**CORE STRANDS and Standards**

**STRAND 9 Students will examine strength training principles, flexibility, and ergogenic aids.**

**Standard 1** Examine the role strength training has on fitness/athletic performance.

* + - Describe and know the function of the following muscular structures:
      * Fascia
      * Fascicle
      * Fibers
      * Myofibrils
      * Sarcomere
        + Actin
        + Myosin
      * Neuromuscular junction
    - Sliding filament theory
    - Compare and contrast the difference between slow twitch and fast twitch muscle fibers and the type of athletic performance each influence.
    - Compare and contrast different types of movements related to strength training
      * Isometric/isotonic/isokinetic
      * Eccentric/concentric
      * Closed chain/open chain
      * Plyometrics
    - Identify methods of resistance.
    - Apply general conditioning principles to improve strength.
      * Speed
      * Muscular endurance
      * Power

**Standard 2** Examine the importance of flexibility in fitness/athletic performance.

* + - Explain the general guidelines of flexibility.
      * Define ROM and how it relates to fitness/athletic performance
      * Identify the benefits of flexibility
        + Decrease risk of injury
        + Reduce muscle soreness
        + Improve muscular balance and postural awareness
      * Demonstrate proper timing of flexibility techniques
        + Before activity
        + After activity
    - Identify the different methods to increase flexibility and the safety/effectiveness of each.
      * Static stretching
        + **REQUIRED SKILL**-Demonstrate the proper techniques of static stretching for all major muscle groups
      * Ballistic stretching
      * Dynamic stretching
      * Proprioceptive Neuromuscular Facilitation Stretching
        + Contract/Relax
        + Hold/Relax

**Standard 3** Compare and contrast the physiological and psychological effects of ergogenic aids.

* + - Define ergogenic aid.
    - Recognize the effects and possible dangers of common ergogenic aides.
      * Stimulants
      * Narcotics
      * Anabolic steroids
      * Beta blockers
      * Diuretics
      * Human growth hormone
      * Blood doping products
      * Erythropoietin
      * Anesthetics
      * Corticosteroids
      * Creatine
    - Discuss the dangers of energy drinks and their effects on the body.

Strand 9 – STRENGTH TRAINING, FLEXIBILITY AND ERGOGENIC AIDS

Lecture Notes

**Standard 1:** Examine the roll strength training has on fitness/athletic performance.

1. Examine the roll strength training has on fitness/athletic performance
   1. Describe and know the function of the following muscular structures

|  |  |
| --- | --- |
| Muscular Structure | Function |
| Fascia | Connective tissue that envelops a muscle or group of muscles |
| Fascicle | Sometimes referred to as “Fasciculus”; bundle of muscle fibers |
| Fibers | Muscle cell |
| Myofibrils | Cylindrical structures that extend along the complete length of each muscle cell; composed of protein filaments |
| Sarcomere   1. Actin 2. Myosin | Basic functional unit within a muscle cell; unit between two z-lines  Thin Protein filament  Thick Protein filament; has ratcheting head to shorten filament |
| Neuromuscular Junction | Synapse between a motor neuron and a muscle fiber; site where a signal is transmitted to the muscle fiber causing a muscle contraction |

* 1. Sliding Filament Theory: Muscle contraction can be explained by a process known as the *sliding filament theory*. In the sliding filament theory, protein filaments called actin and myosin, slide past one another to generate movement.

Examine the roll strength training has on fitness/athletic performance.

1. **Compare and contrast the difference between slow twitch and fast twitch muscle fibers and the type of athletic performance each influences.**
   1. **Slow twitch**
      1. More efficient at using oxygen to generate more fuel for continuous extended muscle contractions over a long time.
      2. These fibers contract more slowly, but can continue for a long time before they fatigue.
   2. **Fast twitch**
      1. Generate short bursts of strength or speed
      2. Fatigue quickly
   3. **Fiber type and performance**
      1. Fiber type may influence what type of sports an athlete is naturally good at.
      2. Most athletes have a fairly even mix of fibers, but some have more of one that the other which predisposes them to certain types of sports/activities.
      3. Slow twitch muscle fibers are better suited to aerobic activities such as cycling, jogging, swimming, etc.
      4. Fast twitch fibers are better suited for anaerobic activities such as weight training, sprinting, jumping, and other explosive type activities.
2. **Compare and contrast different types of movements related to strength training**
   1. **Isometric** 
      1. Does not result in any movement of the joint.
      2. Performed against a fixed resistance.
      3. Least effective form of strength improvement.
      4. Examples: wall sit, stationary press
   2. **Isotonic**
      1. A joint is moved through the full range of motion against a fixed weight, speed is variable.
      2. Greatest gain is in the initial movement of the muscle, least is at the mid-point.
      3. Examples: bench press, bicep curls, squats
   3. **Isokinetic**
      1. Variable resistance with fixed speed
      2. Resistance accommodates to match the force applied.
      3. Machine is required
   4. **Eccentric**
      1. Negative work
      2. Muscle is lengthened or stretched while the weight is lowered
      3. Produce great strength gains, but results in more muscle soreness
      4. Example: down movement of the bicep curl
   5. **Concentric**
      1. Positive work
      2. Muscles shortens as weight is lifted
      3. Example: up movement of bicep curl
   6. **Closed chain exercises**
      1. Distal segment is fixed, the hand/foot remains in constant contact with the surface
      2. Allow strength gains of several muscle groups at one time
      3. Examples: body squats, lunges, push ups
   7. **Open chain exercises**
      1. Distal segments are not fixed and are freely moving in space
      2. These types of exercises are good at targeting one set of muscles, but increases the forces transmitted to the involved joint
      3. Examples: bench press, bicep curls, knee extensions, any throwing movements
   8. **Plyometrics**
      1. Muscles are repeatedly and rapidly stretched (loaded) and then contracted.
      2. The aim is to improve muscle power
      3. Maximize the stretch reflex. The greater the stretch put on the muscle from its resting length immediately before the concentric contraction, the greater the load (power generated) the muscle can lift.
      4. The rate is more important than the magnitude of the stretch.
      5. Examples: jumps, bounds, skips, hops, medicine ball throws, push up with clap.
3. **Identify methods of resistance training**
   1. **Free weight** (dumbbells and barbells)
      1. Variety of exercise selection
      2. Athlete in control of range of motion
      3. Builds coordination
      4. Recruits stabilizing muscles to control movement
   2. **Weight machines**
      1. Simple to use
      2. Relatively safe
      3. Don’t require lots of coordination
      4. Limited to targeting one muscle group
      5. Body may not anatomically match the movement of the machine
   3. **Exercise tubing**
      1. Similar advantages to free weights
      2. High variety of exercise selection
      3. May not be able to generate enough force to increase strength gains as much as free weights
   4. **Body weight exercises**
      1. Does not require any equipment
      2. Exercises can be very functional and sport specific
      3. Difficult for experienced athletes to achieve high level of intensity without high number of repetitions
4. **Apply general conditioning principles to improve strength**
   1. **General guidelines**
      1. Safety first
      2. Allow proper rest between exercises
      3. Weight training program should be balanced to prevent injury and overuse
      4. Use a spotter
   2. Repetition: performing the particular exercise one time
   3. Set: the grouping of a specific exercise into a number of repetitions
   4. Resistance: the opposing force to a muscle contraction
   5. Build strength and size: high resistance/low repetitions
   6. Build muscle endurance: low resistance/high repetitions
   7. Build power: rapid movements

**Standard 2:** Examine the importance of flexibility in fitness/athletic performance.

1. **Explain the general guidelines of flexibility**
   1. Define Range of Motion (ROM) and how it relates to fitness/athletic performance
      1. The range through which a joint can be moved, the range of flexion and extension.
      2. If range of motion is decreased through lack of flexibility, form can be altered, reducing biomechanical efficiency and creating a climate for athletic injuries.
   2. Identify the benefits of flexibility
      1. Decreased risk of injury
      2. Reduce muscle soreness
      3. Improve muscular balance and postural awareness
   3. Identify proper timing of flexibility techniques
      1. Before activity – dynamic stretching is best
      2. After activity – best time to use static stretching, greatest gains can be seen from flexibility routine after the workout.
2. Identify the different methods to increase flexibility and the safety/effectiveness of each.
   1. **Static stretching**
      1. Consists of stretching muscle tissue to a comfortable position and holding this position for a period of time.
      2. Exercise should be taken to the point of tightness, no motion should be forced
      3. General rule of thumb is to hold a stretch for 10 – 30 seconds, longer time, less intensity
      4. Research agrees that static stretching should be used at the end of a training session and not at the beginning. Regardless it is important that the muscles are warmed up before any stretching is done.
   2. **Ballistic stretching**
      1. The use of body momentum to bounce at the end range of a stretch
      2. Has been shown to increase flexibility; however there is the potential to cause musculoskeletal injuries.
      3. Not generally recommended
   3. **Dynamic stretching**
      1. Active muscular effort are used to in an effort to propel the muscle into an extended range of motion, not exceeding the athlete’s static stretching ability.
      2. Functional based exercises which use sport specific movements to prepare the body for movement.
      3. Not bouncy or jerky movements
      4. Recognized as a beneficial way to warm up prior to training
      5. Benefits
         1. Increases core temperature and peripheral blood flow
         2. Elongates muscles and tendons
         3. Enhances coordination, motor learning, & proprioception
         4. Incorporates balance
3. Examples: high knees, butt kicks, straight leg kicks, leg swings, lunge walks (can add trunk rotations), inverted hamstring, inchworm
   1. **Proprioceptive Neuromuscular Facilitation stretching (PNF)**
      1. The muscle to be stretched is first contracted maximally. The muscle is then relaxed and is either actively stretched by contraction of the opposing muscle or is passively stretched. Two types
      2. **Contract/Relax**
         1. Athlete’s body part to be stretched is moved passively until resistance is felt.
         2. At this point the athlete contracts the muscle group against the resistance of a partner
         3. Resistance is applied as the body part is allowed to travel through a selected range of motion
         4. The body part is moved to a new stretch position beyond the original stretch, and the process is repeated.
      3. **Hold/Relax**
         1. Movement does not occur
         2. The athlete actively stretches to a comfortable position.
         3. The athlete then applies force against the resistance of a partner.
         4. An isometric contraction is applied and the partner allows no movement after holding for 10-15 seconds.
         5. When this phase is completed, the body part is move to a new stretch position beyond the original stretch starting point.
         6. The process is repeated

Rapid, beneficial increases in flexibility can be obtained with PNF stretching; however, it is best done with a professional who is trained in PNF techniques.

**Standard 3:** Compare and contrast the physiological and psychological effects of ergogenic aids

1. **Define ergogenic aid.**

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.

d. There is great concern about the number of athletes engaging in the use of ergogenic aids.

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

f. 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!

2. Recognize the effects and possible dangers of common ergogenic aides.

a. **Stimulants:** ephedra, caffeine

i. a substance that raises levels of physiological or nervous activity in the body.

ii. Are used to increase alertness, reduce tiredness, and increase their competitiveness and aggressiveness.

iii. Also includes cocaine & methamphetamines

1. **Narcotics:** 
   1. Narcotics are derived from the opium poppy and include the commonly known painkillers morphine, diamorphine and pethidine.
   2. narcotic analgesics may reduce anxiety, possibly enhancing performance in sport events in which excessive anxiety could affect fine motor control adversely, such as pistol shooting and archery
2. **Anabolic Steroids:**
   1. Anabolic steroids are synthetic variations of the male sex hormone testosterone
   2. Doctors prescribe them to treat problems such as delayed puberty and other medical problems that cause the body to make very low amounts of testosterone. Steroids make muscles bigger and bones stronger.
3. **Beta blockers:**
   1. Beta-blockers are also used to treat abnormal heart rhythms, anxiety, migraines, glaucoma, and overactive thyroid symptoms
   2. Beta blockers, also known as beta-adrenergic blocking agents, are medications that reduce your blood pressure. Beta blockers work by blocking the effects of the hormone epinephrine, also known as adrenaline. When you take beta blockers, your heart beats more slowly and with less force, thereby reducing blood pressure.
4. **Diuretics:** 
   1. Something that promotes the formation of urine by the kidney.
   2. All diuretics cause a person to 'lose water,
      1. One way is by inhibiting the kidney's ability to reabsorb sodium, thus enhancing the loss of sodium and consequently water in the urine
      2. Some block the exchange of sodium for potassium, resulting in excretion of sodium and potassium but relatively little loss of potassium
   3. Used in treating hypertension.
   4. Also known as water pill. Substances in food and drinks, such as coffee, tea, and alcoholic beverages, may act as diuretics.
5. **Human Growth Hormone**: A naturally occurring growth hormone of humans or a genetically engineered form that is used to treat children with growth hormone deficiencies and has been used especially by athletes to increase muscle mass
6. **Blood Doping:** the injection of oxygenated blood into an athlete before an event in an attempt to enhance athletic performance.
7. **Erythropoetin:** 
   1. Erythropoetin is a substance produced by the kidney that leads to the formation of red blood cells in the bone marrow. Abbreviated: EPO.
   2. Its major functions are to promote the differentiation and development of red blood cells and to initiate the production of hemoglobin, the molecule within red cells that transports oxygen.
8. **Anesthetics:** a substance that induces insensitivity to pain; Can be topical or injectable
9. **Corticosteroids:** Corticosteroids (cortisone-like medicines) are used to:
   1. provide relief for inflamed areas of the body.
   2. lessen swelling, redness, itching, and allergic reactions.
   3. Are often used to treat different diseases, such as severe allergies or skin problems, asthma, or arthritis.
   4. Are naturally produced in the body but sometimes the body needs more to fight off reactions
10. **Creatine:** is a nitrogenous acid that occurs naturally in vertebrates.
    1. Its main role is to facilitate recycling of adenosine triphosphate (ATP), the energy currency of the cell, primarily in muscle and brain tissue.
    2. It is often used by athletes to increase both power output and lean mass.
11. Discuss the dangers of **energy drinks** and their effects on the body
    1. Energy drinks are a $10 billion industry!
    2. Marketing tactics are similar to alcohol tactics and are generally directed at the youth.
    3. 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. Ginko is used to support memory
    4. Many of the ingredients are “linked” to unsubstantiated claims; companies can also include them in any quantity they choose.
    5. One of the main ingredients of energy drinks is caffeine. Content in most brands is more than a cup of coffee.
    6. Most contain a very high sugar content which causes an “insulin crash” which actually causes a low blood sugar content