**Interval Training**

More work can be performed at higher exercise intensities with same or less fatigue than in continuous training.

Baechle and Earle, Essentials of Strength Training and Conditioning (p 87)

**Understand Energy Systems to Develop Training Specificity**

- **Immediate** – ATP-PC (Phosphagens)
- **Short-term** – Lactic Acid – Glycolysis
- **Long Term** – Oxidative - Aerobic

**ATP-PC System**

- ≤ 10 seconds
- 30 seconds – 50% ATP-PC/LA
- Intensity – maximal or near maximal
- Active at start of all exercise (regardless of intensity)
- Fast twitch fiber have highest concentration of phosphagens

\[ \text{ATP} \rightarrow \text{ADP} + P_I + \text{Energy} \]
\[ \text{ADP} + \text{CP} \rightarrow \text{ATP} + \text{Creatine} \]

- Stored Energy
- Endpoint – depletion of muscular stores

**ATP/PC**

- Recovery – resynthesis of ATP 3-5 min and CP within 8 min
  - 50-70% resynthesis in 30 sec
  - 100% 3-5 min
- Types of Events
  - 100 m sprint
  - Diving
  - Weight lifting
  - Gymnastics
  - Jumping and throwing in track and field
  - Golf

**ATP/PC**

- Best recovery – minimal activity
  - Why?????
- Work:rest ratio 1:3
- Increasing ATP/PC Stores
  - Sprint Training – related to increased muscle mass
  - Resistance Training
  - Creatine Supplementation
**Lactic Acid/Aerobic Glycolysis**
- 30-180 seconds
- Intensity - 90-100% HRR
- Breakdown of CHO (Fast Glycolysis) to resynthesize ATP
- CHO → pyruvate → lactic acid → lactate
- When energy demands of cell are high pyruvate converted to lactic acid
- Endpoint – muscle fatigue – not directly caused by lactic acid

**Lactic Acid/Aerobic Glycolysis**
- Recovery - Decrease energy demands and lactic acid concentration of muscle, incomplete recovery increases lactic acid tolerance
  - ½ LA removed in 15-25 min
  - All LA removed in 60 min
- Recovery – light exercise to decrease ATP resynthesis and increase lactic acid removal
- Work:rest ratio – 1:2
  - Incomplete recovery increases tolerance to LA and trains body to use more LA for fuel

**Changes in LT with Training**

**Lactic Acid/Aerobic Glycolysis**
- Types of activities
  - 100 m swimming
  - 800 m track
  - 500 m canoeing
  - 1,000 m speed skating
  - 1,000 m cycling

**Aerobic/Oxidative System**
- > 180 seconds
- ATP resynthesis through breakdown of CHO via slow glycolysis and fats
- Amino acids not used unless high intensity exercise > 90 min
- Endpoint – lack of availability of glucose and glycogen
- Peripheral changes are important – increase in mitochondria number and activity of mitochondrial enzymes

**Aerobic/Oxidative System**
- Type of recovery
- Work:rest 1:1/2
- Recovery: light activity
- Types of activities
  - ≥5 Km run
  - Triathlon
  - 1500 m swim
Why interval training?

- Teaches pace
- Train specific energy system – specificity
- Practice skill
- Perform more work – more total exercise at a higher intensity than with longer duration training – reduce risk of injury
- **Do not train like you race!!!!!!!!!!!!!**

Elements of an Interval

- **Work Interval (distance)**
- **Sets**
- **Repetitions**
- **Target distance**
- **Target time**
- **Rest Period**
- **Recovery time**
- 2 sets 10 reps X 400 m in 1:00 with 2:00 active recovery
- Energy system stressed depends on length of time of work interval and rest interval

Types of Training

- **Intervals for ATP-PC System (Sprint)**
  - 0-30 seconds
  - 95-100% effort
  - HR not a good indicator of intensity
  - Little slower than best time
  - 1-3 days/week
  - 1:3 work/rest ratio
  - Recovery – rest (resynthesize ATP)
**ATP-PC System (Sprint)**
- Note rest interval can affect physiological response
- Shorter rest interval (1min) vs longer (4-5 min) results in an increase in VO₂max
- Aerobic capacity important in athletes who do repeated sprints
- Shorter rest periods require you to decrease intensity of sprint slightly
- Distances short – same or less than competitive distance
- Drills/strength important for optimal performance

**Example**
- 100 m Sprint Competition
- Each repetition run is 3 sec slower than best time
  - 12 sec best time – 15 sec training time
  - Effort – near maximal (RPE 9)
  - Repetitions – 4-8
  - Rest – 1:3 – 54 seconds (longer if power goal only)
  - Recovery – rest – stretching or walking
  - 2-3 Sets (3-5 min between)

**Lactic Acid System**
- 30-180 sec Intervals
- 90-100% HRR
  - 1-4 sec faster than average 400 m during a 1500-1600 m race
- 1:2 work:rest ratio
- Recovery – light aerobic exercise speeds removal of lactic acid
- Recovery - incomplete keeps lactic acid levels up and prevents good recovery of ATP-PC system

**Example**
- 1600 m Competition Distance
- Interval 400 m
- Best Time 5:16, run interval 1-4 sec faster than average 400 m during 1500 m race
- Training Time: 1:20 per 400 m interval
- 5 repetitions
- Work:rest ratio – 1:2 – 2:40 between sets
- Recovery – Active – light aerobic exercise (jog or walk)

**Lactate Threshold Runs (Tempo and Cruise Intervals)**
- ≥ 5K distances
- Note – lower intensity than lactic acid intervals training
- Goal – gradually raise lactate threshold
- Not need a track
- Intensity – HR at LT + 10 bpm (not more) – not as intense as lactic acid intervals – 25-30 sec/mile slower than 5K pace – comfortably hard
- 2 types – continuous (tempo runs) and intermittent (cruise intervals)
**Example - Cruise Intervals**
- Athletes – 70-85% HRR at LT to plus 10 bpm
- Same pace as tempo runs – 7:40/mile
- 3-10 min duration
- Rest – 1 min easy jog or walk
- Easier than tempo runs for first time intervals for fitness or weight loss
- Do about anywhere can keep terrain consistent or on treadmill
- Gradually increase duration of cruise interval until can run 20 min at LT

**To improve LT, which is better?**
**LA intervals or Cruise Intervals?**
- LT intervals – best for <5-10K
- Takes ½ time with LT intervals to get same benefit
- Intensity of Cruise intervals and tempo runs is better for less fit and those with no prior interval training experience, injury prone, & overtraining prone

**Improve VO₂max**
- Repeated bouts of reaching and sustaining VO₂max
- Train at VO₂max at a greater time than could sustain in a single run
- Not exceed 15-20 min of actual interval time (not counting rest)
- 3 – 5 min (1/2 – 1 mile) – only a portion of event
- Intensity – 1-4 sec slower than average 400 m during 1600 m race or 5K race pace or slightly slower
- Increase distance, slow pace slightly
- Work:rest ratio - 1:1/2

**Options**
- 5K 45 minutes 7:15/mile – 7:15 pace
- Straight sets - 12 X 800 m at 3:36 with 1:48 active recovery
- 3 sets of 3 X 800 m at at 3:36 with 1:48 active recovery with 3-5 min between sets
- Try both

**Rule of thumb**
- Beginner – 1 day of intervals/week (no lactic acid or VO₂max intervals – intensity is too high) – usually lactate threshold intervals (cruise/tempo) are best
- Recreational runner who wants to get faster – a long run (>6 mi), an interval or LT day and an easy day
- Athlete – depends on sport, age, weekly mileage
- Interval training workouts should not exceed 8% of current weekly mileage

**Long Steady (Slow) Distance (LSD)**
- Continuous Exercise at conversational pace
- 60-120 minutes (30 min for recovery purposes – easy day)
- < Lactate Threshold – 20-30 sec below LT
- Physiological Benefits -
  - Skeletal muscle endurance - 65-70% HRR in most athletes
  - More mitochondria, increased activity of mitochondrial enzymes, less tissue damage
- Distance Runners > 5K – one long run/week (several miles longer than race distance – exception – marathon training)
Other Training
- Repetition Training or Drills
  Improve speed, form, and running economy
  30-90 seconds
  Work:rest ratio – 1:5
  <5% of weekly mileage
  Downhill running
  Uphill running
 Bounding
- Short Intense Bouts (near max) followed by Full Recovery

Interval Rules
- Perform the same workout multiple times before making it more difficult
- Shorten recovery interval before decreasing pace (increasing intensity)
- Intervals (not counting WU and CD) -not >8% weekly mileage
- Not increase total weekly mileage >10%/wk
- Hard/easy days
- If athlete continually gets slower, terminate interval workout.

Steps for Interval Training Workouts
- What energy system to train?
- What is intensity based on HR data or race pace (best)?
- What is distance or time of interval?
- What is work:rest ratio?
- What is type of recovery? Rest or active