**CORE STRANDS and Standards**

**Strand 8 Students will examine performance enhancement philosophies.**

**Standard 1** Define terms associated with performance enhancement.

* + - Cardiovascular endurance
    - Muscular endurance
    - Power
    - Speed
    - Strength

**Standard 2** Discuss general conditioning principles.

* + - Adaptation
    - Overload
    - Specificity
    - Reversibility
    - Periodization

**Standard 3** Examine the role the cardiovascular/respiratory systems have on fitness/athletic performance.

* + - Describe the anatomy of the cardiovascular/respiratory systems.
      * Heart
        + 4 chambers
        + 4 valves
        + 4 blood vessels
      * Lungs
        + Oxygen exchange from alveoli to capillaries
    - Identify vital signs related to the cardiovascular/respiratory system.
      * Describe and accurately measure blood pressure (systolic/diastolic)
      * Describe and accurately measure respiratory rate
      * Describe and accurately measure pulse rate
      * Describe lung volume
      * Describe the importance of cardiac output, stroke volume, and heart rate during exercise
    - Examine different types of tests used to quantify cardiovascular fitness.
      * VO2max
      * Harvard step test
      * 12 minute run test
    - Describe the effects exercise has on the cardiovascular/respiratory systems.
      * Immediate effects of exercise
        + Heart rate
        + Ventilation
      * Long term effects of exercise
        + Heart rate
        + Stroke volume
        + Cardiac output
    - Compare and contrast aerobic/anaerobic training
    - Examine the importance of a warm up/cool down in a training program.
    - Examine different cardiovascular training methods.
      * Interval
      * Fartlek
      * Circuit
      * Continuous
    - Apply general conditioning principles to improve cardiovascular fitness.
      * Rate of perceived exertion (BORG scale)
      * Target heart rate

**Standard 5** Examine the effects of the environment on training and performance.

* + - Discuss the effect of high and low altitude.
    - Describe the effects of acclimatization.
    - Recognize the effects of travel on the body.

**Standard 6** Vocabulary:

* + - Acclimatization
    - Aerobic
    - Anaerobic

Strand 8 – PERFORMANCE ENHANCEMENT

Lecture Notes

**Objective 1:** Define terms associated with performance enhancement.

1. **Cardiovascular Endurance:** The body’s ability, over a sustained period of time during physical activity, to deliver oxygen and nutrients to tissues and to remove wastes.
2. **Muscular Endurance**: the ability of a muscle or muscle group to sustain repeated contractions or to continue applying force against a fixed object.
3. **Power**: The ability to exert maximum muscular contraction instantly in an explosive burst of movement composed of strength and speed.
4. **Speed:** the quickness of movement of a limb or whole body.
5. **Strength:** The extent to which muscles can exert force by contracting against resistance.

**Objective 2:** Discuss general conditioning principles.

1. **Adaptation:** The body’s ability to react to the training loads imposed by increasing its ability to cope with demands.
   1. The purpose of physical training is to systematically stress the body so it improves its capacity to exercise.
   2. Physical training is beneficial only as long as it forces the body to adapt to the stress of physical effort.
   3. If the stress is not sufficient to overload the body, then no adaptation occurs.
2. **Overload:** A greater than normal stress or load on the body is required for training adaptation to take place.
   1. In order for a muscle (including the heart) to increase in strength, it must be gradually stressed by working against a load greater than it is used to.
3. **Specificity:** Sports training should be relevant and appropriate to the sport for which the individual is training in order to produce a training effect.
4. **Reversibility:** There is a gradual loss of training effects when the intensity and duration is reduced.
5. **Periodization:** The process of varying a training program at regular time intervals to bring about optimal gains in physical performance. Using periodization a competitive athlete is able to peak physical performance at a particular point in time.
   1. **Pre-season** (preparatory) phase
      1. High volume, low intensity
      2. Focus on proper exercise technique
      3. Power and strength workouts are introduced in the second half of the pre-season phase.
   2. **In-season** (competitive) phase
      1. Low volume, high intensity
      2. Focus on technique during event
   3. **Post-season** (transition) phase
      1. Active rest – low volume, low to moderate intensity
      2. Engage in recreational activity – allows for physiological and psychological break.

**Objective 3:** Examine the roll the cardiovascular and respiratory systems have on fitness/athletic performance.

1. Describe the anatomy and function of the cardiovascular and respiratory systems.
   1. **Functions of the cardiovascular system**
      1. Deliver oxygen and nutrients to body tissues
      2. Carry waste from the cells to the organs that excrete them.
   2. **Anatomy of the cardiovascular system**
      1. Atrium – receiving chambers from the body (right atrium) and lungs (left atrium)
      2. Ventricles – pumping chambers to the lungs (right ventricle) and body (left ventricle)
      3. Tricuspid valve – between right atrium and right ventricle
      4. Bicuspid (mitral) valve – between left atrium and left ventricle
      5. Pulmonary and aortic Semilunar valves– separate the right and left ventricles from pulmonary and aorta arteries respectively.
      6. Superior and inferior vena cava – bring deoxygenated blood to the heart
      7. Pulmonary artery and pulmonary vein – take blood to the lungs from the heart and to the heart from the lungs respectively.
      8. Arteries – carry blood away from the heart
      9. Veins – carry blood toward the heart
      10. Capillaries – microscopic vessels which are one cell thick. Oxygen and nutrient exchange takes place with the body cells via these tiny blood vessels.
   3. **Functions of the respiratory system**
      1. Respiration – gas exchange, the addition of oxygen to and removal of carbon dioxide from the blood. Takes place between the alveoli and the capillary system in the lungs.
      2. Ventilation – process of inhaling and exhaling air into and out of the lungs
   4. **Anatomy of the respiratory system**
      1. Nose
      2. Pharynx (throat) – passageway for both air and food
      3. Larynx (voice box) – connects pharynx with the trachea. Serves as the organ of voice by vibration of the vocal cords
      4. Trachea (wind pipe) – tubular passageway for air
      5. Bronchi – tubes that branch off the trachea and extend into the lungs
      6. Bronchioles – smaller and smaller tubes that branch into the lungs off of the bronchi
      7. Alveoli – air sacs at the end of the bronchioles that are surrounded by tiny capillaries, where gas exchange takes place between the air and the blood. Through diffusion, oxygen moves from the alveoli into the blood and carbon dioxide moves from the blood into the alveoli.
2. **Identify vital signs related to the cardiovascular/respiratory systems.**
   1. Describe blood pressure
      1. The pressure exerted by blood on the walls of the blood vessels. Normal blood pressure is 120/80 mmHg
      2. Systolic pressure is the numerator and identifies the pressure when the heart is contracting.
      3. Diastolic pressure is the denominator and identifies the pressure when the heart is relaxed.
   2. Describe respiratory rate
      1. The number of breaths per minute
      2. **Average adult – 12 – 18 bpm**
   3. Describe pulse rate
      1. The number of times the heart beats per minutes
      2. As the heart pushes blood through the arteries, they expand and contract with the flow of blood
      3. **Average adult resting rate – 60 – 100 bpm**
      4. Common arteries – carotid (neck), brachial (upper arm), radial (wrist, preferred site during exercise), femoral (2/3 of the way in from the hip)
   4. Describe lung volume
      1. **Tidal Volume –** amount of air breathed in and out during normal breathing
      2. **Vital Capacity –** amount of air breathing in and out with maximal inspiration and expiration.
      3. Spirometer – an apparatus for measuring the volume of air inspired and expired by the lungs. Records the amount of air and the rate of air that is breathed in and out over a specified period of time.
   5. **Describe the importance of stroke volume, cardiac output, and heart rate during exercise.**
      1. Stroke Volume – the amount of blood the heart ejects from one left ventricular contraction. At rest about **50-70 ml/beat.** During intense exercise can increase up **to 110-130 ml/beat.** The stronger an athlete’s heart is, the larger the stroke volume is. The more blood the heart can circulate, the more oxygen is available to muscles to generate energy.
      2. Cardiac output – the amount of blood the heart can eject in one minute, a function of stroke volume and heart rate. Rest – about **5L/min**. during intense exercise can increase to **20-40 L/min.**
      3. During exercise oxygen demands to working muscles increases driving the increase of stroke volume and heart rate, therefore increasing cardiac output.
3. **Examine different types of tests used to quantify cardiovascular fitness.**
   1. VO2max – Measures the efficiency which someone can use oxygen while exercising. Those who are fit have higher VO2max values and can exercise more intensely than those who are not as well conditioned. Average VO2max for male athletes is about 35 ml/min and for female athletes is about 27 ml/min.
   2. Harvard Step Test – Step up and down on a platform (20 in. high) at a rate of 30 steps per minute (every 2 seconds) for 5 minutes or until exhaustion. Take heart rate 1 minute after finishing, 2 minutes, and 3 minutes. Determine fitness index – (100 X test duration in seconds) / (2 X sum of hearts beats in the recovery periods). Excellent = ≥ 90, good = 80 – 89, high average = 65 – 79, low average = 55 – 64, poor = ≤ 55.
   3. 12 minute run/walk test – The objective of the test is to measure the maximum distance covered by the individual during the 12 minute period. Calculate estimated VO2max. VO2max = (22.351 X kilometers) – 11.288.
4. **Describe the effect exercise has on the cardiovascular/respiratory systems.**
   1. Cardiovascular System
      1. Increased heart rate
      2. Decreased blood flow to non-muscular tissue
      3. Dilation of the capillaries to increase blood flow to muscle tissue
      4. Increased arterial pressure
      5. Increased body temperature
   2. Respiratory System
      1. Increased respiration rate
      2. Expiration requires energy instead of being primarily passive
   3. Long term effect
      1. Reduction in blood pressure
      2. Increase of HDL cholesterol
      3. Decreased total cholesterol
      4. Decreased body fat stores
      5. Decreased feelings of anxiety, tension, and depression
      6. Increased heart function
5. **Compare and contrast aerobic and anaerobic fitness**
   1. **Aerobic** 
      1. Activity in which the body’s large muscles move in a rhythmic manner for a sustained period of time.
      2. Also called endurance activity improves cardiovascular fitness
      3. Examples: walking, running, swimming, bicycling, hiking, etc.
   2. **Anaerobic**
      1. Activity in which the body is working so hard that the demands for oxygen and fuel exceed the rate of supply and the muscles have to rely on the stored reserves of fuel.
      2. The muscles, being starved of oxygen, take the body into a state known as oxygen debt.
      3. The body’s stored fuel soon runs out and activity ceases.
      4. Examples: weight lifting, sprinting, interval training, etc.
6. **Examine the importance of a warm up and cool down in a training program.**
   1. Warm up
      1. Helps prepare the body for training by increasing muscle and body temperature.
      2. A warm up may include walking, jogging, slow cycling, or anything that will allow the athlete to gradually increase the intensity of their specific sport.
   2. Cool down
      1. Gradually slowing of exercise to allow all body systems to return to a resting state.
      2. Best time to use static stretching and increase flexibility.
7. **Examine different cardiovascular training methods**
   1. Interval – series of repeated bouts of strenuous exercise alternated with period of relatively lighter exercise or rest
      1. Advantages
         1. Precise control of stress
         2. Systematic day-to-day approach
         3. Easily observable progress
         4. Can be performed almost anywhere
         5. Requires no special equipment
      2. Overload is accomplished through the manipulation of 5 variables
         1. Rate and distance of interval
         2. Number of repetitions
         3. Rest time between intervals
         4. Type of activity during rest
         5. Frequency of training per week
      3. Example: running 4 X 200 meters on the track at 75% max speed with a 4 minute walking rest between each attempt.
   2. Fartlek – Swedish word meaning “speed play.”
      1. Involves alternating fast and slow running over natural terrain.
      2. Can be thought of as an informal interval training program.
      3. Work and rest intervals are not precisely timed
      4. Builds both aerobic and anaerobic capacities.
      5. Example: Going out for a jog, after a warming up, picking up the pace to the point that it is difficult to maintain, run at this pace for as long as possible, when the pace can no longer be maintain, decrease the pace to recover. Continue to alternate between fast and recovery paces.
   3. Circuit – series of exercise stations with brief rest intervals between each station
      1. The number of stations can vary from 4 – 10 or more.
      2. Stations can be adjusted to maximize specific sport skills
      3. Example stations: pushups, sit-ups, jumping jacks, burpees, wall sits, ski jumps, lunges, squat jumps, etc.
   4. Continuous – activity without rest intervals.
      1. Usually between 60 – 80% max heart rate
      2. Should last at least 30 minutes
      3. Distance/time/speed can be varied based on goals
         1. Threshold pace – a pace that is comfortably hard that can be maintained.
         2. Long slow distance – slower pace that can be maintained for longer periods of time
8. **Apply general conditioning principles to improve cardiovascular fitness**
   1. F.I.T.
      1. Frequency – how often training occurs during a week (3 X wk, 7 X wk, 10 X wk)
      2. Intensity – how hard the athlete is training
         1. Target Heart Rate = 220 – age = estimated MHR (max heart rate). Moderate intensity = 50-70% MHR. Vigorous intensity = 70-85% MHR
         2. Rate of Perceived Exertion (BORG scale) – Intensity based on perceptions of physical sensations a person experiences during physical activity, including increased heart rate, increased respiration rate, sweating, and muscle fatigue. Scale = 6-20. Rating between12 – 14 suggests physical activity is at a moderate level of intensity.
      3. Time – how long the training lasts (20 minutes, 5 miles, etc).

**Objective 4:** Examine the effects of the environment on training and performance

1. **Discuss the effect of high and low altitude**
   1. Definition: at high altitudes (above 8,000 ft.) the concentration of oxygen decreases, therefore decreasing the amount of oxygen the body is able to bring into the body.
   2. A number of **physiological changes** take place in the body. Just a few are:
      1. Immediate
         1. Respiratory rate increases
         2. Heart rate increases
         3. Unable to reach VO2max
      2. Longer term
         1. Increased number of red blood cells (body’s adaptation to increase oxygen saturation)
   3. Research has shown that the increase of red blood cell production will allow the body to intake more oxygen, which in turn allows the athlete to work harder. More effective with endurance sports.
   4. Several theories regarding high altitude in which they all utilize the concept of the body receiving more oxygen (increased red blood cell production) allowing the athlete to achieve increased performance.
      1. Live high, train low
      2. Live high, train high
      3. Live low, train high
2. **Describe the effect of acclimatization**
   1. **Definition:** Physiological adaptation of an athlete to changes in climate or environment such as light, temperature, or altitude.
   2. Altitude – Several approaches
      1. Compete within 24 hours of arrival at altitude, most symptoms will not have had time to manifest themselves
      2. Train at higher altitude for at least 2 weeks prior to competition
      3. Spend a greater percentage of training time at sea level to endurance training several weeks prior to competition. Helps to raise athlete’s VO2max to a peak allowing performance at lower relative intensity without significant loss to overall performance.
   3. Temperature
      1. Heat training directed to improving athletic performance in warm climates.
         1. Volume and intensity reduce for first exposure to hot environment
         2. Volume and intensity are increased as the athlete adapts
         3. Important to closely monitor body mass and hydration rates
         4. Extreme care is required to ensure proper hydration
         5. Complete acclimatization requires up to 10 - 14 days
3. **Recognize the effects of travel on the body.**
   1. Athletes involved in international competitions must learn to deal with the effects of long air travel and changing time zones. This can lead to a disturbance of circadian rhythms and sleep-wake cycles
   2. Symptoms of jet lag:
      1. Sleep loss
      2. Headaches
      3. Dizziness
      4. Fatigue
      5. Decrease in energy
      6. Decrease in alertness
      7. Decrease in cognition
   3. Before a flight
      1. Be well rested
      2. Gradually shift sleep schedule to match final destination time a few days before the flight
   4. During a flight
      1. Drink plenty of water, limit caffeine
      2. Stretch and walk around
      3. Use earplugs to minimize noise and improve sleep
   5. Upon Arrival
      1. Perform low-intensity exercise to reduce muscle stiffness
      2. Avoid heavy training for the first few days
      3. Can use correctly timed light to shift circadian rhythms