OBJECTIVE:
To Develop Programs that will develop the energy capabilities and skills of the athlete
Specific programs to develop the specific capabilities required for a Specific Skill or Activity

Three types of Training Specificity

1. Metabolic (Sprint vs Endurance)
2. Mode of Exercise (Cycling vs swimming)
3. Muscle Group (Arms vs Legs)
A Training program used to develop the dominant ENERGY SYSTEM (ATP) capabilities required by a skill or sport

• ATP-PC or Phosphagen System
  – highest ATP rate (moles/min) = 3.6; lowest amt.

• Lactic Acid or ANAEROBIC (glycolysis)
  – moderate rate = 1.6; moderate Amt

• Oxygen or AEROBIC System
  – lowest rate = 1.0; greatest Amt.
  – lower power output of longer duration
METABOLIC Specificity Training Program

GOAL- to improve the dominant energy system used by the sport
i.e. Sprinter vs Marathon Runner
Which system is used for each?

See Table 9.2 for various Sports and Energy Systems
EXERCISE Mode Specificity

Exercise Mode Training consistent with the skill performed by the athlete to maximize performance and Energy Capabilities
MUSCLE Group Specificity

Training exercises specific to muscle groups and the movement patterns of those muscles used during the performance of specific athletic skills
<table>
<thead>
<tr>
<th>Training Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration Sprints</td>
<td>Interval Training</td>
</tr>
<tr>
<td>L-D running-Fast Pace</td>
<td>Jogging</td>
</tr>
<tr>
<td>L-D running-Slow Pace</td>
<td>Repetition Running</td>
</tr>
<tr>
<td>Hollow Sprints</td>
<td>Speed Play (fartlek)</td>
</tr>
<tr>
<td>Interval Sprinting</td>
<td>Sprint Training</td>
</tr>
</tbody>
</table>
HOLLOW SPRINTS:
Two sprints at a time with a period of jogging or walking between the sprints (Hollow Period)

- 85%-ATP-CP
- 10%-LA +O2
- 5%-O2
SPEED PLAY (FARTLEK)

An exercise program involving alternating fast & slow running over natural terrains.

This is the forerunner of Interval Training.
TRAINING METHODS

Acceleration Sprints

Bouts of running in which the running speed is gradually increased from jogging to stride to sprint
TRAINING METHODS

INTERVAL TRAINING

Repeated intervals of work interspersed with rest

- **Variations** in the % of development of each energy system (0-80% for each).

- **INTENSITY** most impt. Factor affecting VO2 max
TRAINING METHODS

INTERVAL TRAINING Guidelines

• Determine which energy system to Improve
• Select the type of exercise to be used during the work interval
• Use Tables 9.2 & 9.7 to write prescription according to energy system used
INTERVAL TRAINING Prescription

· **ITP** - the specification for the routines to be performed in an interval training workout

· **EX.** SET 1- 6 x 220 @ 0:28 (1:24)

· the # of reps X

· training distance of the work interval

· at a training time of 28 secs and a

· relief time of 1 min, 24 secs

· work-relief ratio???

· 28 sec/84 secs =
• **WORK Interval** - the work phase

• **RELIEF Interval** - the recovery time between work intervals in a set-
  
  – this may be light activity (walking) **REST-RELIEF** or mild to moderate exercise (jogging) **WORK-RELIEF**

  – **WORK-RELIEF RATIO**: time ratio of work/relief
    
    • ex. 1:2 > relief interval is twice as long as work interval

    • also called Work-to-Rest Ratio
INTERVAL TRAINING TERMS

Table 9.6

• SET: A grouping of work-relief intervals

• REPETITION - the # of work intervals/set
  - ex. 6 x 220 yards running including the relief intervals

• TRAINING TIME - The rate of work during the work cycle (220 yds in 25 secs)

• TRAINING DISTANCE - the distance of the work interval (220 yds)
• Work-out programs designed for different athletes using specific types of training methods (i.e. Interval, Hollow sprints)

• Variations should include movement patterns specific to sport

• Effects on Anaerobic system are small, but PERFORMANCE is improved
I. FREQUENCY/DURATION

How often - How Long?

II. INTENSITY

HEART RATE

REPETITION Method

RUNNING SPEED Method
I. FREQUENCY/DURATION

- **Endurance Sports:**
  - 4-5d/wk x 12-16 wks

- **Nonendurance:**
  - 3d/wk x 8-10 wks

  - **SPEED or SPRINTERS** *(Swimmer & Runner Sprinters are an EXCEPTION)*
    - 5-6d/wk x 12 months
    - Intensities vary from day to day
    - Given time for skill development
    - Relay starts, swim mechanics
Rx PLAN - II. INTENSITY

For INTERVAL TRAINING

Determine Intensity of the Work Interval by:

A. HEART RATE

M or F < 20 yrs- a HR of 180-190/m is sufficiently intense

B. REPETITION Method

Number of work intervals possible per WO

C. RUNNING SPEED Method

Calculate running speeds for diff. distances
A. Calculate the THR (Endurance)

THR: level sufficient enough to raise the HR to 80-85% of max HR

1. **KARVONON Method for THR**

   THR = 80% of HRR + HRrest

   - **Calculate HRR (Heart Rate Reserve)**
     subtract resting HR (HR rest) from HR max
     \[- \text{HR max (197) - (72) HR rest} = 125 \text{ (HRR)}\]

   - **Find 80% of HRR**
     \[
     0.80 \times 125 = 100
     \]

   - **Add HR rest:**
     \[
     100 + 72 = 172/\text{bpm} = \text{THR}
     \]
**Rx PLAN - II. INTENSITY - HEART RATE**

**A. Calculate the THR (Endurance)**

1. **KARVONON Method**

2. **ESTIMATE HR max and use as THR**

   If unable to measure a HR max during intense exercise-
   can calculate the HR:

   - 220 - Age = HR max
   - Use as the THR
TRAINING PROGRAM: I. WARM-UP

Preliminary Exercise prior to Training Session

- **Cardiac Output**, therefore more blood to areas of body involved in activity
- **Body & Muscle Temperature:**
  - the higher the Temp, the higher the $O_2$ consumption and HR
  - Amt of blood to muscles > Oxygen > metabolism of muscles > less LA

Number of Injuries
TRAINING PROGRAM: I. WARM-UP

• **ACTIVE**
  - Utilizing the specific skill training (FORMAL) or
  - Stretching and Calisthenics (INFORMAL)
  - Rec. 15-30 min of both before Training Session

• **PASSIVE**
  - Utilizing heat supplies prior to WO
    - Hot showers, Whirlpools
    - Probably as effective as Active
I. WARM-UP: STRETCHING

BEFORE and AFTER Training or Sport

20-30 minutes

Should Follow an easy 3-5 min. jog or movement

Include major muscle groups and joints

Final position > help relax muscles

Increases Temp and protects agst. possible tear
I. WARM-UP: Calisthenics

Performed after Stretching: 5-10 min.

Active - involve muscle contractions

Include Major Muscle groups involved in Sport
I. WARM-UP: Formal Activity

- Last phase of Warm-Up
- **Serves Two Purposes:**
  - Ensures Physiological factors are Optimal (blood flow & Temperature)
  - Warm-Up for Hand-Eye Coordiation or other Neuro-muscular Skills
WARM-DOWN

Follows Competition or Training Session

Reverse Order of Warm-Up:
Formal Activity --> Calisthenics --> Stretching
1. **Off-Season Training: Non-Specific**
   GOAL: Maintain body weight near “Playing Weight”
   Weight Training & Low-Intensity Endurance training 6-10 wks

2. **Pre-Season Training**
   Increase Max Energy System Capabilities
   Learning Strategies or Skills needed in Sport

3. **In-Season Training**
   Emphasize prep for next opponent
   Maintain energy Capabilities thru Drills, scrimmages, & competitions
   Conditioning/ Maintenance program:
   - High Intensity endurance (running) 1-2d/wk
   - weight training 1d/wk
   - Skills, competitions
### Effects of Endurance vs. Sprint Training

<table>
<thead>
<tr>
<th>Skeletal Muscle Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENDURANCE</strong></td>
</tr>
<tr>
<td><strong>INCREASED</strong></td>
</tr>
<tr>
<td>• <strong>Myoglobin</strong></td>
</tr>
<tr>
<td>• <strong>Aerobic System</strong> -CHO and fat utilization (Oxidation)</td>
</tr>
<tr>
<td>- Increased Glycogen stores</td>
</tr>
<tr>
<td>- Increased Triglyceride levels which increases Perform.</td>
</tr>
<tr>
<td>• <strong>Stores of Phosphagens</strong> (ATP+CP) after training</td>
</tr>
<tr>
<td>• <strong>SIZE of ST muscle fibers</strong> after training - no changes in number of fibers</td>
</tr>
<tr>
<td><strong>DECREASED</strong></td>
</tr>
<tr>
<td>• -<strong>Anaerobic Glycolysis</strong> (LA)-</td>
</tr>
<tr>
<td><strong>SPRINT</strong></td>
</tr>
<tr>
<td><strong>INCREASED</strong></td>
</tr>
<tr>
<td>• Myoglobin? same?????</td>
</tr>
<tr>
<td>• <strong>ATP-CP enzyme activity</strong> &amp; total Concentration but total Phosphagen stores unchanged</td>
</tr>
<tr>
<td>• <strong>Size of FT &amp; ST fibers</strong> - no changes in number of fibers</td>
</tr>
<tr>
<td>• <strong>Aerobic &amp; Anaerobic</strong> - small increase in aerobic enzyme activity, $VO_2\text{max}$, &amp; Glycolytic Enzymes - not significant - surprising since LA system used in sprint training</td>
</tr>
</tbody>
</table>
Effects of Endurance & Sprint Training

Cardio-Respiratory Effects

Increased
- Stroke Volume-
- Total blood volume - but no rise in HBG volume
- Hemoglobin content
- Lung Volumes
- Anaerobic Threshold during submaximal exercise
- $O_2$ Consumption, Transport, Extraction of $O_2$ by muscles
- Cardiac Hypertrophy
  Size in Endurance-
  Size & Thickness in Sprint

Decreased
- Heart Rate
  BRADYCARDIA
- BP in older Athletes
- Minute Ventilation
- Glycogen stores used by Muscles
- LA build-up since Oxygen capability improved using Aerobic metabolism

$O_2$ Transport during Exercise
LACTIC ACID Levels are lower in Endurance trained athletes vs Sprint-trained
The objective is to train at the speed at which the lactate threshold occurs.

The Lactate Threshold increases with training.

The **SPEED** at which you should train should increase as you improve.
FACTORS Influencing the Effects of Training

• **Intensity, Frequency & Duration**
  – Increased benefits in performance
  – EXCEPT in VO₂ max-(no diff in freq on this)
    • ex. 2d/wk x 7 weeks = 4d/wk x 13 weeks

• **Genetic Influences**
  – Capacity of VO₂ max is 95% inherited
  – Capacity of LA system is 81% inherited

• **Sex & Age Differences**
  – Probably no differences in response to the same stress except muscular hypertrophy
Training and Female Issues

- Mild Exercise - No Effect on Menstruation
- Heavy Exercise - Amenorrhea (No menses)
- Dysmenorrhea - (Painful Periods) may interfere - usually gets better
- Iron Deficiency might become a problem in females with heavy menstruation which would lead to a decrease in the oxygen binding capacity
- Complications of Pregnancy & Childbirth lower in trained female athletes
- Performance returns to or is > Pre-pregnancy levels
SPEED is a function of Stride LENGTH & FREQUENCY or Rate of Leg Movement

Speeds INCREASE from Supplements such as:
- PLYOMETRICS
- Downhill/ Uphill Running
- Treadmill Pacing

These Programs help the Runner to:
- Take a Longer Stride
- Lift Knees Higher
- Develop greater Strength in Legs
- Increase the Rate of Leg Movement
PLYOMETRICS  STRENGTH & SPEED

• speed + strength = POWER

• Method of training for **Power or Explosiveness** Exercises involve powerful muscular contractions

• Rapid **Eccentric Contractions**(STRETCH-LENGTHEN)-then immediate **Concentric Contraction**-(CONTRACT-SHORTEN) ex. Push-ups/Clap

• The **maximum force** that a muscle can develop is **attained** during a rapid eccentric contraction
• Specificity to Muscle groups & movement used in Sport

- Volleyball player interested in increasing jump height, then
  - drop jumping or box jumping.

» Football?? Baseball??

• The stored energy during the stretch cycle is available to the muscle only during a subsequent contraction.

• This energy boost is lost if the eccentric contraction is not followed immediately by a concentric effort.

• The muscle must contract within the shortest time possible. This whole process is frequently called the stretch-shortening cycle.
• The choice of exercises within a session and their order should be planned. A session could:

  • begin with exercises that are fast, explosive and designed for developing elastic strength (low hurdle jumps; low drop jumps)

  • work through exercises that develop concentric strength (standing long jump; high hurdle jumps)

  • finish with training for eccentric strength (higher drop jumps).
**Altitude Training**

**THEORY** that: helps **Endurance Training**

Altitude Training Stresses the general Physiological functions to the Max at lower workloads without causing undue stress on local, Injured tissues and Muscles

*In Other Words*—*If you work your body in conditions that make it more difficult to gain* \( VO_{2max} \) *once acclimatization occurs, you will improve this* \( VO_{2max} \) *—thus increase max workload so at sea level workload is easier!*

Research evidence ??? Too many conflicts??

**DISADVANTAGE**—Demanding endurance programs probably can not be sustained at sea level??
TRAINING METHODS

Reaching your Goal:

THE END