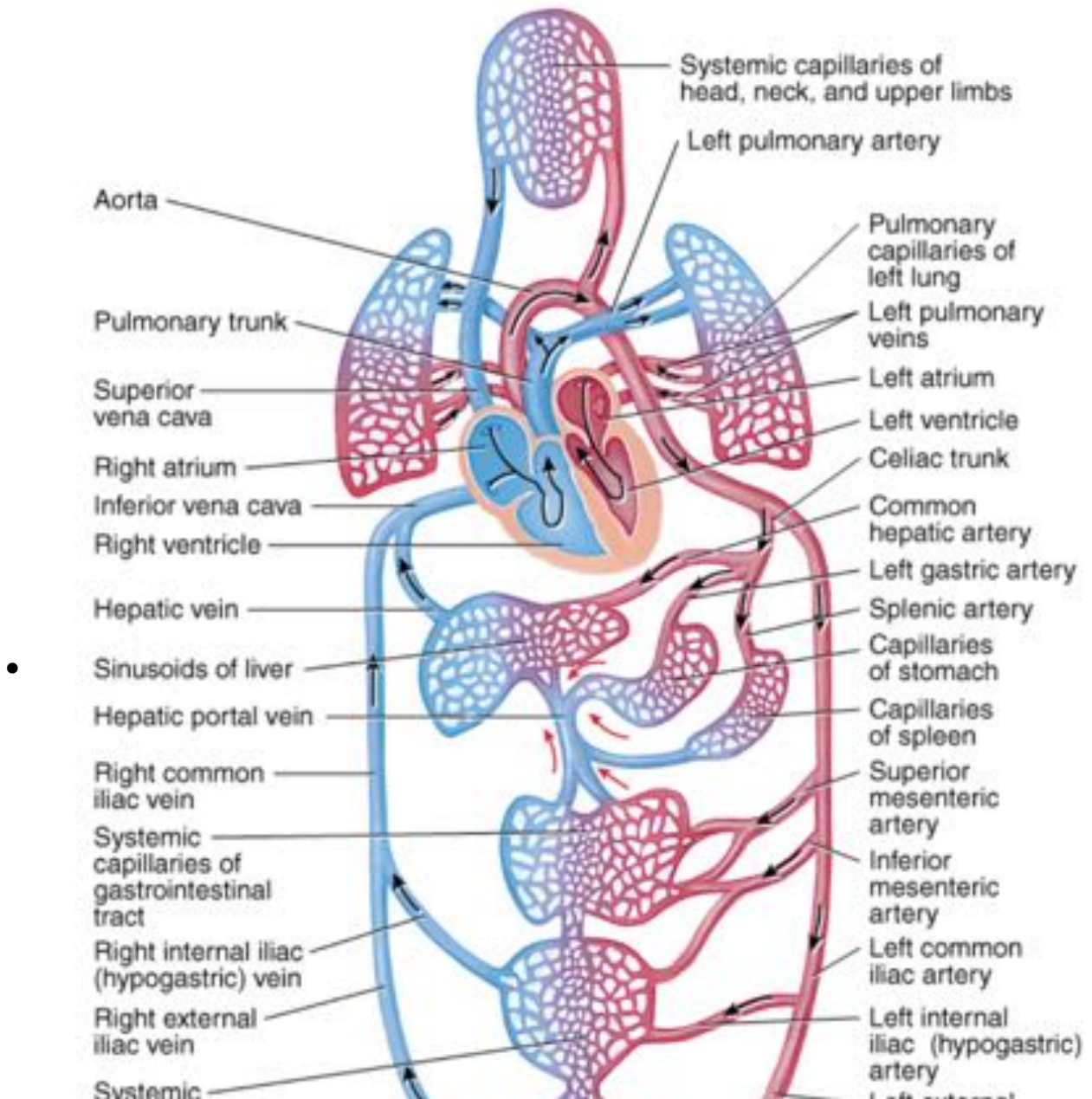
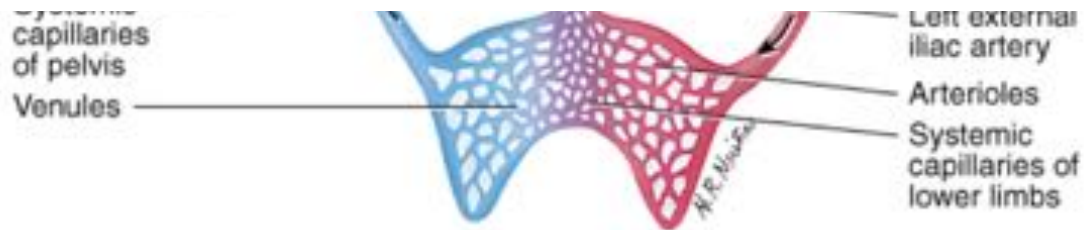


Cardiorespiratory System

Monday, 18 May 2015 12:00 pm

- Gas exchange at the lungs
- Delivery of gases and nutrients to tissues
- Removal of wastes
- Regulation
- Pulmonary ventilation
- Pulmonary diffusion
- Transport
- Capillary gas exchange



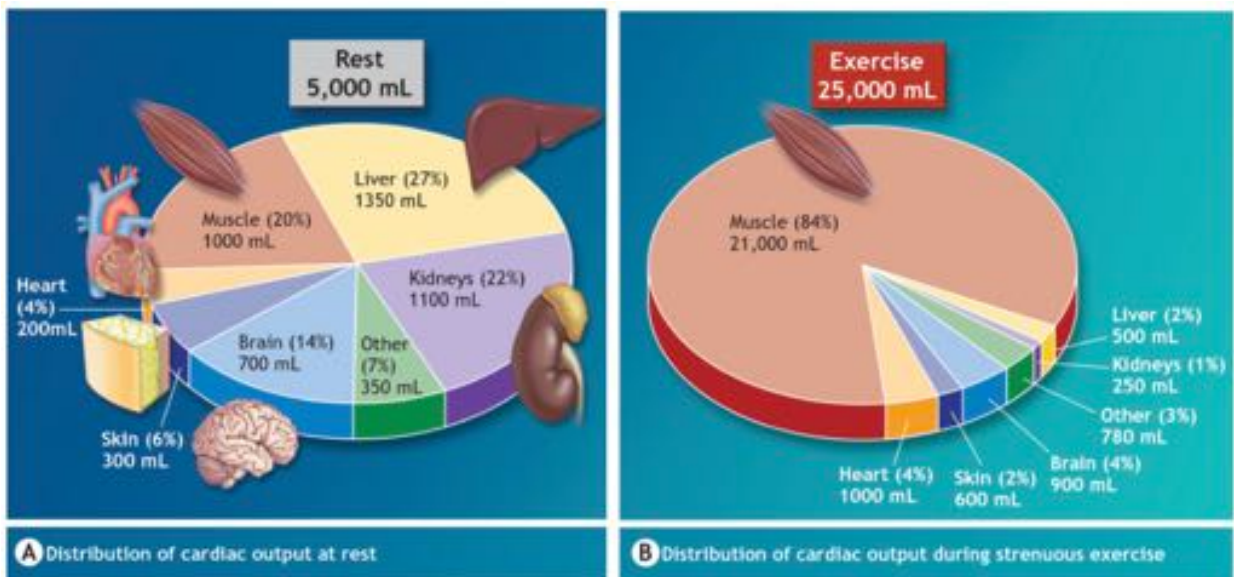


Cardiovascular Response to Exercise

- Heart rate (HR), stroke volume (SV), and cardiac output (Q) increase
- Blood flow and blood pressure change
- All result in allowing the body to meet the increased demands placed on it efficiently
- As result of endurance training, stroke volume increases

	Resting			Maximal		
	Cardiac Output (L/min)	Stroke Volume (mL)	Heart Rate (bpm)	Cardiac Output (L/min)	Stroke Volume (mL)	Heart Rate (bpm)
Sedentary	5-6	68	74	20	100	200
Trained	5-6	90	56	30	150	200
Highly trained	5-6	110	45	35	175	200

Change to blood volume and distribution during exercise



- Body only has 5L of blood in a 25L system
- This is because if it was any greater, the heart would have to work very hard and blood pressure would be very high

Cardiorespiratory Fitness

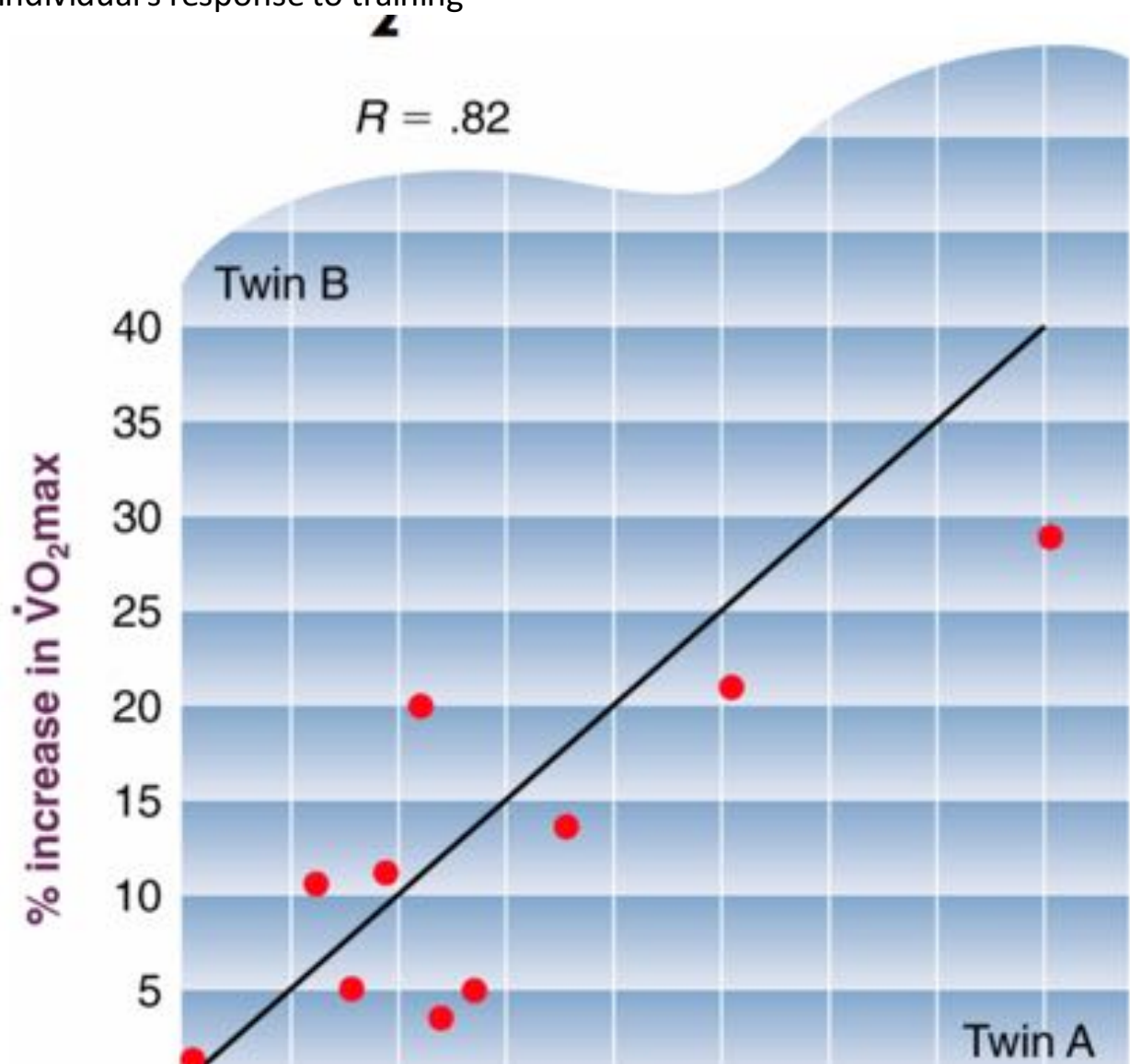
- Ability to continue strenuous exercise requiring large muscle groups for a prolonged amount of time
- Improved ability of the heart to deliver oxygen to the muscles and an improved ability of the muscle to generate energy with oxygen

Maximal Oxygen Uptake (VO₂max)

- Upper limit of a person's ability to increase oxygen uptake
- Good indicator of cardiorespiratory endurance and aerobic fitness
- Can differ according to sex, body size, age and to some degree according to level of training
- Expressed relative to body weight in ml of O₂ consumed per kg body weight per min (ml.kg⁻¹.min⁻¹)
- Typically begins at a low intensity and increases in stages. Generally stages are around 2-3 minutes in length, allowing them to reach steady state each time

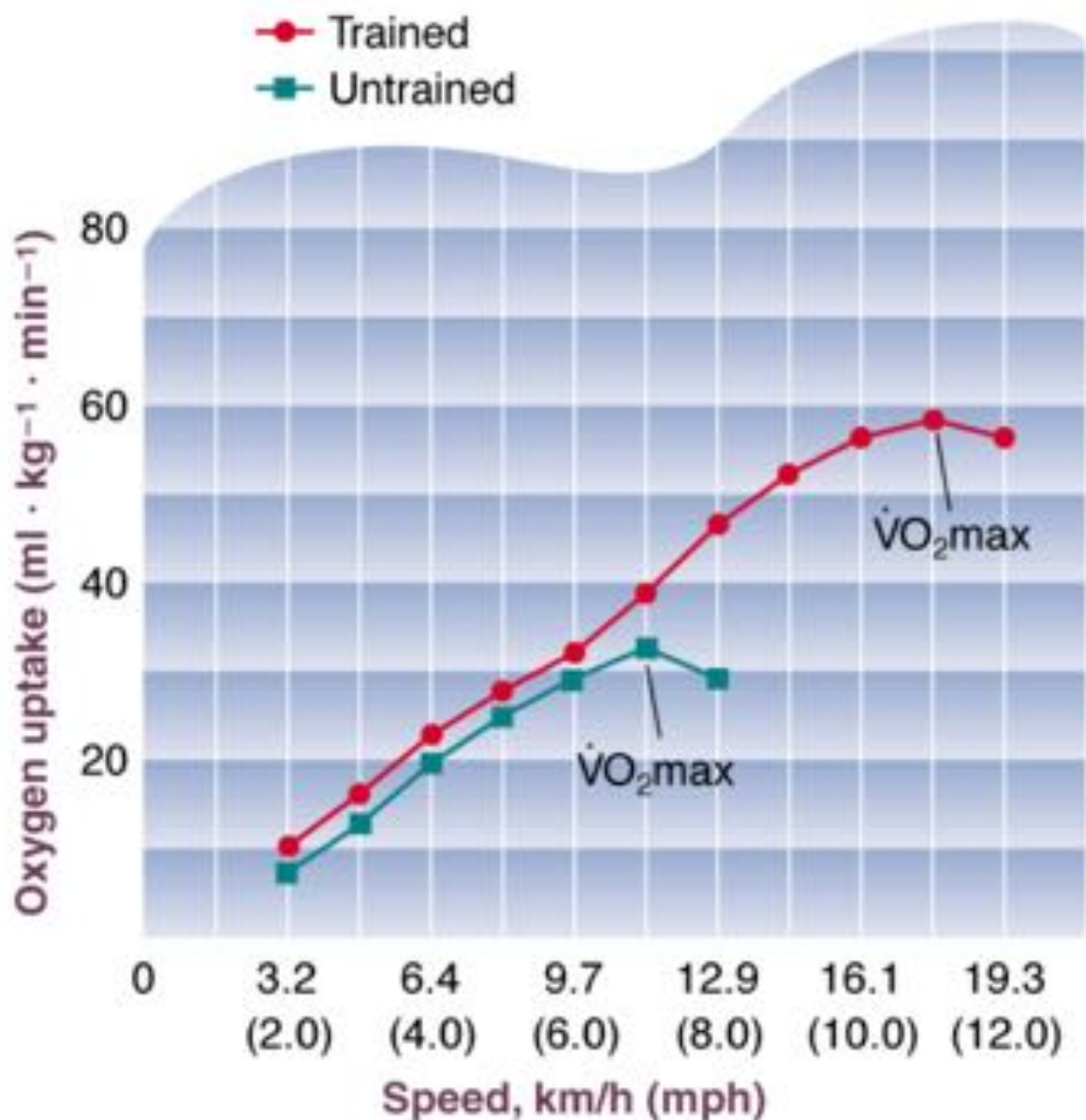
Factors affecting VO₂max

- Level of conditioning - max is reached within 8 to 18 months of heavy endurance training
- Heredity - accounts for as much as half the variation in VO₂max as well as an individual's response to training

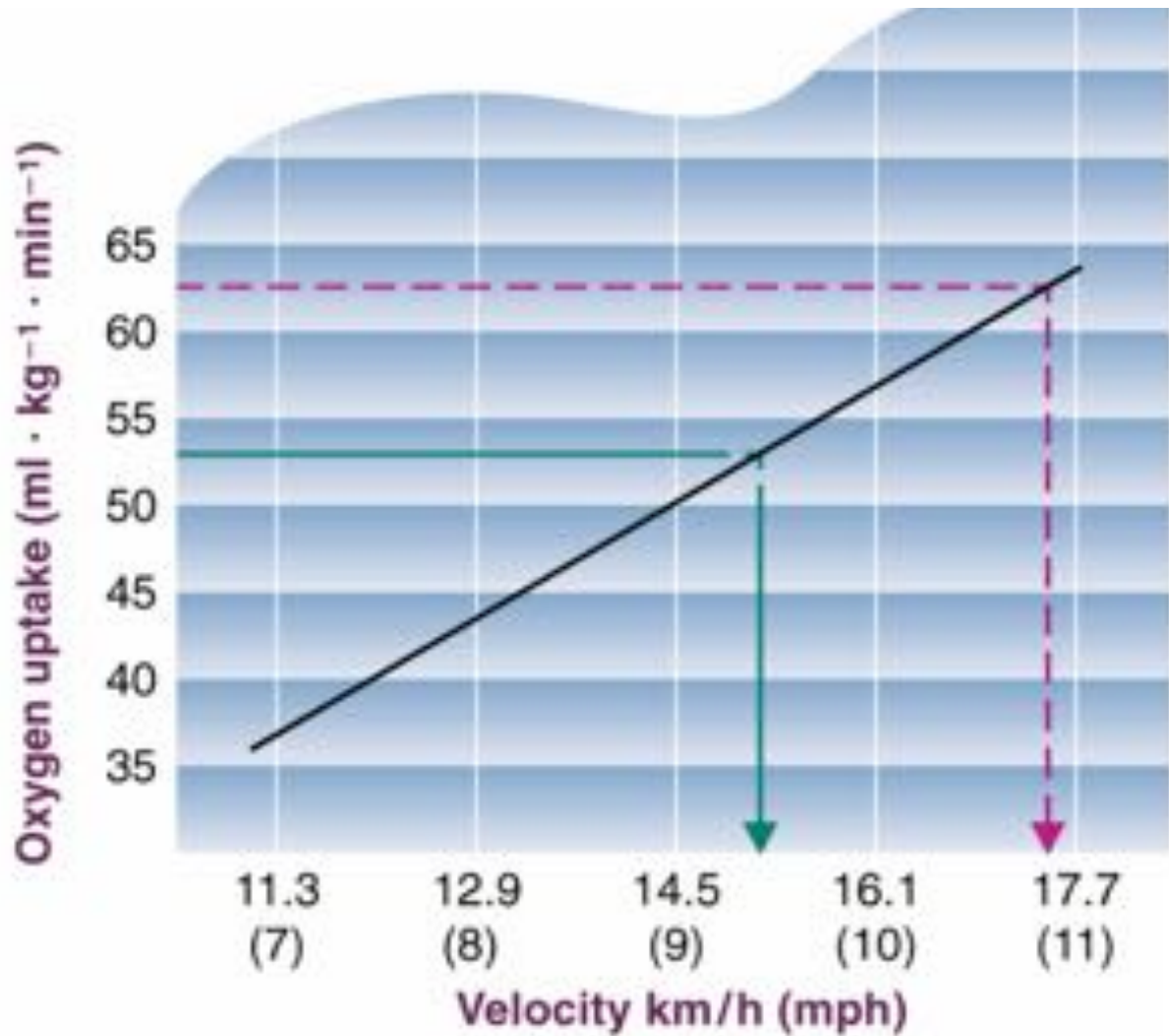


5 10 15 20 25 30 35 40
% increase in $\dot{V}O_2\text{max}$

- Age - decreases in $\dot{V}O_2\text{max}$ with age might be a result of age-related decreases in activity levels
- Gender - lower in women than men (20% to 25% lower in untrained women; 10% lower in highly trained women)
- Specificity of training - the closer training is to the sport to be performed, the greater the improvement and performance in that sport



--- 88% $\dot{V}O_2\text{max}$ = 62.5 ml · kg⁻¹ · min⁻¹
 — 75% $\dot{V}O_2\text{max}$ = 53.3 ml · kg⁻¹ · min⁻¹



Exercise Prescription

- Mode
- Intensity
- Duration
- Frequency

Mode

- Repetitive actions of large muscle groups
- Enjoyment
- Availability
- Variety
- Specificity
- Injury Risk

Intensity

- Methods of measuring intensity
 - % VO₂max
 - Heart rate or % heart rate reserve

- Heart rate or heart rate reserve
- Rating of perceived exertion (RPE)
- MET

VO₂max Intensity

- Training threshold approx. 50% VO₂max
- Recommended training zone 50-85% VO₂max

Heart Rate

- Heart rate related to VO₂ during exercise
- $Hr_{max} = 220 - \text{age}$ or $207 - (0.7 \times \text{age})$
- Heart rate reserve = $Hr_{max} - Hr_{resting}$
- Heart rate reserve more closely related to VO₂

Rating of perceived exertion

- Scale of overall exertion
- 6-20
- No exertion - maximal exertion
- Useful if other monitoring tools are not available
- RPE x 10 roughly translates to HR

Scale	Verbal Rating
6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	

19
20

Very, very hard

Metabolic Equivalents (MET)

- 1 MET is equivalent to the amount of energy expended at rest. Therefore, if an activity has a MET level of 5, the energy expended during that activity is equal to 5 times the amount of energy expended during rest
- MET Hours or MET minutes often used as a unit of measurement of the amount of physical activity

Intensity for health Benefits

- 30-60% Heart rate reserve (HRR)
- Health benefits can be achieved at light-moderate exercise intensities
- Energy expenditure important

Intensity for Fitness

- Dependant on age, health status and initial fitness level
- 60-85% heart rate reserve
- Balance between optimal training gains and minimal risk of injury



Frequency

- Health benefits - most days of the week
- Fitness benefits - 3-5 days/wk
- Performance 5+ days/wk

Duration

Duration

- Health benefits - accumulate 30 mins/day
- Fitness benefits - 20-60 mins
- Performance benefits - 60+ mins depending on intensity
- Inverse relationship with frequency, if one is high, the other will be low

Continuous Training

- Typically for training in lower intensity zones
- Often performed for a longer period than encountered during an event (progressive overload)
- Good for those just starting exercise or those at risk from high intensity activities

Interval Training

- Periods of high intensity exercise with periods of low intensity recovery
- Used primarily for higher intensity training
- Interval duration and work: rest ratio dependant on specific needs
- Allows exercise to be performed above 'race pace' (progressive overload)
- Best improvements in cardiorespiratory fitness

Fartlek Training

- Very effective at increasing VO₂max
- Imprecise method of interval training
- Individual adjusts intensity as an when they wish
- Best performed outdoors with natural hills and obstacles
- Enjoyable and motivating