

# **Sprint & Endurance Training: Methods and Effects (chpt.9)**

## **OBJECTIVE:**

**To Develop Programs that will develop  
the energy capabilities and skills of the  
athlete**



# Specificity of Training

**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)

# METABOLIC Specificity

**! 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; grteatest Amt.
  - lower power output of longer duration

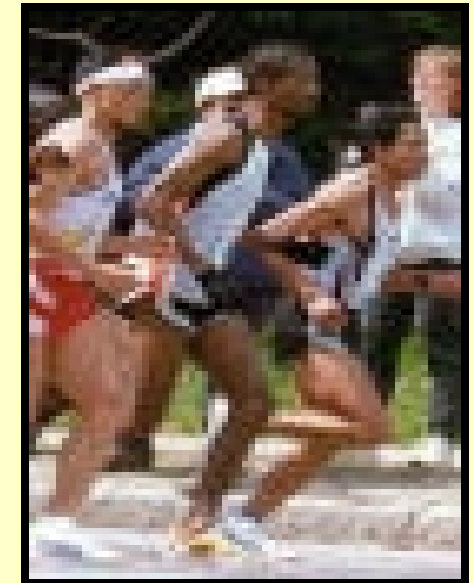
# **METABOLIC Specificity Training Program**



**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

# TRAINING METHODS

## !!!! TABLE 9.3 !!!!

**Acceleration Sprints**

**Interval Training**

**L-D running-  
Fast Pace**

**Jogging**

**L-D running-  
Slow Pace**

**Repetition Running**

**Hollow Sprints**

**Speed Play (fartlek)**

**Interval Sprinting**

**Sprint Training**

# TRAINING METHODS

## **HOLLOW SPRINTS:**

**Two sprints at a time with a period of jogging or walking between the sprints**

**(Hollow Period)**

- » **85%-ATP-CP**
- » **10%-LA +O<sub>2</sub>**
- » **5%-O<sub>2</sub>**



# TRAINING METHODS

## SPEED PLAY (FARTLEK)

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

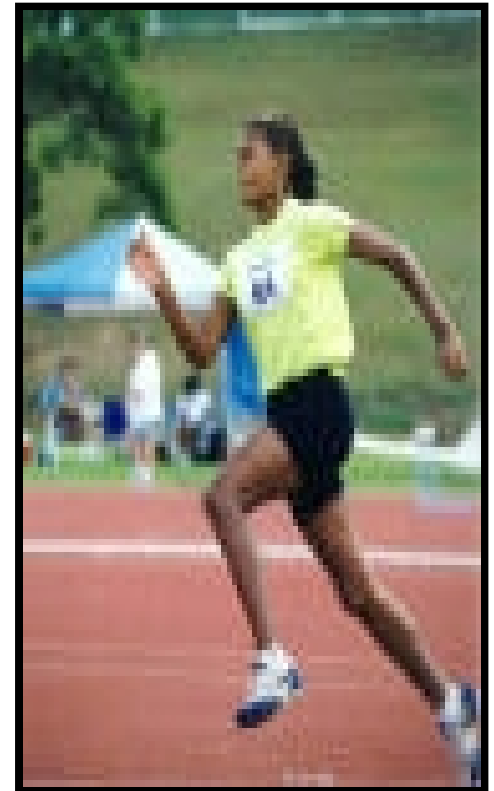


*This is the forerunner of Interval Training*

# 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 VO<sub>2</sub> max



# TRAINING METHODS

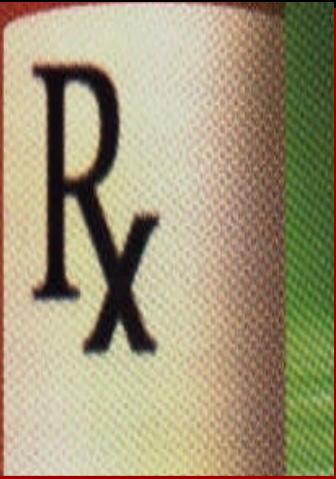
## INTERVAL TRAINING Guidelines

- 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 =**



# INTERVAL TRAINING TERMS

## Table 9.6

- **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)*



# TRAINING METHODS: Prescription Plans



- 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

# **TRAINING METHODS:**

## **Prescription Plans**

### **I. FREQUENCY/DURATION**

**How often- How Long?**

### **II. INTENSITY**

**HEART RATE**

**REPETITION Method**

**RUNNING SPEED Method**

# Rx PLAN- I. FREQUENCY & DURATION



## 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**

# Rx PLAN- II. INTENSITY- HEART RATE



## 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**

- $220 - \text{Age} = \text{HR max}$**
- 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<sub>2</sub> 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 Coordination or other Neuro-muscular Skills**

# WARM-DOWN

**Follows Competition or Training Session**

**Reverse Order of Warm-Up:**

**Formal Activity--->Calisthenics--->Stretching**



# Year Round Training

## The Training Phases

### **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

## ENDURANCE

## SPRINT

### Skeletal Muscle Changes

#### INCREASED

- Myoglobin
- Aerobic System -CHO and fat utilization(Oxidation)
  - Increased Glycogen stores
  - Increased Triglyc levels which increases Perform.
- Stores of Phosphagens (ATP+CP) after training
- SIZE of ST muscle fibers after training- no changes in number of fibers

#### DECREASED

- -Anaerobic Glycolysis (LA)-

#### INCREASED

- Myoglobin? same?????
- ATP-CP enzyme activity & total Concentration but total Phosphagen stores unchanged
- Size of FT & ST fibers- no changes in number of fibers
- Aerobic & Anaerobic -small increase in aerobic enzyme activity,  $VO_2$  max, & Glycolytic Enzymes-not significant -surprising since LA system used in sprint training

# Effects of Endurance & Sprint Training

## Cardio- Respiratory Effects & Changes in <sup>2</sup> O<sub>2</sub> Transport during Exercise

### Increased

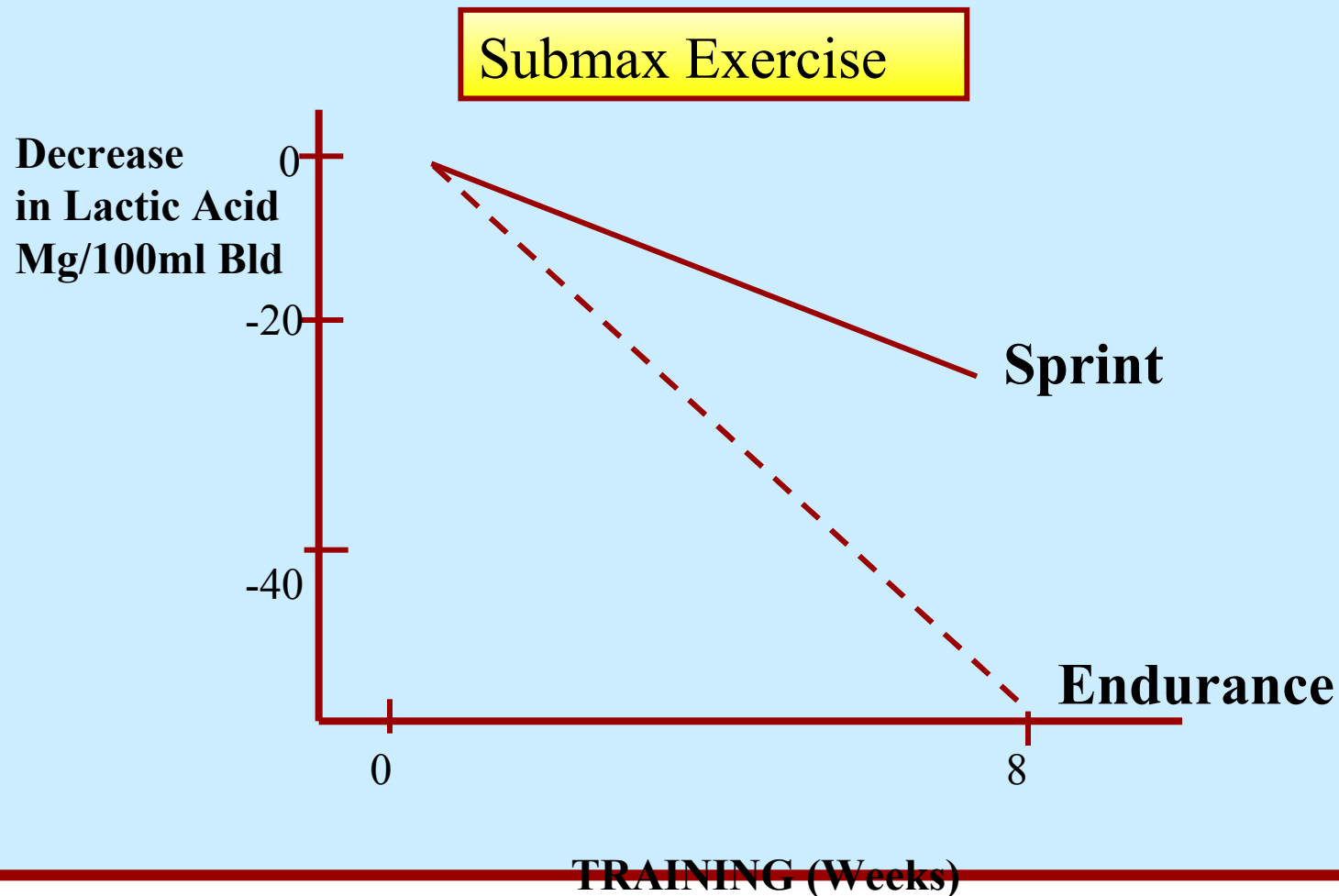
- Stroke Volume-
- Total blood volume- but no rise in HBG volume
- Hemoglobin content
- Lung Volumes
- Anaerobic Threshold during submaximal exercise
- O<sub>2</sub> Consumption, Transport, Extraction of O<sub>2</sub> by muscles
- Cardiac Hypertrophy  
Size in Endurance-  
Size & Thickness in Sprint

### 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

# Effects of Endurance vs. Sprint Training

**LACTIC ACID Levels are lower in  
Endurance trained athletes vs Sprint-trained**



# Lactate versus Intensity graph





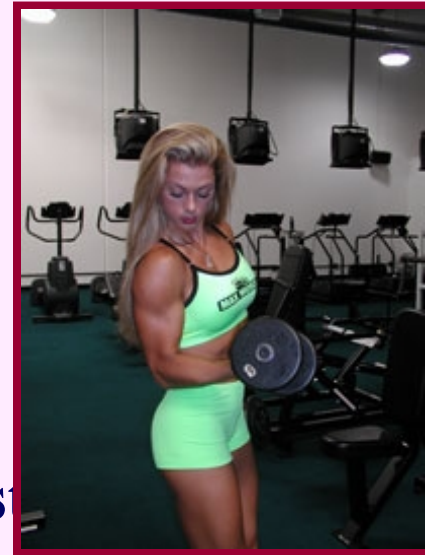
The objective is to train at the speed at which the lactate threshold occurs

**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 VO<sub>2</sub> max-(no diff in freq on this)
    - ex. 2d/wk x 7 weeks = 4d/wk x 13 weeks
- **Genetic Influences** 
  - Capacity of VO<sub>2</sub> max is 95% inherited
  - Capacity of LA system is 81% inherited
- **Sex & Age Differences** 
  - Probably no differences in response to the same stimulus 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**

# TRAINING SUPPLEMENTS

**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**

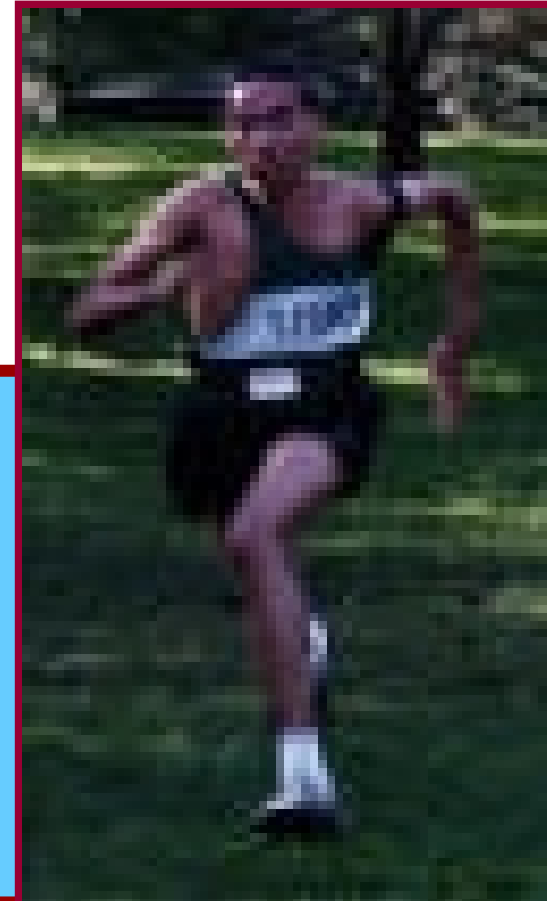
**These Programs help the Runner to:**

Take a Longer Stride

Lift Knees Higher

Develop greater Strength in Legs

Increase the Rate of Leg Movement



# PLYOMETRICS

# STRENGTH & SPEED

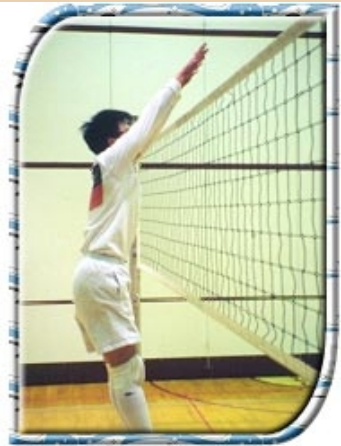


- speed + strength = POWER
- Method of training for Power or Explosiveness Exercises involve powerful muscular contractions
- Rapid Eccentric Contractions(STRETCH-LENGTHEN)-then immediate Concentric Contraction-(CONTRACT-SHORTEN)  
ex. Push-ups/Clap
- The maximum force that a muscle can develop is attained during a rapid eccentric contraction

# PLYOMETRICS

# STRENGTH & SPEED

- **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**

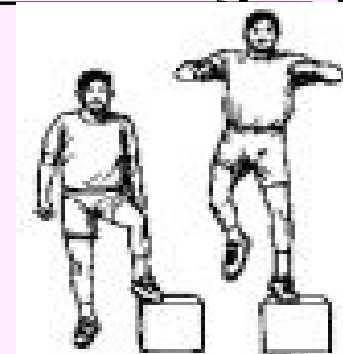
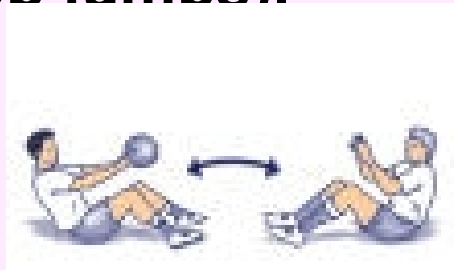
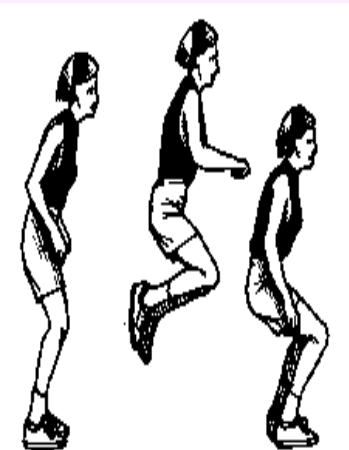
# PLYOMETRICS

# STRENGTH & SPEED

- 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  $VO_2$  max, once acclimzation occurs, you will improve this  $VO_2$  max --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**

