in your lungs
         A. as little as 2 cups of air can affect body fat measurements by as much as 3-5%.
      ii. The equipment may not have the precise weighing systems which are more accurate.
      iii. Skill of the technician

3. Plethysmography (Bod Pod)
   a. Measures displacement of air to determine body volume
   b. The subject sits in an air-tight enclosure while the amount of air displaced by the subject’s body is sensed by a special diaphragm and pressure transducer
c. Once body volume is determined, body density can be calculated and body fat estimated
d. Errors include air pockets in clothing
   i. Tight fitting clothing and swim cap can reduce this error

4. Skinfold calipers, which are more convenient and still relatively accurate.
a. Calipers are large “pinchers” that measure the thickness of the fat layer on specific body sites.
   i. Common sites are abdomen, triceps, scapula, hip, and thigh
b. Poorly calibrated calipers or imprecise location of the specific body sites may cause errors in measurement.

5. Bioelectrical impedance analysis (BIA)
a. An imperceptible electrical current is sent through the body via electrodes
   i. Current typically flows up one leg and down the other
   ii. The flow of the current is affected by the amount of fat that is encountered
b. Inaccurate readings may occur if the subject is dehydrated, pre-menstrual, has undigested food in the stomach, or is improperly positioned during the test.
   i. Error may also come due to fat carried throughout other sites on the body through which the current does not pass

6. Near Infrared Reactance (NIR)
a. Measures the thickness of the skin at only one site, which may poorly represent overall body fat.
b. This method measures fat thickness based on principles of light absorption and reflection.
c. An instrument that emits an infrared light beam is placed over the biceps. It measures the light that is absorbed by the muscle and fat is reflected off the bone.
d. The measurement at only one site limits the accuracy of this method.
7. Comparison of Methods used to estimate Body Composition

<table>
<thead>
<tr>
<th>Method</th>
<th>*Accuracy</th>
<th>Practicability &amp; Portability</th>
<th>Ease of Use</th>
<th>Time</th>
<th>Cost</th>
<th>Subject Comfort &amp; Effort</th>
<th>Technician Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underwater (Hydrostatic Weighing)</td>
<td>+or-2.7%</td>
<td>Practical in exercise physiology laboratories or large fitness centers, not portable</td>
<td>Requires subject to submerge, exhale all air, and hold breath</td>
<td>~30 min. Procedure should be repeated 3-5 times</td>
<td>Initial purchase of equipment is expensive</td>
<td>Subject may be uncomfortable wearing bathing suit, submerging in water, and exhaling air</td>
<td>Training is not difficult</td>
</tr>
<tr>
<td>Plethysmography (Bod Pod)</td>
<td>+or -2.7 to 3.7%</td>
<td>Requires 8’X8’ space; can be moved but takes effort</td>
<td>Requires subject to sit quietly</td>
<td>~5 min.</td>
<td>Initial purchase of equipment is expensive</td>
<td>Subject may be uncomfortable wearing bathing suit and cap and sitting in an enclosed space</td>
<td>Minimal training needed</td>
</tr>
<tr>
<td>Skinfold Measurements (Calipers)</td>
<td>+or-3.5%</td>
<td>Practical in settings that have a private area; very portable</td>
<td>Requires subject to be still; Measurement sites must be determined and marked</td>
<td>&lt;5min</td>
<td>Initial purchase of equipment is moderately expensive</td>
<td>Subject may be uncomfortable partially disrobing; some skinfolds are difficult to grasp</td>
<td>Training and consistency are critical; technique improves with experience</td>
</tr>
<tr>
<td>Bioelectrical Impedance Analysis (BIA)</td>
<td>+or-3.5%</td>
<td>Practical in most settings; very portable</td>
<td>Easy to use</td>
<td>&lt;5min</td>
<td>Initial purchase of equipment is moderately expensive</td>
<td>Procedure is simple but pre-measurement guidelines require substantial subject compliance</td>
<td>Minimal training needed</td>
</tr>
<tr>
<td>Near-infrared Interactance (NIR)</td>
<td>+or -4 to 5%</td>
<td>Practical in most settings; very portable</td>
<td>Easy to use</td>
<td>~5 to 10 min</td>
<td>Initial purchase of equipment is moderately expensive</td>
<td>Simple procedure; generally no problems</td>
<td>Minimal training needed</td>
</tr>
</tbody>
</table>

*Error assumes that the procedure is done with quality equipment and a skilled technician

XIII. Weight Gain & Loss
A. In order to gain or lose weight, proper exercise and diet must be combined in the right ways.
B. Weight Gain
1. Theoretically, in order to gain 1 pound of body weight per week, the consumption of an additional 500 calories per day is needed.
2. The extra calories should primarily come from extra carbohydrates.
a. Carbohydrates fuel muscle so the muscles can perform intense muscle-building exercise.
b. However it is recommended that protein intake increase by 14 grams per day to provide necessary amino acids for muscle growth.

3. To date, research indicates that protein powders and amino acid supplements are a fruitless expense when it comes to gaining muscle weight.
   a. The only reason some athletes may see results from these is likely due to the additional calories.

4. Weight is most likely gained if larger-than-normal meals are consumed.

5. Finding the time to eat can be the biggest challenge to boosting caloric intake.
   a. Pack portable snacks
   b. Eat frequently throughout the day
   c. Eat an extra snack
   d. Eat larger than normal portions at mealtime
   e. Eat higher calorie foods.

6. Taking the prescribed 500-1000 additional calories per day should cause some weight gain.
   a. It is vital to include muscle-building resistance exercise (weight workouts) to promote muscular growth rather than just fat deposits.
   b. It is recommended to have body fat routinely measured, to be sure that weight gain is mostly muscle, not fat.

C. Weight Loss
   1. Understanding body composition is an important component of weight loss
      a. Muscle weighs more than fat
      b. When an individual begins an exercise program in an effort to lose weight he or she may find that the scale is not showing significant weight loss
         i. However, it is likely that body composition is changing
            A. Fat may be decreasing while muscle is increasing
      c. For this reason some form of body composition analysis should be utilized rather that body weight itself
   2. Body fat is stored energy
      a. In order to decrease body fat one must burn more calories that he or she eats which forces the body to use these energy stores (fat)
      b. Quite simply, the equation to lose excess body fat is to burn more calories than you take in (eat less and exercise more)
c. It should be noted that every human body is different and fat is stored at different rates for each person
   i. Storing fat can be effected by genetics, emotion, health, etc
   ii. Therefore, while the equation seems simple, it can be quite difficult
3. To lose weight healthfully, and successfully keep it off:
   a. Pay attention to the quantity of food eaten
   b. Pay attention to when food is eaten (eat big breakfasts, rather than big dinners).
   c. Pay attention to why food is eaten
      i. ie: boredom, stress, loneliness, or actually hungry
   d. Studies show that eating 5-6 small meals per day is an effective method to lose body fat
4. Theoretically, 1lb. per week should be lost if 500 fewer calories per day is eaten than normally
5. It is recommended that only 2 pounds per week be lost for safety reasons.
6. Eat slowly! The brain needs about 20 minutes to receive the signal that food has been eaten.
   a. No matter how much food is consumed during those 20 minutes, the satiety signal doesn’t move any faster.
7. Exercise regularly, but do not over-exercise.
   a. Too much exercise may lead to injury, fatigue, and irritability.
   b. Exercise will be more satisfying when it is for fun and fitness, not simply for burning off calories.
8. Crash Diets
   a. Weight loss fads are common in today’s world
   b. These techniques usually focus on restriction of calorie intake and usually have an individual eating foods that vary from their usual choices
   c. Such diets are unsuccessful because losing body fat and keeping it off requires a **behavior change that can continue throughout the person’s life**!
   d. These diets can actually cause long term weigh gain because caloric restriction causes the body to slow its metabolism in an effort to save the calories that are available
      i. This means that the body will burn less calories day to day than normal
   e. These fads are dangerous and can cause problems such as hair loss, weakened immune system, pH imbalances, and sudden death
D. Rapid weight loss is sports
   1. Sports that have weight categories because differences in body size make it impossible for all athletes to fairly compete among one another are at risk for unhealthy weight loss tactics
      a. Examples include wrestling, boxing, martial arts, and lightweight rowing
   2. Other sports in which weight must be moved or that physical appearance may be judged may also be at risk
      a. Examples include gymnastics, figure skating, horse racing, and cheerleading
   3. Weight loss tactics include calorie restriction, excessive exercise, fluid restriction, or a combination (exercising in rubber suits, spitting in a cup, etc)
   4. These tactics have serious risks and should never be condoned.
      a. Most health risks are associated with prolonged energy deprivation (see eating disorder section below) or dehydration (see hydration section above)
      b. There are several documented cases of deaths due to these tactics
      c. Other side effects include frequent nose bleeds, headache, dizziness, nausea, etc
      d. Studies are also showing that the weight “cycling” of these athletes is leading to lowered metabolic rate as aging occurs and an increase likelihood of being over weight later on in life
      e. Many states are implementing rules to limit such tactics in order to create a safer environment for the athletes
         i. In 2006 the National Federation of State High School Associations instituted rule changes that include:
            A. A body fat assessment no lower than 7% in males and 12% in females
            B. A monitored weight-loss program that does not exceed 1.5% loss of body weight per week
            C. A specific gravity of urine not to exceed 1.025

XIV. Eating Disorders
   A. Eating disorders affect more that 8 million Americans at any given time
   B. All forms of eating disorders can be fatal
      1. 1 in 10 people will die as a direct result of their eating disorder
   C. Males can get eating disorders but the vast majority are females
D. Signs to look for include:

1. Social isolation.
2. Lack of confidence in performance.
3. Ritualistic eating behaviors, such as cutting food into small pieces and playing with it.
4. Obsession with calories.
5. Obsession with weight.
6. Distorted body image.
7. Wearing layers of baggy clothing to hide thinness.
8. Nervous at mealtime, avoidance of eating in public.
9. Patterns of leaving the table directly to go to the bathroom.
10. Running water in the bathroom after meals to hide the sound of vomiting.
12. Obsession with grades.
13. Obsession with organization of personal space.
14. High emotions; tearful, uptight, overly sensitive, restless.
15. Signs of malnutrition.
17. Loss of hair.
18. Light-headedness.
20. Inability to concentrate.
21. Chronic fatigue.
22. Hyperactivity – compulsive exercise beyond normal training.
23. Decrease in performance.
25. Depression.

E. Anorexia Nervosa

1. People with anorexia restrict their caloric intake for long periods of time and deliberately starve themselves, resulting in loss of body weight of at least 15%.
2. They have an intense fear of becoming obese as well as a distorted body image.
3. Weight loss is achieved by avoiding food, frenzied exercise, or both.
4. The following signs and symptoms are used by the American Psychiatric Association to define Anorexia Nervosa:
   a. Intense fear of gaining weight or becoming fat, even though they are already under-weight.
   b. Disturbance in the way a person experiences his or her body (i.e., claiming to “feel fat” even when emaciated), with an undue influence of body weight or shape on self-perception.
   c. Weight loss to less than 85% of normal body weight.
d. Refusal to maintain body weight over a minimal normal weight for age and height.
e. Denial of the seriousness of the current weight loss.
f. Absence of at least three consecutive menstrual cycles.

5. Anorexia is a life-threatening condition if left untreated.

F. Bulimia Nervosa

1. A cyclical pattern of binge-eating associated with some type of purging
   a. Purging takes on different forms: fasting, self-induced vomiting, excessive exercising, or the use of enemas or diuretics.

2. The definition used by the American Psychiatric Association includes:
   a. Recurrent episodes of binge eating, characterized by both of the following:
      i. Eating an unusually large amount of food in a discrete period of time (the amount eaten is larger than most people would eat during a similar time period and under similar circumstances).
      ii. Feeling out of control during the eating episode and unable to stop eating or control what and how much is eaten.
   b. Compensating for the food binge to prevent weight gain, such as inducing vomiting; misusing laxatives, enemas, or other medications; fasting; or exercising excessively.
   c. Binge eating and purging, on average, at least twice a week for three months.
   d. Evaluating self-worth according to body shape and weight.

3. Many individuals (up to 50%) who have been diagnosed with anorexia will also develop symptoms of bulimia.

4. Bulimic behavior can cause stomach rupture, tooth decay, inflammation of the mucous lining of the mouth and throat, and can eventually cause heart and liver damage.

G. The Female Athlete Triad

1. A term used to describe three interrelated conditions that can occur in competitive women athletes:
   a. Low energy availability which may be caused by disordered eating
      i. This may be the result of simply trying to prevent any added fat in order to keep body weight low
         A. This athlete may or may not have the same psychological risk as a similar athlete with disordered eating
      ii. Can occur in sports in which a low body weight is desirable
         A. Gymnastics, ballet, distance running, etc
iii. The low energy availability coupled with the energy demands of the sport brings the athlete into energy deficit.
iv. This can be worsened in the adolescent athlete due to the energy demands of growth and development.
v. Energy deficits force the body to adapt and begin to suppress physiological functions that are associated with normal growth and development.

b. Amenorrhea
   i. The absence of menstruation for 3 or more consecutive months.
   ii. Caused by high energy expenditure and can be coupled with low energy intake.
      A. This alters the secretion of luteinizing hormone (LH) and estrogen which control the menstrual cycle.

c. Osteoporosis
   i. Low bone mineral density.
   ii. Low estrogen secretion interferes with the female's ability to store calcium in the bones.
      A. One of estrogens' functions is to protect against calcium loss from bone.
   iii. This increases the athlete's susceptibility to fractures; especially stress fractures.
   iv. Studies show that amenorrhea that lasts longer than six months will likely have a negative effect on the athlete's bone mineral density.
   v. Because this bone loss is typically occurring at a vital time when bone density should be increasing as the athlete matures.
   vi. This causes a significant increase in the susceptibility of problems due to osteoporosis in the athlete in later years of life.

2. If not treated, the energy deficit can result in the following severe health problems (this list is not exhaustive):
   a. Long term osteoporosis.
   b. Cardiac arrest.
   c. Electrolyte imbalance.
   d. Severe dehydration.
   e. Suicide.

3. Prevention begins with preventing persistent energy deficits.
   a. A healthy goal should be established for a desired training weight of the athlete.
      i. This goal should be such that will be beneficial to the athlete's performance yet not compromise health.
ii. Use of body composition analysis to establish a minimum is useful
iii. Input from exercise physiologist, dieticians, or physicians may be recommended
b. A training and diet plan can be established that provides the adequate energy and nutrients for the athletes energy expenditure

4. Treatment involves decreasing energy expenditure and increasing energy intake until symptoms resolve
   a. Menstruation will return when energy balance is achieved
   b. Depending on the length and severity of the osteoporosis there may be long term effects associated with bone health especially in the post menopausal years

H. Any victim of an eating disorder must be approached and handled extremely carefully. Referral for medical treatment is essential!

I. Prevention of Eating Disorders
   1. Many athletes think – or feel pressured to believe – that by restricting their food intake to lose weight they will exercise better, look better, and enhance their overall performances.
   2. Ironically, restricting food in an attempt to improve performance can actually result in depleted fuel stores, amenorrhea, stress fractures, fainting, weakness, fatigue, and ultimately impaired performance.
   3. Some athletes may manage to do well for a while without an obvious decline in performance, but then injuries and lack of energy will catch up with them.
   4. Eating disorders would fade if people could learn to love their bodies. As a society we must:
      a. Dispel the myth that thinness equals happiness and success.
      b. Discourage the notion that the thinnest athlete is the best athlete.
      c. Love our bodies for what they are, rather than hate them for what they are not.
      d. Emphasize fit and healthy as more appropriate goals than slender and skinny.

XV. Ergogenic Aids
A. Any substance (or food) that is believed to enhance one’s performance above normal standards.
B. The IOC definition: “The administration or use of substances in any form alien to the body or of physiological substances in abnormal amounts and with abnormal methods by health persons with the exclusive aim of attaining an artificial and unfair increase in performance in sports.”
C. The use of these substances and practices is controversial. There is great concern about the number of athletes engaging in the use of ergogenic aids.

1. Drug testing has been instituted in many sporting programs in order to help curtail the use of these substances.

D. Because of ethical violations associated with the inequities that result in competition and health problems that can result, use of these substances cannot be condoned!

E. Common Ergogenic Aids:

<table>
<thead>
<tr>
<th>Ergogenic Aid</th>
<th>Explanation</th>
<th>Physiologic Effect</th>
<th>Common Sports</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ephedra (known as Ma Huang in traditional Chinese medicine)</td>
<td>A genus of plant that can also be synthesized in a lab</td>
<td>A stimulant that opens airway passages, and increases alertness. Commonly used to treat asthma, nasal congestion, and to lose weight</td>
<td>varied</td>
<td>Headache, increased heart rate, increased blood pressure, insomnia, strokes, heart attacks, seizure, and psychiatric problems. Is addictive and many of these effects are associated with withdrawal. *Death</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Most widely consumed, self-administered psychotropic drug in the world. Found in many beverages and a few foods. Primary active ingredient is methylxanthine</td>
<td>Energy-enhancing effect (for some athletes) likely related to its ability to make exercise seem easier. Has stimulant effect upon the brain, may reduce fatigue associated with long bouts of exercise. Gives heightened sense of awareness. Tolerance can be achieved to its effects causing a need for more in order to achieve its desired effects. **A diuretic</td>
<td>Any sport to increase alertness and for perceived decreased fatigue. Wrestlers may abuse drug for diuretic effect.</td>
<td>increase heart rate, increase blood pressure, gastrointestinal distress, insomnia, and anxiety, reduced insulin sensitivity. Addictive leading to withdrawal effects: headache, drowsiness, inability to concentrate, feeling of discontent. Banned in large quantities by most sports</td>
</tr>
<tr>
<td>Morphine &amp; Codeine</td>
<td>Narcotics (opiates) taken for pain management needed for more than a few days. Have many side effects that may drastically actually impede performance</td>
<td>Changes the way the body senses pain</td>
<td>Any sport to decrease the symptoms of pain</td>
<td>Dizziness, drowsiness, nausea, loss of appetite, weakness, hallucination, etc. Highly addictive. Banned by most sports</td>
</tr>
<tr>
<td>Beta Blockers</td>
<td>Produce a relaxation of blood vessels which slows heart rate</td>
<td>Decrease heart rate, decreased cardiac output, increased relaxation, decrease nervousness.</td>
<td>Sports which physical activity is of little importance and a steady hand is necessary (such as marksmanship events)</td>
<td></td>
</tr>
<tr>
<td>Diuretics</td>
<td>Increase kidney excretion and urine output</td>
<td>Used to reduce body weight quickly or to decrease a drugs’ concentration in the urine</td>
<td>Wrestling, gymnastics, horse racing, dance or any sport in an attempt to mask</td>
<td>Affects associated with dehydration</td>
</tr>
<tr>
<td>Drug Type</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Anabolic Steroids (including any drug which is a precursor to testosterone such as Androgen)</strong></td>
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<tr>
<td><strong>Human Growth Hormone (Hgh)</strong></td>
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<tr>
<td><strong>Erythropoietin (EPO)</strong></td>
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<tr>
<td><strong>Blood Doping</strong></td>
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<tr>
<td><strong>Local Anesthetics (Including Corticosteroids)</strong></td>
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<tr>
<td><strong>Creatine</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingestion of Other Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sports in which strength and power are a large component such as power lifting, throwing events, football, and baseball</td>
</tr>
<tr>
<td>Too many to list – see handout!</td>
</tr>
<tr>
<td>Mostly strength and power events.</td>
</tr>
<tr>
<td>Increased blood viscosity, kidney and liver damage, heart defects. Banned by most sports Difficult to test for</td>
</tr>
<tr>
<td>Endurance events</td>
</tr>
<tr>
<td>Increased injury. Continued use may lead to weakness and degeneration of tendons and ligaments</td>
</tr>
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<td>Increased injury. Continued use may lead to weakness and degeneration of tendons and ligaments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Effects</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase muscle size and strength but only accompanied by intense training. Increase weight.</td>
</tr>
<tr>
<td>Increase growth of muscle, bone and connective tissue, decrease body fat, increased weight.</td>
</tr>
<tr>
<td>Increase the body’s ability to transport oxygen to working muscles</td>
</tr>
<tr>
<td>Increase of red blood cells increases the body’s ability to transport oxygen to working muscles</td>
</tr>
<tr>
<td>The body creates a limited amount so loading may increase ATP availability through this pathway and allow athlete to train harder</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sports</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many to list – see handout!</td>
</tr>
<tr>
<td>Banned by most sports</td>
</tr>
<tr>
<td>Mostly strength and power events.</td>
</tr>
<tr>
<td>Premature closure of growth sites, acromegaly, liver and kidney disease, heart defects. Banned by most sports Difficult to test for</td>
</tr>
<tr>
<td>Endurance events</td>
</tr>
<tr>
<td>All sports</td>
</tr>
<tr>
<td>Increased injury. Continued use may lead to weakness and degeneration of tendons and ligaments</td>
</tr>
</tbody>
</table>

* There have been numerous accounts of death where ephedra is a contributing cause leading to bans in many professional sports including the NFL
** Although caffeine has been thought to have a diuretic effect, recent studies indicate that caffeine is safe up to the level of 300mg which is far above what a person would typically take in through coffee, carbonated drinks, etc. Caffeine intake in an already dehydrated state may obviously increase risks associated with dehydration. 
***Studies have only showed positive performance results on weight lifters
****These symptoms where postulated when creatine first came onto the market, however, current scientific studies have not shown these side effects when used in the recommended doses.
F. Prevention of Drug Use
   1. The major goal of sporting organizations is to protect the health of athletes and to help ensure that competition is fair and equitable.
   2. Sports programs should have full-service programs that provide substance abuse education, counseling, and drug-detection.
   3. Drug testing should be performed periodically in a random manner.
   4. Athletes, parents, coaches, athletic trainers, physicians, and administrators must be educated about the dangers of drug abuse and the fact that it has no place in sports participation and recreation.
   5. Above all, a sports program must adopt the philosophy that “winning at all costs” is wrong.
   6. It is essential for athletes to believe that if they do their very best and adhere to the rules of the sport, they will be doing exactly what is expected of them.