**CORE STRANDS and Standards**

**STRAND 5 Students will explore various aspects of sports nutrition.**

**Standard 1**  Describe the basic components of nutrition and the sources of the following nutrients.

* + - Carbohydrates
    - Proteins
    - Fats
    - Vitamins
    - Minerals
    - Water

**Standard 2**  Examine the importance of fluid replacement and hydration.

* + - Examine the importance of water and its role in the body.
    - Explain the correct process of hydration during athletic activity.
      * Identify the dangers of inappropriate hydration techniques.
      * Identify the dangers of dehydration.
    - Compare and contrast advantages and disadvantages of sports drinks.
      * Identify the role of sports drinks in hydration.
      * Discuss the correct chemical make-up of sports drinks.

**Standard 3**  Identify the components of a pre and post event meal and explain the value of each.

* + - Describe recommended nutrient percentages of pre and post event meals.
    - Identify foods that are easily digested.
    - Identify foods that should be avoided.
    - Identify when pre and post event meals should be eaten.
    - Explain the process of carbohydrate loading and discuss when it is most effective.

Strand 5 – SPORTS NUTRITION

Nutrition Lecture Notes

1. **Introduction**
   1. Proper nutrition is a vital consideration for athletes who seek to maximize their performance.
   2. 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!
   3. 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.
   4. Many factors affect nutrient needs and nutrient availability including the athletes’:
      1. physical condition
      2. nutritional status
      3. age
      4. genetic background
   5. These factors make it essential that the diet be individualized.
2. **Purpose of Nutrition**
   1. Good nutrition promotes a healthier mind and body.
   2. Aids in resistance to illnesses.
   3. Provides energy
   4. The right foods help the athlete to:
      1. Feel better
      2. Sleep better
      3. Speed the healing process.
3. **Sports Nutrition Goals are to Ensure:**
   1. Adequate energy intake to meet the energy demands of training
   2. Adequate replenishment of muscle and liver glycogen with dietary carbohydrates
   3. Adequate protein intake for growth and repair of tissue, particularly muscle
   4. Adequate overall diet to maintain a healthy immune system
   5. Adequate hydration
   6. Consumption of food and beverages to delay fatigue during training and competition
   7. Minimization of dehydration during exercise
   8. Utilization of dietary strategies known to be beneficial for performance including:
      1. Pre-competition meals
      2. Carbohydrate loading
4. **Basic Nutrients**
   1. 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.
   2. **The six classes of nutrients are:**
      1. **Carbohydrates**
         1. One of the 3 nutrients that provide energy
         2. Yields approximately 4kcals/gram
            1. Carbohydrates are the primary source of energy for the body
         3. Common carbohydrates are sugars, starches, and fiber found in fruits, vegetables, and grains.
         4. The body converts sugars and starches to glucose for energy or to glycogen for energy storage in the liver and muscles.
            1. When glycogen stores are full, excess carbohydrates are converted to fat.
         5. Carbohydrates tend to be high in fiber
            1. Fiber is a type of carbohydrate that the body cannot absorb but is essential for gastrointestinal functioning
            2. While a high-carbohydrate diet is essential to good health in all individuals, it is especially important to the athlete
            3. 50-60% of the athlete’s caloric intake should be from carbohydrates to keep the glycogen stores filled.
            4. Athlete recommendation is 5 to 10 grams of carbohydrate per kilogram of body weight per day

Varies depending on sport, gender, etc

* + 1. **Proteins**
       1. Protein is critical to growth and development especially muscle and bones
          1. 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
       2. General functions of protein
          1. Function as enzymes to catalyze chemical reactions in the body
          2. Many hormones are proteins
          3. Can be a source of energy

Yields approximately 4kcals/gram

Occurs abnormally when carbohydrates and fats are not available

Such as in starvation

Also occurs normally during prolonged endurance exercise

* + - 1. Proteins are derived from animal foods – meat, milk, eggs, fish, cheese, and poultry.
         1. Other sources are soybeans, dry beans, some nuts, and whole-grain products.
         2. See handout for extended list
      2. During the digestive process, proteins are broken down into different amino acids.
         1. Eight of these amino acids are essential to build and repair body tissues.

The term “essential” means they must be provided in the diet; they cannot be manufactured in the body as the rest of them can.

The term “indispensible” is now being used to describe this type of amino acid

* + - 1. As stated earlier proteins may be used by the body for cellular energy, but proteins are the body’s least efficient source of energy.
      2. The body cannot store protein; therefore, extra protein is converted to fat.
      3. Protein intake should be approximately 10-12% of caloric intake.
      4. The Dietary Reference Intake (DRI) for adults is .8g/kg body weight
         1. Athlete recommendation is 1.2 to 1.7g of protein per kg body weight per day

Specifically, 1.2 – 1.4g/kg for endurance athletes and 1.6-1.7 for strength athletes

* + 1. **Fats (Lipids)**
       1. The third energy yielding nutrient
          1. Yields 9kcals/g
          2. That’s over twice carbohydrates and proteins!
       2. Main sources include meats, eggs, milk, avacodo, cheese, fried foods, butter, margarine, salad dressings, oils, and mayonnaise.
       3. Fats also carry vitamins A and D to cells, and are necessary for normal growth and development.
       4. Fats insulate the body from temperature extremes, protect the body from the impact of injuries, and shield the body’s organs
       5. Add flavor to our foods.
       6. Fats are necessary, in fact important, in the diet. Yet many people consider fats to be a harmful nutrient.
          1. The problem is the fact that we often eat far more than the daily recommended amount of fats (30% of our caloric intake).
          2. Most Americans eat a whopping 50% or more of their daily calories from fats.
       7. Athlete recommendation is 1.0 to 2.0g of fat per kg of body weight per day
       8. High-fat diets are associated with heart disease, hypertension, and cancers.
       9. Fats are not digested as quickly as other nutrients.
       10. Fats are a basic source of muscular energy, since fats are used when the carbohydrate sources are depleted.
    2. **Vitamins**
       1. *Vitamins do not provide energy!*
       2. Vitamins are essential for maintaining good health.
       3. A lack of vitamins in the diet leads to deficiency conditions, which express themselves in a variety of ways.
       4. Most vitamins cannot be synthesized by the body and must be ingested via foods or pills.
       5. No single food or food group will supply all the vitamins needed by the body
          1. A good reason to eat a variety of different foods.
       6. Vitamins are usually identified as either fat soluble or water soluble.
          1. Fat soluble vitamins (vitamins A, D, E, and K) are emulsified and absorbed in the small intestines.

These vitamins are stored in body cells, especially liver cells.

* + - * 1. Water soluble vitamins (B complex and vitamin C) are absorbed along with water through the digestive tract and dissolve in body fluids.

The body doesn’t store these vitamins well and excess quantities are excreted in urine.

* + - * 1. Vitamin requirements do not increase during exercise.

Available evidence does not justify supplementing the diet of the athlete with vitamins to improve physical performance unless a pre-existing vitamin deficiency exists.

However, many athletes do not choose nutrient dense foods. In these cases, supplementation may be suggested

* + 1. **Minerals**
       1. *Minerals do not provide energy!*
       2. Minerals are inorganic substances and are known to have functions essential to life.
       3. Some examples of essential minerals include:
          1. Calcium – necessary for bone strength and muscle contractions.
          2. Potassium – regulates cardiac rhythm.
          3. Iron – assists hemoglobin in the delivery of oxygen to body tissues.
          4. Sodium – essential in maintaining fluid balance.
          5. Phosphorus – needed for strong bones and teeth.
       4. Exercise does not seem to affect dietary needs of most minerals with the exception of the effects of sweating
          1. Heavy sweating may lead to excess losses of sodium, chloride, and potassium
          2. Losses of these minerals may affect performance
          3. 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

Generally, this added salt can easily be gained through the salt added to foods and not through “salt pills”

* + 1. **Water**
       1. Water is often considered the most important nutrient:
          1. 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!
       2. Provides an aqueous medium for chemical reactions
       3. Provides a medium for transportation of oxygen, hormones, nutrients, etc. throughout the body (i.e. the blood)
       4. Facilitates thermoregulation for the body (I.e. sweet)
       5. Lubricates joints and cushions organs and tissues
       6. In saliva and gastric secretions, water helps digest food
       7. Note that a loss of fluid through exercise may have an effect on these functions; many of which will affect performance
       8. See the “Fluid Replacement” section for an in depth study of how water affects performance

1. **Fluid Replacement**
   1. Exercise increases water loss
      1. During normal breathing, water is added to inspired air to protect delicate respiratory cells from drying out.
         1. Increased breathing during exercise increase this loss
      2. Heat production is a byproduct of muscle contraction.
         1. Increased muscle contraction during exercise increases overall body heat forcing the body to compensate through sweating
         2. Athletes may loss up to 1 liter per hour!
   2. Blood Composition
      1. Lowers ability to transport oxygen and nutrients
      2. Diminished ability to rid the body of excess heat, thus body temperature rises
         1. Cells cannot maintain normal function
   3. Water loss affects performance
      1. Diminished water content in the blood causes:
         1. Diminished capacity to transport oxygen and nutrients to body cells
         2. Diminished capacity to get rid of excess heat from working muscles causing increased body temperature since heat is transported in the blood
            1. 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:
         1. Decreased VO2max
         2. Decreased mental capacity
         3. Increased fatigue rate
         4. Increase susceptibility to heat illness
   4. Electrolyte Loss
      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
         1. 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
         1. There does not seem to be a performance or health issue with sodium loss during shorter exercise bouts
         2. 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
         3. 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 re-absorption 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
         1. Sports drinks may help to replenish lost sodium and glycogen stores
         2. Sodium replacement and maintaining hydration during exercise may help to reduce muscle cramping during exercise especially in salty and heavy sweaters.
      7. Muscle Cramping
         * 1. One cause of muscle cramping is an **electrolyte imbalance** caused from fluid and sodium loss from sweating. Consider how you are hydrating during exercise
           2. It should be noted that another cause of muscle cramping is **muscle fatigue**

It is vital to assure proper intensities during training that match intensities during competition to prevent fatigue that may lead to cramping

* + 1. Sports Drinks
       1. There are many types of sports drinks to choose from and choosing one over another is up to each individual
          1. However, there is a proper proportion of the chemicals in the drink in order to optimize performance and limit any detrimental affects

6-8%carbohydrate is recommended and is less likely to induce gastric distress due to slowed gastric emptying in most individuals

Sodium content of 460-690mg/liter is recommended to replace sodium loss and encourage further drinking since sodium tend to induce thirst

* + - 1. Example of a sports drink recipe
         1. 1 quart or 1 liter water
         2. 1/3 cup sugar
         3. ¼ teaspoon table salt
         4. Flavor to taste – use orange juice, lemon juice, etc
         5. Keep refrigerated
    1. Monitoring hydration status
       1. The body’s thirst mechanism lags behind dehydration
          1. By the time you are thirsty, you are already dehydrated
          2. Therefore, thirst is not a good indicator of hydration
       2. Urine color is a good indicator of hydration
          1. See *Urine Color Chart*
          2. Diet, supplementation, or medications, may affect urine color but this method is easy and practical
       3. Weight loss that occurs during a single bout of exercise is likely due to fluid loss
          1. Changes in body weight can be used as a marker for short term fluid loss
          2. One liter of water weighs approximately 1 kg (2.2 lbs)
          3. 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

Or just simply drink until the pre-workout weight is reached

* + - * 1. 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

In these instances an alternate method may be more appropriate

* + 1. **Fluid Replacement strategies**
       1. Pre-hydration should begin at least 4 hours before competition
          1. Recommendation is 5-7ml/kg
          2. Ex: a 50kg (110lb) female would drink 250- 350ml (8-12 oz or 1-11/2 cups)
          3. This recommendation assumes the athlete is in a hydrated state at the time
          4. 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
          5. Pre-hydration should be determined on an individual basis and by trial and error to determine the appropriate amount for each individual

Too little may lead to dehydration during completion and therefore, decreased performance

Too much may leave the athlete feeling blotted and cause too frequent urine brakes that may interfere with pregame activities

* + - 1. Hydration during activity
         1. It is generally recommended that an athlete drink 6-8oz of fluid every 15-20 minutes

Small amounts taken frequently are tolerated best by most athletes and leads to more effective gastric emptying

* + - * 1. Hydration needs during activity is highly individual and routines should be established well before competition to avoid introducing a “new” routine during competition.
        2. Cool beverages are tolerated best although studies do not show that temperature influences gastric emptying
      1. Free access to water before, during, and after activity should be encouraged.
    1. The thirst mechanism can be unreliable for athletes.
       1. Athletes should be encouraged to drink before they are thirsty.
       2. By the time the brain signals the thirst mechanism, the athlete may be well on the way to becoming dehydrated.
       3. This can significantly impair performance.
  1. Hyponatremia
     1. A potentially serious medical complication that may occur in endurance athletes during prolonged exercise such as ultra-marathons or triathlons
        1. 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
        1. Low sodium level in the extracellular compartment causes fluid to move into cells causing them to swell
        2. 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
        1. 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
        1. 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.
        1. The recommendation is .5 to .7g of sodium per liter of fluid
        2. Athletes should be encouraged to consume enough fluid to match fluid loss and prevent dehydration while not exceeding the amount of fluid lost

1. **Pre Game Meals**
   1. 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.
   2. 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.
         1. Food eaten within an hour before exercise primarily decreases hungry and maintains blood sugar
            1. 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.
         1. 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.
         1. 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.
         1. These proteins take longer to empty from the stomach because the fat delays gastric emptying.
         2. 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).
         1. 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.
         2. Experiment and learn how your body responds.
      6. Allow adequate time for food to digest.
         1. Remember that high calorie meals take longer to leave the stomach than do lighter snacks.
         2. 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.
         3. 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.
         4. It should be noted that exercise increases blood flow to working muscles and away from digestive organs
            1. This can cause stomach irritation if a large meal is eaten just prior to exercise
      7. Always eat familiar foods before a competition.
         1. Don’t try anything new!
         2. New foods always carry the risk of settling poorly; causing intestinal discomfort, acid stomach, heartburn, or cramps.
      8. Drink plenty of fluids.
2. **Carbohydrate Loading**
   1. 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
   2. 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
   3. 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.
   4. The most accepted protocol is a 6 day cycle:
      1. Phase 1- The “Depletion Phase”
         1. The athlete participates in 3 days of high intensity training to deplete glycogen stores
         2. Carbohydrate intake during this phase should be 5g/kg/day
         3. This is the minimum amount recommended to athletes in training
         4. The first day should be 90 minutes of intense training (at 70% of VO2max)
         5. Followed by 2 days of 40 minutes of intense training
      2. Phase 2- The “Repletion Phase”
         1. Intensity of training is tapered over the next 3 days
         2. Carbohydrate intake increases to 10g/kg/day
         3. This is followed by 1 day of rest
   5. Some side effects may occur
      1. During carbo-loading, the athlete’s weight should increase 1-3 pounds, since water is stored with glycogen.
         1. 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
   6. 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.
3. **Post Game Meals**
   1. What you eat after a hard workout or competition does affect your recovery.
   2. Foods eaten after exercise or competition require the same careful selections as the meal before exercise.
   3. 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.
   4. Athletes commonly have reasons to eat inadequately after exercise, including that they don’t feel hungry and don’t have time.
   5. Recovery Carbohydrates
      1. Recommendation is 1.5g/kg body weight
         1. Ex: a 176lb athlete should consume approximately 120 g of carbohydrates.
            1. This could easily be achieved with a banana, 10oz of sports drink, and a bagel
            2. 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

With larger meals, blood glucose and insulin rise rapidly and then return to baseline relatively quickly

Blood glucose levels can be sustained for a longer period of time with smaller meals

* + - 1. It is also recommended that .75 to 1.5g/kg body weight be consumed each of the next 3 hours
    1. Ideally, carbohydrate-rich foods and beverages should be consume within 15 minutes after a workout
       1. This is when the enzymes responsible for making glycogen are most active and will most rapidly replace the depleted glycogen stores.
    2. Liquids and solid foods will refuel muscles equally well.
       - 1. Liquids should contain glucose rather than fructose
         2. Studies show fructose does not result in glycogen synthesis rates that are as high as those with glucose
         3. Solid foods should have a high glycemic index

These are most effective in enhancing the re-synthesis of glycogen

Ex: white bread, corn flakes, baked potatoes, white rice, pancakes, bagels

Many “energy bars” have a high glycemic index

* + 1. See handout for a more complete list of carbohydrates with a high glycemic index
  1. Recovery Protein
     1. Protein intake after exercise is important for muscle anabolism
     2. Recommendation is 6g immediately after exercise
        1. 0.1g/kg body weight
     3. Good examples of proteins are:
        1. Yogurt with fruit in the bottom
        2. Chocolate milk
        3. 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
  2. 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.
        1. Salt tablets or special supplements are rarely needed