

Assessing Health & Functional Fitness

Lecture 5 – Cardiovascular Health



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Cardiovascular Exercise

		EXERCISE ZONES									
		AGE									
BEATS PER MINUTE	100%	20	25	30	35	40	45	50	55	65	70
		200	195	190	185	180	175	170	165	155	150
		VO ₂ Max (Maximum effort)									
	90%	180	176	171	167	162	158	153	149	140	135
		Anaerobic (Hardcore training)									
	80%	160	156	152	148	144	140	136	132	124	126
		Aerobix (Cardio training / Endurance)									
	70%	140	137	133	130	126	123	119	116	109	105
		Weight control (Fitness / Fat burn)									
	60%	120	117	114	111	108	105	102	99	93	90
		Moderate activity (Maintenance / Warm up)									
	50%	100	98	95	93	90	88	85	83	78	75



Cardiovascular Fitness

The ability of heart, lungs and blood vessels to supply oxygen and nutrients to the working muscles and remove metabolic by-products.



Factors that it may be useful to measure

- Heart Rate - beats per min (bpm)
- Blood Pressure – mm mercury (mmHg)
- Oxygen Uptake – VO_2max (ml/kg/min)

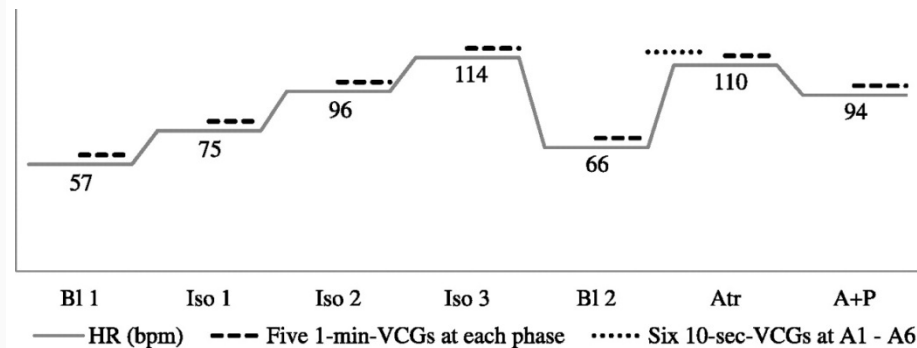
Heart Rate

- Number of beats per minute the heart beats in response to physiological demand.
- Linear then curvilinear response to exercise intensity

Heart Rate (bpm)

Average
151

Maximum
161

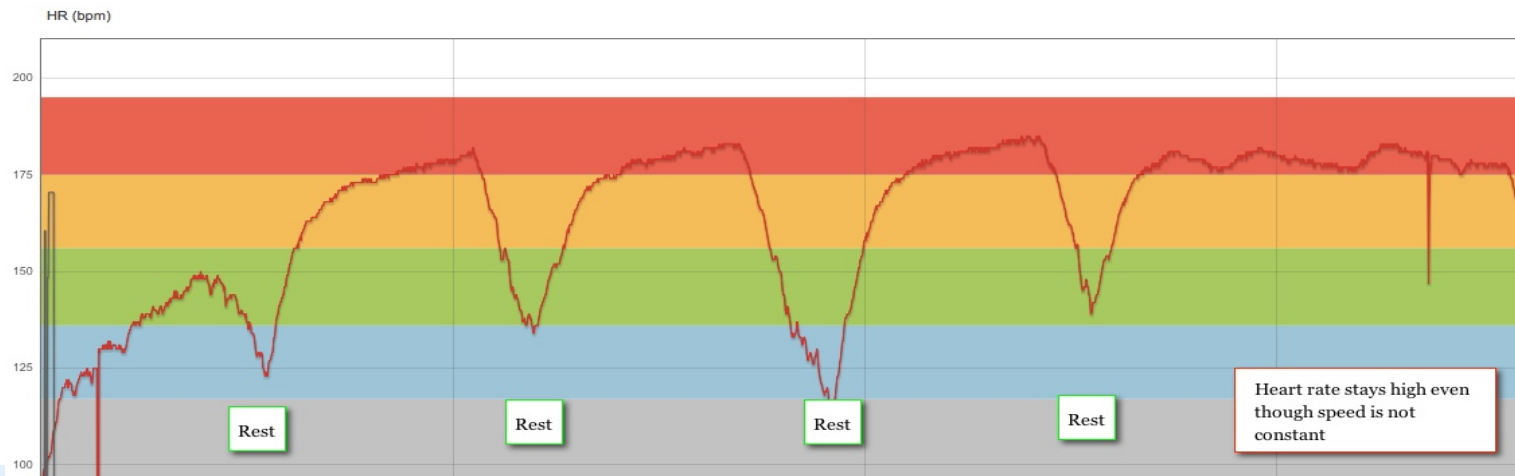


Determining Heart Rate

- Resting
 - Sit quietly for 2 minutes
- Maximal
 - $220 - \text{age}$
 - $210 - 65\% \text{age}$
 - Maximal exercise test (step wise)
- Aerobic training
 - Between 65% and 90% max heart rate

Using Heart Rate for Training

Heart Rate Zone	Description
Zone 1 BLUE Zone (Aerobic)	<u>Active Recovery</u> This is a low-intensity heart rate exercise zone used to establish a strong cardiovascular "base" or foundation. Exercising in the BLUE Zone promotes increased oxygen absorption, fat-burning capacity, and energy-making capacity. Generally, exercising in this zone is used for what is known as "active recovery" following intense exercise in other, more intense heart rate zones.
Zone 2 GREEN Zone (Aerobic)	<u>Endurance</u> This is a moderate-intensity heart rate exercise zone used to improve overall conditioning and endurance. A good portion of your cardio/aerobic exercise time will be spent in this zone, at least initially. Exercising in the GREEN Zone is also good for efficient calorie burning, particularly after you perform your strength training.
Zone 3 YELLOW Zone (Aerobic+Anaerobic)	<u>Lactic Acid Tolerance/Strengthening</u> This is a higher-intensity heart rate exercise zone designed to improve your aerobic conditioning while introducing a slightly-challenging anaerobic component. When exercising in this zone, lactic acid is produced, but not in sufficient quantities to immediately degrade your performance and prematurely exhaust you. Exercising in the YELLOW Zone increases your tolerance and ability to exercise harder when you are required to, particularly when strength training or performing "intervals" during your cardio/aerobic exercise. It also enhances your fat-burning potential only if you are "conditioned" for it.
Zone 4 ORANGE Zone (Anaerobic)	<u>Interval Training/Fitness Enhancement</u> This is a high-intensity exercise zone designed to take your cardio/aerobic fitness to the next level without compromising your strength and muscle mass. Exercising in the ORANGE Zone challenges both your aerobic and anaerobic metabolisms and teaches your body to perform at higher exercise intensities. But it must be used carefully with adequate rest periods between

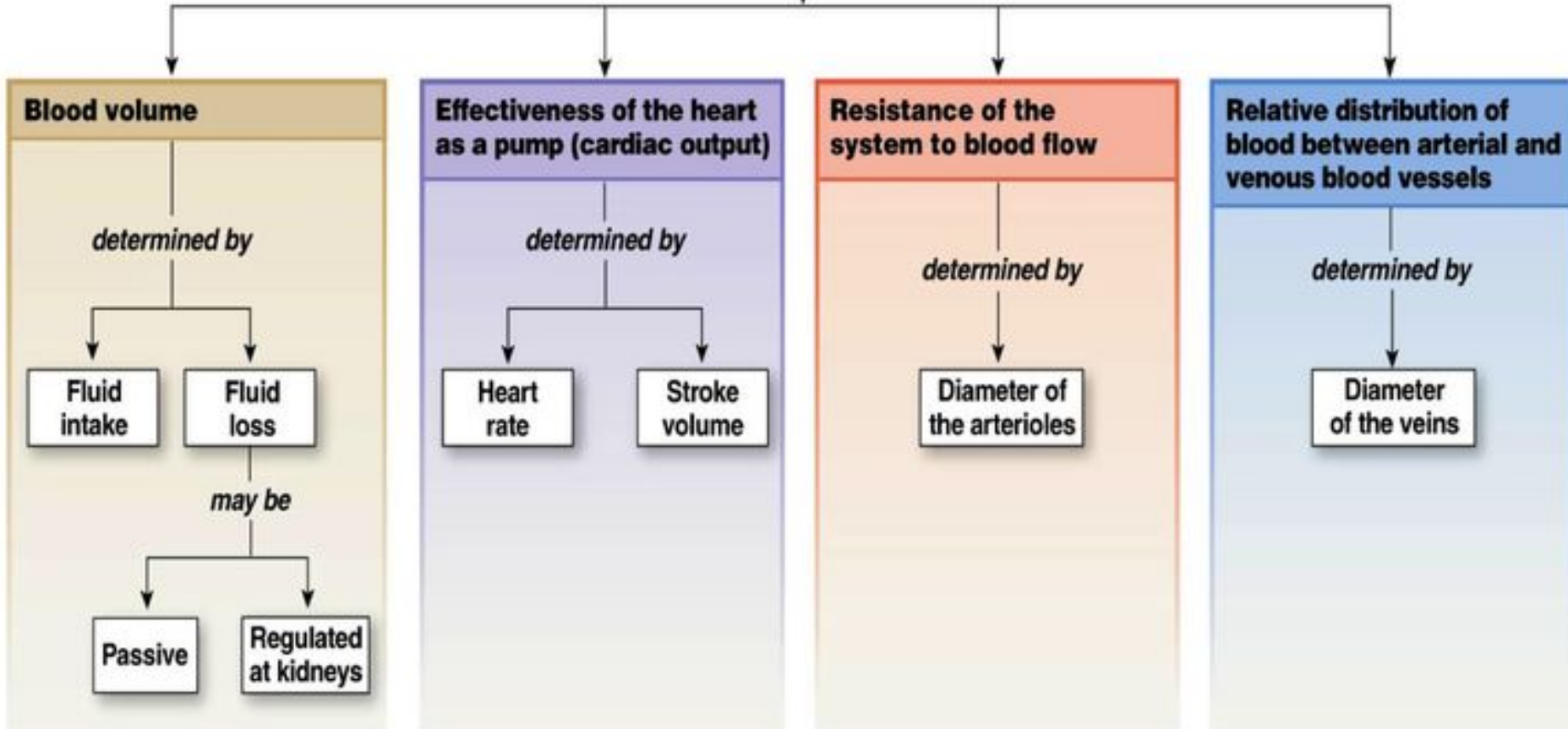


Blood Pressure

- Measured using a sphygmomanometer
- Pressure exerted on the arterial wall (brachial) during the rhythmic contraction and relaxation of the heart
- Systolic – pressure during contractile phase
- Diastolic – pressure during the relaxation phase
- Systolic / Diastolic mmHg
- Mean Arterial Pressure

MEAN ARTERIAL BLOOD PRESSURE

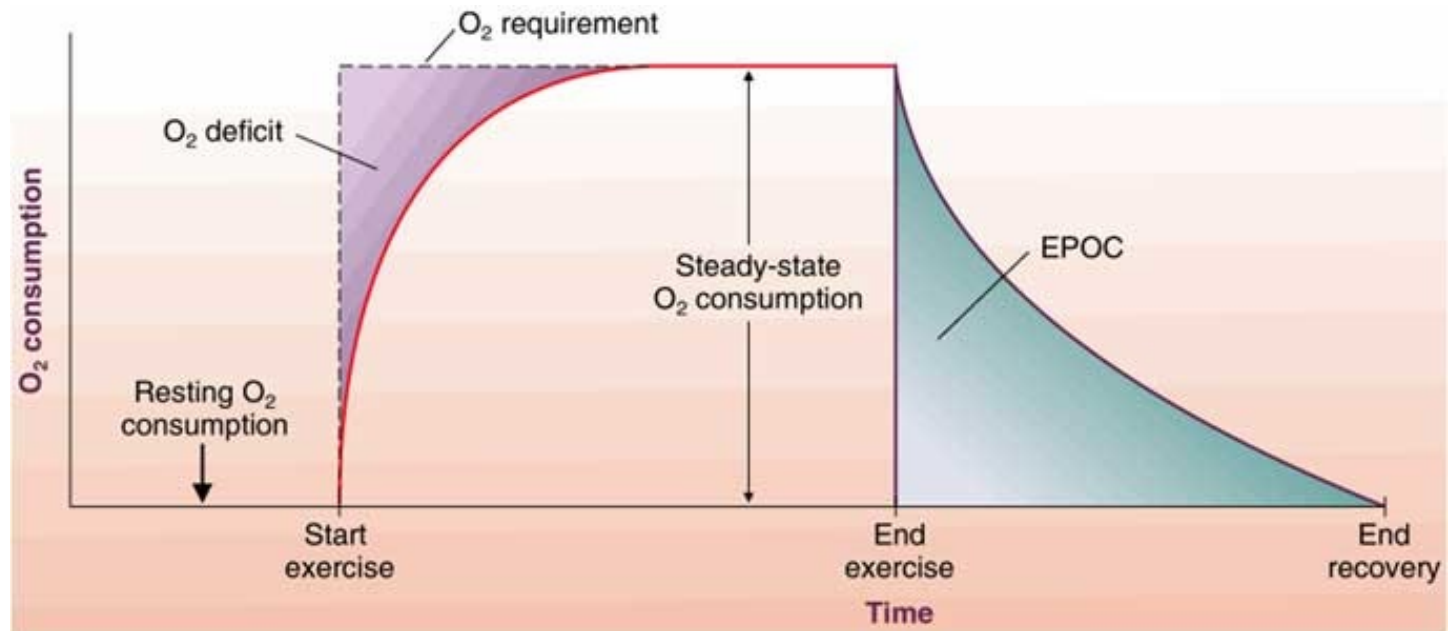
is determined by



Oxygen Uptake (VO_2)

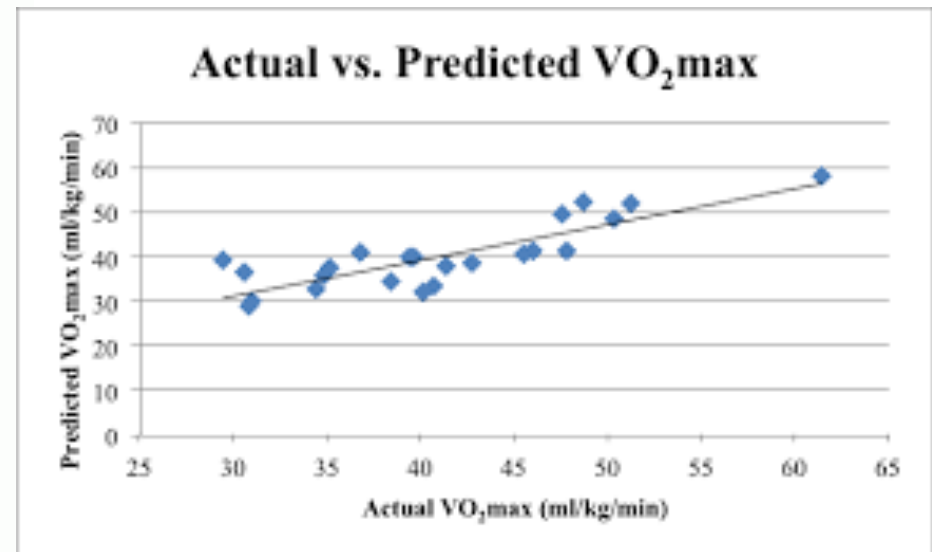
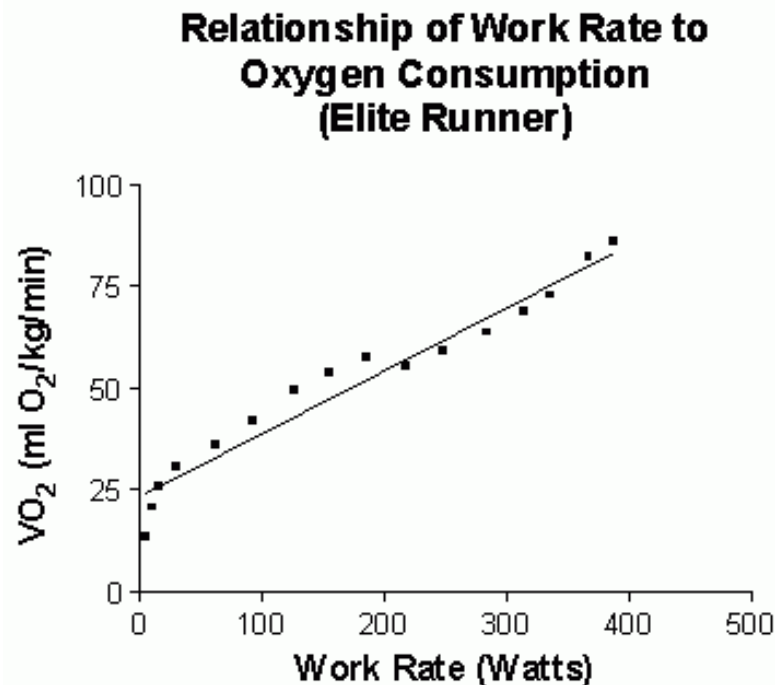
- the amount of oxygen required to sustain aerobic energy requirements at any given intensity of exercise.
- $\text{VO}_{2\text{max}}$ – the maximal amount of oxygen that can be used within the aerobic energy pathways.
- Expressed as lt/min – absolute value
- Expressed as $\text{ml}/\text{kg}/\text{min}$ – relative value

Oxygen Uptake



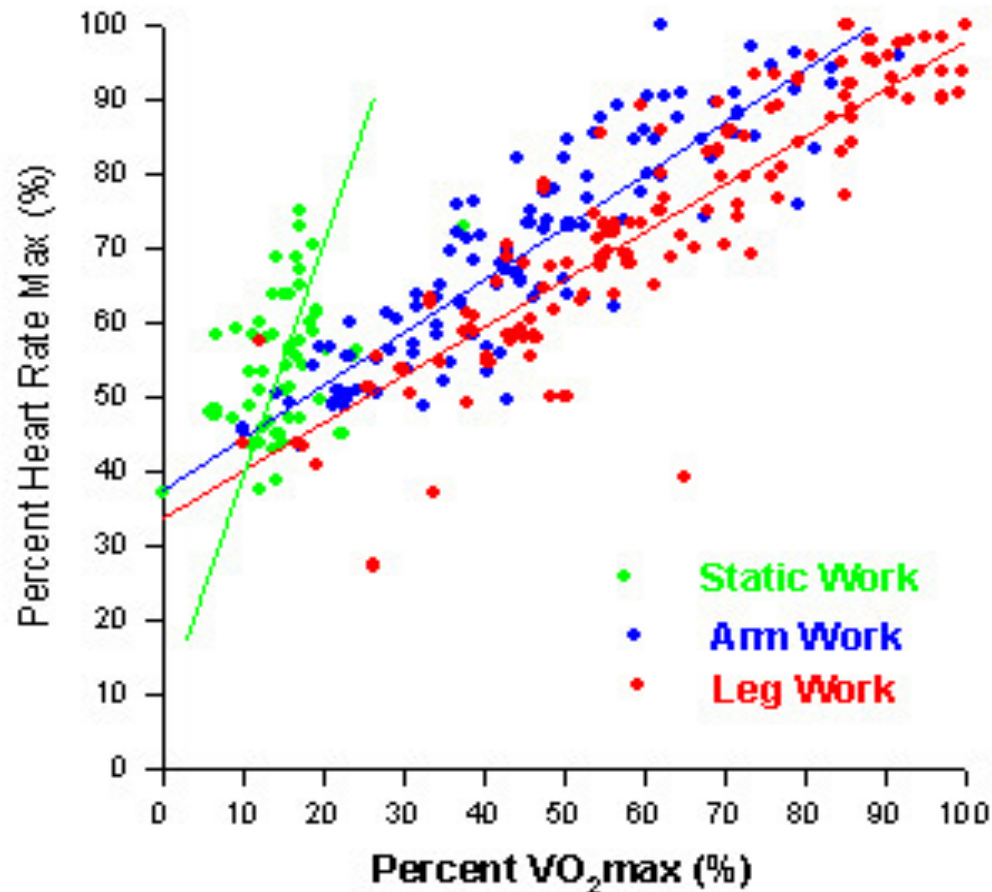
Oxygen uptake & Heart Rate

- Exercise economy – the oxygen uptake required to sustain a specific intensity of exercise



VO₂ & HR Relationship

HEART RATE - VO₂ RELATIONSHIP: PERCENT MAX



Factors Affecting VO_2max

- Respiration
- Vascular system
- Cardiac function
- Blood volume and Hb concⁿ
- A- VO_2 difference
- Muscle fibre type
- Concentration of Mitochondria

VO₂max Norm values for Men (ml/kg/min)

	18-25 years old	26-35 years old	36-45 years old	46-55 years old	56-65 years old	65+ years old
excellent	>60	>56	>51	>45	>41	>37
good	52-60	49-56	43-51	39-45	36-41	33-37
above average	47-51	43-48	39-42	35-38	32-35	29-32
average	42-46	40-42	35-38	32-35	30-31	26-28
below average	37-41	35-39	31-34	29-31	26-29	22-25
poor	30-36	30-34	26-30	25-28	22-25	20-21
very poor	<30	<30	<26	<25	<22	<20

VO₂max Norm values for Women (ml/kg/min)

	18-25 Years old	26-35 years old	36-45 years old	46-55 years old	56-65 years old	65+ years old
excellent	56	52	45	40	37	32
good	47-56	45-52	38-45	34-40	32-37	28-32
Above average	42-46	39-44	34-37	31-33	28-31	25-27
average	38-41	35-38	31-33	28-30	25-27	22-24
Below average	33-37	31-34	27-30	25-27	22-24	19-22
poor	28-32	26-30	22-26	20-24	18-21	17-18
very poor	<28	<26	<22	<20	<18	<17

Factors Affecting the Adaptation to Aerobic Training

- **Heredity** accounts for between 25% and 50% of the variance in VO_2 Max values.
- **Age**-Related decreases in VO_2 Max might partly result from an age-related decrease in activity levels.
- **Gender** plays a small role (10% difference) in the VO_2 Max values of male and female endurance athletes.
- There will be **RESPONDERS** (large improvement) and **NONRESPONDERS** (little improvement) among groups of people who experience identical training.
- The greater the **Specificity of Training** for a given sport or activity, the greater the improvement in performance.

Measuring VO_2max

- Submaximal
 - Multi-stage fitness assessment (bleep test)
 - **Astrand cycle test**
 - Balke 15 min run
 - Maximal oxygen uptake for each of the assessments mentioned can be determined using the following equations.

1 mile steady state jog

$$100.5 - 0.1636(\text{BW kg}) - 1.438 (\text{time min}) - 0.1928 (\text{HR bpm}) + 8.344$$

(male only)

Queens College Step test

$$\text{Men } 111.33 - (0.42 \text{ HR bpm}) \quad \text{Women } 65.81 - (0.1847 \text{ HR bpm})$$

- Maximal (**you will do this Exercise Physiology next year**)
 - Expired air sampling at max exercise using step wise protocol

Effects of CV exercise

- Increase heart size and volume
- Increase blood volume and haemoglobin
- Increase stroke volume
- Increase Cardiac output
- Increase VO_2max
- Normalisation of blood pressure
- Increase oxygen extraction from blood
- Increase number and size of mitochondria
- Increase myoglobin stores
- Increase oxidative enzyme concentration
- Decreased heart rate at any given intensity

Effects of CV exercise

- Increase strength of connective tissues
- Improved heat acclimitisation
- Increase HDL levels
- Reduced body fat
- Reduced LDL and VLDL levels

Gender, Fitness and Genetics

- Men and women respond similarly to **training** programs
- **Training** improvement is always greater in individuals with lower initial fitness
- Genetics plays an important role in how an individual responds to **training**