



**Archery
Victoria**



Challenge Coaching Overview

www.archeryvictoria.asn.au

Introduction

Like any top athlete the archer must train to achieve top performances. A lot of people will say they shoot top scores without training and in fact they do, however, they are not world class scores and these people will never realise their potential due to their lack of fitness.

As with everything in life, a balance is most important. To be a top athlete requires a lot of hard work and effort and it is difficult to fit a training program into your normal lifestyle without some compromises. Remember;

Desire
Determination
Discipline
Dedication

The effort you put in is up to you, the rewards will follow in time.

The Challenge Coaching Program

Once an archer completes their 40 metre qualification they can move into the Challenge Coaching Program.



This is where we get the archers into a formalised training format. This is all done at 40 metres on a 122cm face as most people can hit the gold often without having to aim too hard.

The format is primarily group coaching concentrating on items such as bow tuning, arrow physics and selection, biomechanics, nutrition, physical fitness and most of all some psychological training to start toughening them up.

The psychological training is preparation for your future in international events. Whether it is the one on one competition or the team on team competition, it is all about the execution of the shot in a regimented and mechanical way whilst ignoring the distractions of your opposition and a cheering crowd.

Once you have mastered the techniques shown in challenge coaching you are ready to start competing in open competition. After this program you should find yourself a Club Coach or a Regional High Performance Coach for further instruction.

Energy Systems

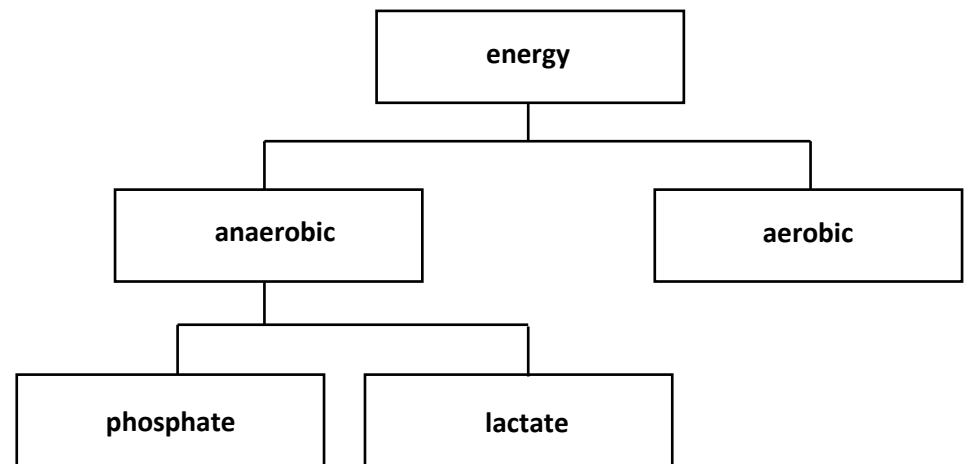
All human movement, no matter how small, requires some form of energy. This energy is supplied from only one source known as ATP (Adenosine Triphosphate). ATP is a chemical molecule stored within the muscles. Each muscle has millions of ATP molecules.

Any movement, including breathing, digesting food, etc uses energy. The energy comes from a chemical reaction when ATP is changed to ADP (Adenosine Diphosphate) leaving in the muscle an ADP molecule and a single phosphate molecule. This changing of ATP molecules to ADP + P releases energy to allow muscles to perform contractions.

The ADP + P molecule quantities are static within a muscle. These molecules then go through a chemical process to bond them back to an ATP molecule. This chemical reaction does not use or create energy and is fuelled by different sources within the body depending on the intensity and duration of the work being performed.

To summarise, muscles contract by the myosin and actin filaments sliding over each other and the energy required for this contraction is supplied by the chemical process of ATP releasing a phosphate molecule.

The speed at which ADP + P is resynthesised back to ATP depends on the energy system being employed. There are two major systems of energy supply, they are aerobic and anaerobic. Of the anaerobic energy system there are two sub-systems, they are phosphate and lactate.



The Phosphate Sub-System

The phosphate sub-system has the following analysis;

- System type: anaerobic
- Source: creatine phosphate
- Site: muscle
- O₂ required: no
- ATP resynthesising ability: limited
- KJ quantity: 40
- Time to exhaustion: 10 seconds
- Recovery time: 50% in 30 seconds
100% in 2 minutes
- Waste products: nil
- Consequences: oxygen debt
- Intensity: 90% to 100%

The phosphate sub-system allows for short duration, high intensity movements (lifting a heavy weight) by immediately resynthesising ATP.

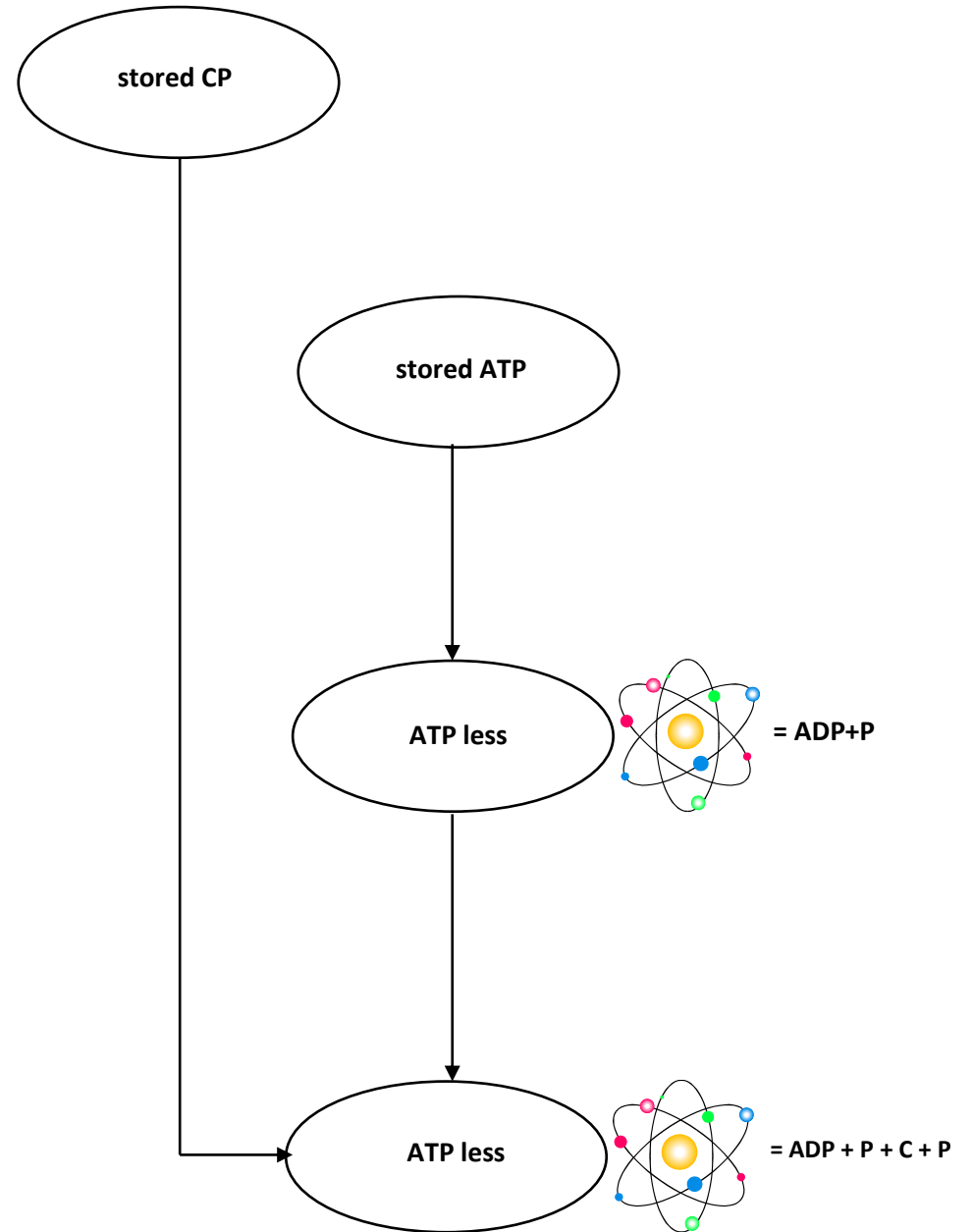
In each muscle there are millions of ATP molecules but only hundreds of CP (Creatine Phosphate) molecules. In the whole body there is only 85 grams of CP stored. This is the reason why the phosphate sub-system has only 10 seconds of energy available.

To produce this immediate energy the CP molecule releases its phosphate molecule so it may join up with the ADP molecule thereby resynthesising ATP.

This resynthesised ATP is then available to again release its energy by changing to ADP + P. This process cannot continue for long because of the limited quantity of CP within the muscle, however, given a short recovery period the body will resynthesise the C molecule and P molecule back to CP very quickly with full energy available within 2 minutes.

Given a longer recovery period the body will restore the ADP + P molecules back to ATP. The quantities of C, A and P molecules do not change within the muscle only the speed and length of time that they can be restored.

Phosphate Sub-System (continued)



The Lactate Sub-System

The lactate sub-system has the following analysis;

- System type: anaerobic
- Source: glycogen
- Site: muscle
liver
- O₂ required: no
- ATP resynthesising ability: limited
- KJ quantity: 6,000 in muscles
2,000 in liver
- Time to exhaustion: 60 seconds
- Recovery time: 20 minutes to 2 hours
- Waste products: lactic acid
- Consequences: oxygen debt
lactic acid accumulation
muscular fatigue
- Intensity: 60% to 95%

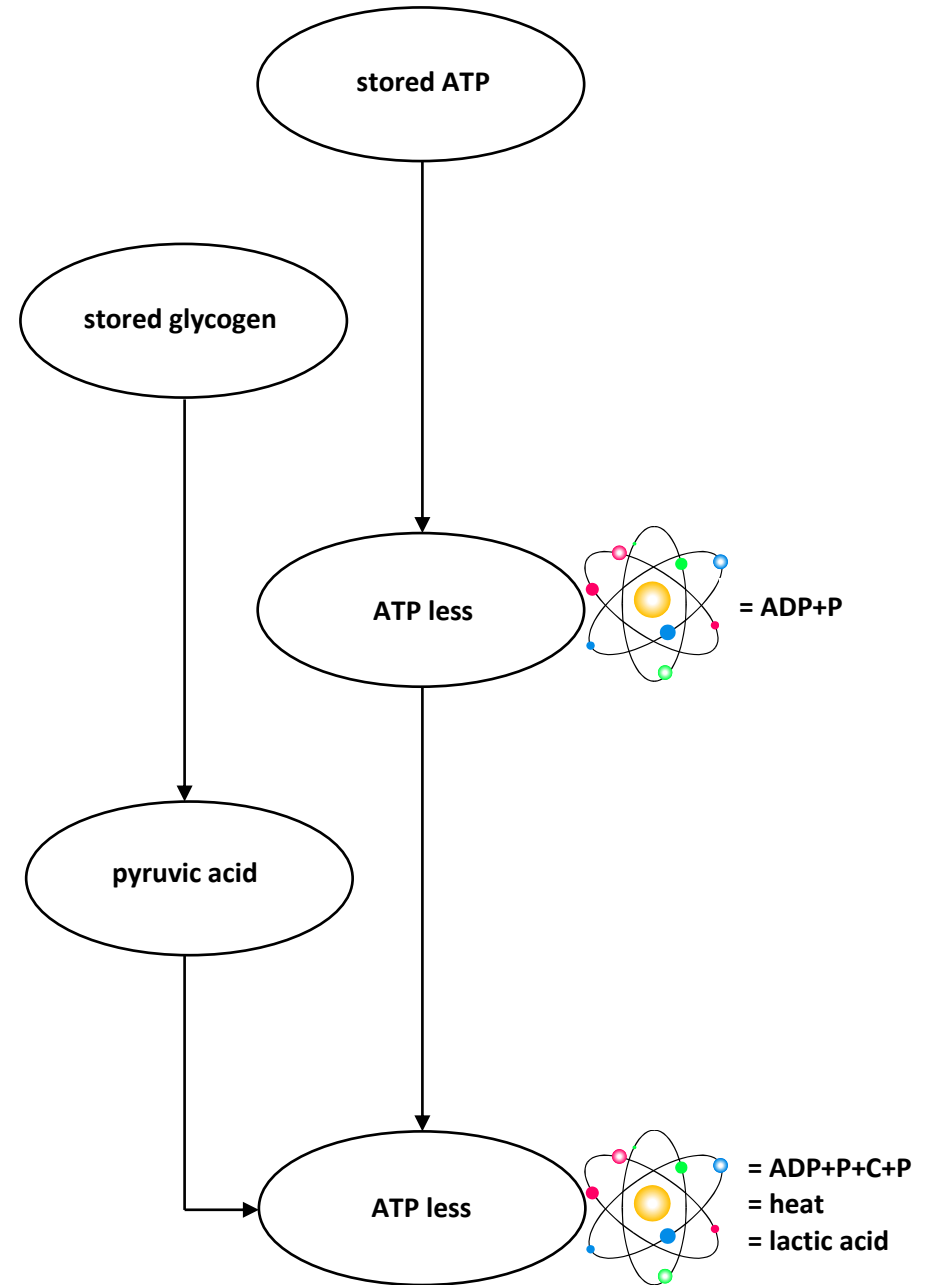
The lactate sub-system allows for medium duration, medium to high intensity movements (running 400 to 800 metres) by resynthesising ATP through a short series of chemical reactions without the use of oxygen.

To resynthesise the ATP for a slightly longer period of time the body utilises the glycogen stored in the muscle and the liver.

The glycogen in the liver is transported to the muscle through the blood as glucose.

The glucose is broken down into pyruvic acid which allows the ADP + P to be reformed back into ATP and for each molecule of glucose there is enough pyruvic acid to resynthesise 2 molecules of ATP.

The Lactate Sub-System (continued)



The Aerobic System

The aerobic system has the following analysis;

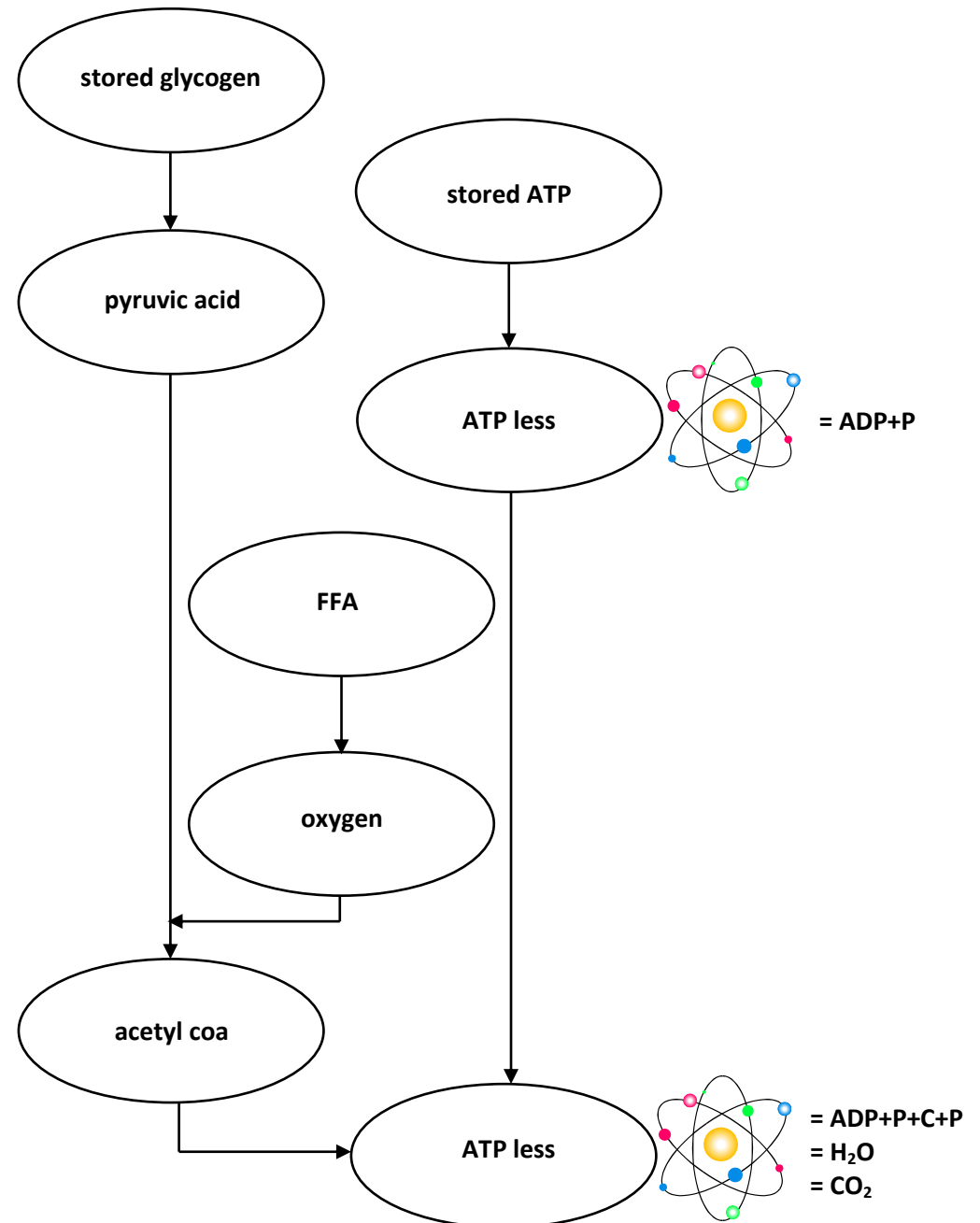
- System type: aerobic
- Source: glycogen
protein
fats
- Site: muscle
liver
fat deposits
- O₂ required: yes
- ATP resynthesising ability: unlimited
- KJ quantity: 46,000 in muscles
2,000 in liver
250,000 in fat deposits
- Time to exhaustion: 2 hours from glycogen stores
40 days from protein stores
30 days from fat stores
- Recovery time: time to replace fuel stores
- Waste products: CO₂
H₂O
- Consequences: gradual exhaustion
- Intensity: 00% to 60%

The aerobic system allows for long duration, low to medium intensity activity (long distance running) by resynthesising ATP through a series of several chemical reactions with the use of oxygen.

For endurance activities the body utilises the glycogen in the muscles and the liver along with the FFA (free fatty acids) stored in the body's adipose tissue.

Because of this process each molecule of glucose creates enough acetyl coa to resynthesise up to 36 molecules of ATP.

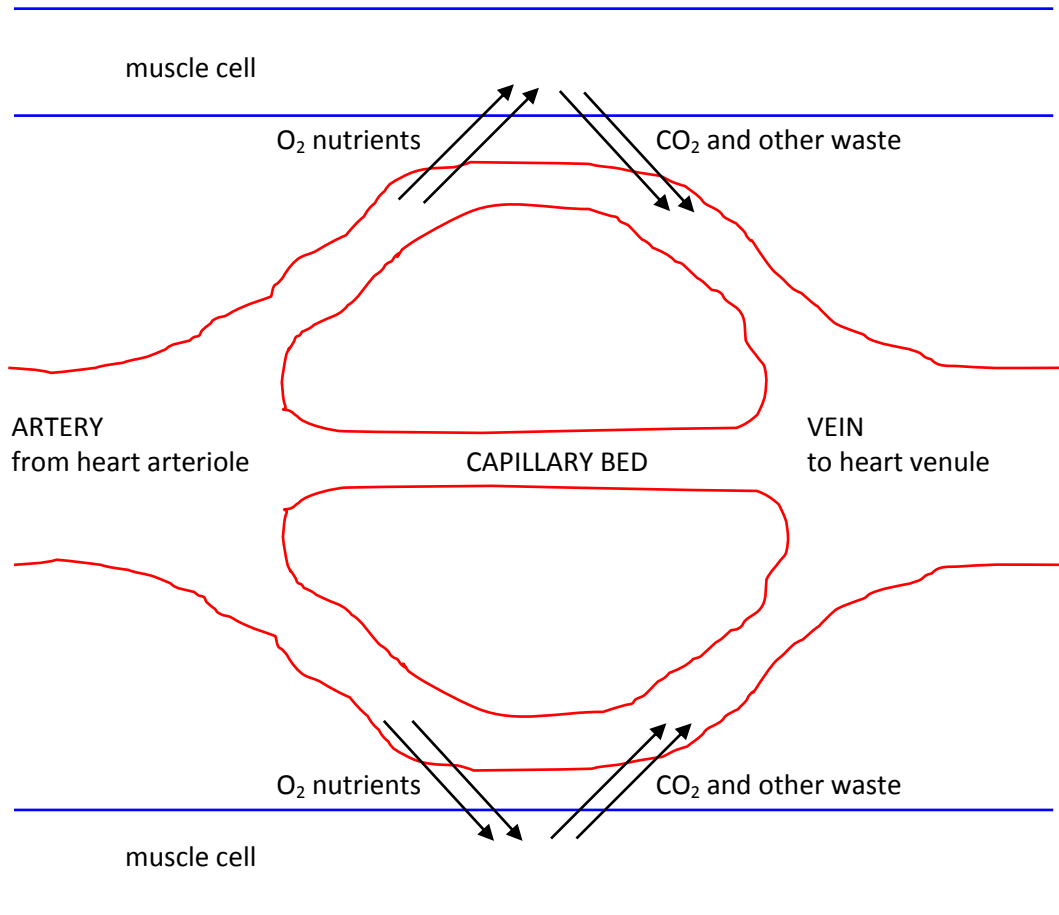
The Aerobic System (continued)



General Anatomy

Oxygenated blood flows away from the heart in arteries which slim down to arterioles and then down to capillaries where the exchange of gases, nutrients and wastes take place between the blood and the tissues.

Blood leaving the capillaries travels into larger vessels called venules which in turn travels into larger vessels called veins which transport blood back to the heart.



All cells need a ready supply of oxygen and food while carbon dioxide and other waste products must be carried away from them.

Cardiac Overview

The heart and lungs co-ordinate the pulmonary circulation system where de-oxygenated blood is pumped from the right side of the heart via the pulmonary arteries to the lungs for oxygenation.

Oxygenated blood is then returned to the left side of the heart via the pulmonary veins. This is the only part of the circulatory system where oxygenated blood flows through veins.

Oxygenated blood is then pumped to the muscles and organs of the body through the systemic circulation system where de-oxygenated blood is returned to the right side of the heart. High intensity exercise increases the need of the muscle cells for oxygen and for the removal of waste products.

If sufficient oxygen does not get through to the muscles, and the intensity of the activity is maintained, the additional energy requirements will come from the anaerobic system. This results in muscle fatigue through the accumulation of lactic acid.

Cardiac Output

At rest the heart pumps 4 to 6 litres of blood into the arteries per minute.

The quantity of blood is called the CO (cardiac output) and is a result of the HR (heart rate) or the number of times the heart BPM (beats per minute) multiplied by the volume of blood pumped with each of those strokes, this is called the SV (stroke volume).

At rest $CO = HR \times SV$ $60 \text{ BPM} \times 80 \text{ mls} = 4.8 \text{ litres per minute}$

At maximum activity $CO = HR \times SV$ $180 \text{ BPM} \times 160 \text{ mls} = 28.8 \text{ litres per minute}$

The heart has the capacity to increase its heart rate at a steady rate but cannot increase the stroke volume at the same rate because of the capacity of the heart by volume.

The heart rate is limited by fitness and age but can be improved; however, the stroke volume is limited by the size of the heart and cannot be increased.

Blood Components

Approximately 45% of the blood is made up of red blood cells, white blood cells and blood platelets and the remaining 55% is called plasma.

Red blood cells are composed of iron/protein molecules called haemoglobin which binds readily with O₂ and CO₂ and when required can release these gases quickly.

The plasma is responsible for carrying and releasing the food, minerals, hormones, etc for the rest of the body.

Blood Profile

The red and white cells of the blood, as well as the plasma, carry a wide variety of components that can be measured and reflect a state of health and fitness. The major components are:

Cholesterol	0.00	to	5.50
Glucose	3.50	to	6.00
Calcium	2.20	to	2.55
Protein	65.0	to	83.0
Potassium	3.50	to	5.40
Sodium	135.0	to	148.0
Haemoglobin	11.5	to	16.5

Blood Cholesterol

Cholesterol and other fats are carried in the blood in the form of lipoproteins;

HDL (high density lipoprotein)	aim to increase in cholesterol limits
LDL (low density lipoprotein)	aim to decrease in cholesterol limits
Triglyceride	0.00 to 1.00

Blood Pressure

Blood pressure is the measure of force the hearts needs to push blood through the body. Blood pressure is measured in two parts, the first is systolic pressure and the second is diastolic pressure.

Systolic pressure is the pressure on the artery walls when the heart contracts and blood pumps through the body.

Diastolic pressure is the pressure in the artery walls when the heart is relaxing between heart beats.

VO₂ Max. (Maximal Oxygen Uptake)

VO₂ max. is the maximal amount of oxygen capable of being transported to and consumed by the working muscles and is used in determining a measure of fitness.

At rest, the body uses around 3.5 millilitres of oxygen per kilogram of body weight per minute to sustain life. This is expressed as (3.5 ml/kg/min).

Physical training, especially aerobic type training, will improve the capacity of the heart to perform better during strenuous activity. As fitness improves so will the ability of the muscles to more efficiently consume oxygen. This efficiency is called VO₂ max.

An average middle aged man would have a VO₂ max of 25.0/ml/kg/min.

Average young	men	45.0	women	38.0
Australian rules footballers	men	53.9		
National level volleyball players	men	56.4	women	46.8
National level squash players	men	59.0	women	51.5
National level middle distance runners	men	67.0	women	62.1
National level long distance runners	men	73.5	women	69.8

Respiration

To develop aerobic fitness it is necessary to exercise at an intensity above the training threshold for 15 to 60 minutes per day, 3 to 5 times per week.

Exercise may be continuous such as long distance running or it may be intermittent where the intervals of exercise are interspersed with periods of rest, this is termed interval training.

Aerobic training can also be interspersed with short bursts of strength and/or flexibility training; this is known as circuit training.

Continuous exercise training is suitable for improving initially lower fitness levels whilst interval and circuit training are seen as being the most effective for competitive sports where aerobic fitness is important.

To increase fitness it is necessary to train above the training threshold. The threshold is calculated by the Karvonen formula.

Maximum HR – resting HR x 60% + resting HR = training HR.

E.g. $200 - 50 = 150 \times 60\% = 90 + 50 = 140$ THR.

Maximum heart rate is calculated as 220 BPM less age.

Resting heart rate is best taken in the morning before arising.

Strength VS Aerobic Fitness

This argument has been raging in archery for many decades. What has put an end to it was Matchplay.

You can be as strong as you like, the best way to win a Matchplay event is to be calm. The best way to be calm is to be aerobically fit as this will help oxygenate the blood as well as assist in keeping your heart rate down.

A low resting heart rate is a good sign of fitness. Not just in sport but in your life generally, the fitter you are the healthier you are.

Respiratory Quotient

When O₂ is used in the process of catabolising particular food stuffs the O₂ consumption is associated with a certain amount of CO₂ production.

Each type of food broken down gives a particular ratio to the volume of CO₂ produced to the volume of O₂ consumed. This ratio is known as the RQ (respiratory quotient).

$$\text{RQ} = \frac{\text{V CO}_2 \text{ volume of CO}_2 \text{ produced}}{\text{V O}_2 \text{ volume of O}_2 \text{ consumed}}$$

$$\text{RQ for glucose} = 1.00$$

$$\text{RQ for protein} = 0.83$$

$$\text{RQ for fat} = 0.70$$

A litre of O₂ will produce more energy if the oxygen is used for catabolising carbohydrates rather than fats. Protein breakdown is insignificant during exercise for a well fed person. Carbohydrates are utilised mostly during heavy exercise and fats are the major source of fuel for low intensity, long duration exercise.

Respiratory Rate

It is the function of the lungs to supply oxygen to the blood and to allow carbon dioxide to be released from the blood. Within the lungs the air passages divide down to air sacs called alveoli which cover the capillaries. It is the alveoli that allow the exchange of gases to take place.

There are approximately 1 billion alveoli in the lungs and their quantity and size are limited by the dimensions of the body and cannot be increased in number or in size.

However, they can be irreparably damaged by smoking with every puff destroying hundreds of alveoli. This is why smokers get short of breath; their lung capacity is continually being diminished.

Respiratory Rate (continued)

TV (tidal volume)

The volume of air moving in and out of the lungs at rest.

Average male 600 ml. Average female 500 ml.

RV (residual volume)

The volume of air remaining in the lungs after forced expiration.

Average male 1,200 ml. Average female 800 ml.

VC (vital capacity)

The volume of air that can be forcefully expired after maximal inspiration.

Average male 4,800 ml. Average female 3,200 ml.

TLC (total lung capacity)

The total volume of air in the lungs at the end of maximum expiration.

Average male 6,000 ml. Average female 4,000 ml.

RR (respiratory rate)

The number of breaths taken per minute.

RMV (respiratory minimum volume)

The respiratory rate multiplied by the tidal volume

$RMV = TV \times RR$

At rest an average man breathes 6 litres of air per minute; this is described as the RMV.

600 ml. x 10 breathes per minute = 6 litres.

During exercise the RR can rise to as high as 40 to 50 per minute and the TV can become as great as the VC, however, at rapid breathing rates a person cannot sustain a TV greater than one half the VC.

The respiratory system has the capacity to increase the RMV as much as 28 fold for short periods of time and as much as 20 fold for prolonged periods of time. On average, this can be as high as 120 litres per minute.

Cardiovascular Training

Your overall health, your training efforts, your ability to relax and concentrate can be directly related to how aerobically fit you are. Aerobic fitness training will improve your heart, your VO_2 max. uptake, reduce your body fat (in conjunction with a balanced diet), lower your heart rate and reduce the possibility of muscle tiredness and soreness by more efficiently removing lactic acid build-up.

A minimum of one hour with a moderately accelerated heart rate three times a week will help maintain fitness, but, a more aggressive program is required to improve fitness.

One of the greatest hindrances to obtaining fitness is smoking. The major component in obtaining aerobic fitness is for the body to obtain and use oxygen in vast quantities as its energy source. Smoking impedes the transportation of oxygen through the lungs into the blood stream which in turn forces the body to use other forms of inefficient energy sources and their resultant by-products.

Strength

To shoot a bow requires a certain amount of strength. No matter how light the bow may be you must have control of it. At the same time you do not have to be over muscled to shoot a bow, however, the heavier the bow the more muscle mass is required to shoot it properly. Most people have some form of inherent strength but not always in the muscles required to shoot the bow correctly. These muscles must undergo specific training to obtain the best results.

Please note that to gain optimum performance we must not only train one set of muscles but also the opposing set. Biceps training should be balanced with the triceps; the back should be balanced with the chest, etc. This gives overall strength and allows the workload of shooting a bow to be spread over a greater area thereby reducing the effects of tiring.

Flexibility

Flexibility in archery can best be expressed as range of motion. It is important that the muscles be able to contract further than that is necessary as this is where the power is generated. Flexibility will give you a better feeling in your shot as well as better control. It will enable you to perform well as soon as you start shooting as you will warm up a lot faster.

Diet Control

In order to maximise your training efforts you should control your food and liquid intakes. Diet control, as opposed to dieting, is important to maintain overall health and fitness. This overall control will enable your body to access the important nutrients for strength, fitness and muscle repair.

A good training diet is devoid of salts, sugars and fats and limited intakes of red meat (although an iron supplement may be required). A good training diet is high in fibre and carbohydrates along with a liberal consumption of water. Eating is best done by having up to 5 small meals a day. As with everything else it is recommended that a variety of fruits and vegetables are eaten to gain access to a broader spectrum of vitamins and minerals.

As you will see on the following pages you can use various methods to analyse the effectiveness of the training regime. The best result of course is how fit and healthy you feel. Above all, don't engage in any fad diets, crash course dieting or excessive water loss to achieve a reduction in body weight. Proper eating and hard work gives the best, healthiest, long term results.

Summary

Any archer that wants to be serious should undergo some form of training program. No matter how well you shoot now I guarantee you will shoot better if you are fitter, stronger and healthier.

On the next few pages you will find a personal training program which will give you some idea of the work and effort that needs to be performed as well as some of the results that can be achieved. The body analysis measurement sheets are a suggested way to track the effectiveness of your training. I strongly urge you to do something similar if you want to be professional in your approach.

In one week there is 168 hours.

Work equals	50 hours per week
Sleep equals	56 hours per week
Eating equals	12 hours per week
Relaxation equals	20 hours per week
Training equals	17 hours per week
Spare time equals	13 hours per week

Total 168 hours

Training Schedule - Winter

Monday	5.30 am 6.00 pm	run 12 km. shoot 100 arrows at 10m.	Time 1.00 Time 1.00	
Tuesday	5.30 am 6.00 pm	run 12 km. aerobics/weight training	Time 1.00 Time 2.00	
Wednesday	5.30 am 6.00 pm	run 12 km. shoot 100 arrows at 10m.	Time 1.00 Time 1.00	
Thursday	5.30 am 6.00 pm	run 12 km. aerobics/weight training	Time 1.00 Time 2.00	
Friday	5.30 am 6.00 pm	run 12 km. shoot 100 arrows at 10m.	Time 1.00 Time 1.00	
Saturday	3.00 pm 4.00 pm	shoot 100 arrows at 10m. aerobics/weight training	Time 1.00 Time 2.00	
Sunday	4.00 pm	shoot 200 arrows at 10m.	Time 2.00	<u>17.00 hours</u>

Training Schedule - Summer

Monday	5.30 am 6.00 pm	run 12 km. shoot 100 arrows at 10m.	Time 1.00 Time 1.00	
Tuesday	5.30 am 6.00 pm	run 12 km. aerobics/weight training	Time 1.00 Time 2.00	
Wednesday	5.30 am 6.00 pm	run 12 km. shoot 100 arrows at 10m.	Time 1.00 Time 1.00	
Thursday	5.30 am 6.00 pm	run 12 km. aerobics/weight training	Time 1.00 Time 2.00	
Friday	5.30 am	run 12 km.	Time 1.00	
Saturday	1.00 pm	shoot 150 arrows at 90m/70m.	Time 3.00	
Sunday	1.00 pm	shoot 150 arrows at 50m/30m.	Time 3.00	<u>17.00 hours</u>

Weight Training Program

Average Male

Bench Press	180 lbs.	Lat. Pulldowns (chest)	180 lbs.
Bicep Curls	100 lbs.	Lat. Pulldowns (back)	180 lbs.
Upright Rowing	100 lbs.	Seated Rowing	180 lbs.
Military Press	120 lbs.	Pullups	80 lbs.
Tricep Pulldowns	80 lbs.	Leg Curls	60 lbs.
Inner Pec Laterals	140 lbs.	Leg Extensions	100 lbs.

Body Analysis – Blood Profile - Quarterly

Average Male

Triglyceride	0.80	0.70	0.70	0.70	0.70
Hdl	----	----	----	----	----
Ldl	----	----	----	----	----
Total Cholesterol	5.40	4.70	4.90	4.70	4.60
Glucose	5.40	5.20	4.90	4.90	4.90
Calcium	2.34	2.35	2.34	2.35	2.36
Protein	66	68	70	70	70
Potassium	5.20	5.20	4.70	5.10	5.00
Sodium	139	137	143	138	137
Haemoglobin	15.8	16.3	16.1	16.3	16.1

Body Analysis – General Profile - Quarterly

Average Male

Body Fat %	14.5	12.6	10.5	10.7	8.6
Weight	80	78	77	80	80
Lung Capacity	675	675	675	675	675
Blood Pressure	120/80	120/80	115/78	115/75	115/75
Resting Pulse	48	46	44	48	46
VO ₂ Max.	53.8	55.8	57.3	59.8	61.8
Speed	12.0	15.0	19.0	18.0	19.0

Body Analysis – Measurement Profile

Average Male

Weight	80 kg	Height	185 cm
		Neck	38 cm
Upper Arm (left)	34 cm	Upper Arm (right)	34 cm
		Chest	110 cm
		Sternum	88 cm
		Waist	80 cm
		Hips	91 cm
Groin	56 cm	Groin	56 cm
Thigh	54 cm	Thigh	54 cm
Calf	39 cm	Calf	39 cm

Skills Training

This is the most important part of any serious training program. Most archers think that practice consists of just shooting a bow for a few hours at a time but we should treat it far more seriously and professionally than that.

Specific skills training should be part of any good archer's fitness program, listed are a few basic ideas for you to start on.

Feel Shooting

Shoot at 2 metres with your eyes closed. This will remove the distraction of aiming and peaking. It will also allow for an analysis of your form/technique as well as measuring any changes you may be making to your equipment setup. (other than grouping changes)

Clicker Control

The serious recurve archer must be in control of the clicker. Practice by having someone direct you to various parts of a target face and pulling through the clicker. Your instructor should vary the commands of whether to release or not.

This training will remove anxiety and induce control, comfort and confidence.

Endurance

As part of your cardiovascular and weight training measurements you can record how many arrows you can shoot properly before lactic acid build-up takes over.

You can also measure how good your recovery is by how long it takes before you can shoot again.

Angle Shooting

Take specific measurements on how you and your equipment react to varying angles in field shooting. Analyse why these changes occur.

Dusk Shooting

As an assignment, please write in 50 words or less the reasons why when you shoot during dusk that your arrows land lower on the target, and yet at the same time, your grouping actually improves.

Give your answer to your Coach and they shall explain the effect to you.