Physical Preparation

INTRODUCTION

You have been introduced to the body's three energy systems in an earlier module. This module studies these systems in more depth and looks at their application to training. It also examines the general training principles and the principles of periodisation, and applies these to the design of athlete training programmes.

Upon completion of this module, you will be able to:

- **EXPLAIN THE BODY'S ENERGY SYSTEMS AND THEIR APPLICATION TO TRAINING**
- **EXPLAIN THE GENERAL TRAINING PRINCIPLES**
- **APPLY THE GENERAL TRAINING PRINCIPLES AND GUIDELINES TO THE DESIGN OF ATHLETE TRAINING PROGRAMMES**
- **EXPLAIN THE PRINCIPLES OF PERIODISATION AND APPLY THEM TO DEVELOPING A SIMPLE PERIODISED TRAINING PROGRAMME**
- **EXPLAIN THE BODY'S ENERGY SYSTEMS AND THEIR APPLICATION TO TRAINING**

THE ENERGY SYSTEMS

ENERGY

Humans rely on the transformation of chemical energy from the foods we eat into energy for muscular contraction in order to perform physical activities. Maximal physical performance may be a direct reflection of the body's ability to convert the nutrients from our food into a useable energy form in our body. Protein, fat, and carbohydrates from the food we eat provide us with an important form of chemical energy. This energy is converted to Adenosine Triphosphate (ATP), which is stored in our muscle cells, and broken down to supply our body with energy for movement.

ADENOSINE TRIPHOSPHATE (ATP)

ATP is the sole source of energy for muscle contraction. It is continually being used in muscular activity and resynthesised for continual use. ATP is stored in very small amounts, so it must be constantly replenished so that activity can continue. There is enough ATP stored within the body to facilitate an all-out sprint for about two seconds. Creatine phosphate (CP) supplies energy for immediate ATP resynthesis, and is stored in the muscle for this purpose.

Pathway	**Anaerobic Alactic System**	**Anaerobic Lactic Acid System**	**Aerobic System**
Energy	Immediate energy system. ATP without the presence of O2. High intensity activity.	Short-term energy system. ATP without the presence of O2. High intensity activity.	Long-term energy system. ATP produced in the presence of O2. Medium to low intensity activity.
	ATP/CP stored in muscle.	Glycogen lactic acid.	Glycogen completely burned in the presence of O2. / Fats. / Protein.

O sec	10 sec	40 sec	70 sec	2 min	6 min	1 hr	2 hr	3 hr

Events	100m sprint, throws, jumps, weight lifting, ski jumping, diving, vaulting.	200-400m track, 500 skating, most gym events, cycling – track.	100m swimming, 800m track, 500m canoe, 1000m skating, floor exercise – gymnastics, alpine skiing, cycling – track (1000m pursuit).	Mid-distance track, 1000m canoe, boxing, wrestling, martial arts, figure skating, synchro swimming, cycling – pursuit.	Long dist track, swimming, canoeing, cross-country ski, cycling, road.
Action	Mostly acyclic	Acyclic and cyclic			Cyclic

* Acyclic = one action, e.g. shot put, gymnastics vault; Cyclic = repeated movement, e.g. swimming, running.

Table 1. The anaerobic alactic, lactic acid, and aerobic energy systems. (Source: adapted from Bompa, 1990)

THE THREE ENERGY SYSTEMS

There are three energy systems in the human body. These are the anaerobic alactic system, the anaerobic lactic acid system, and the aerobic system. The sole purpose of these energy systems is to resynthesise ATP in order to continually provide the energy necessary for muscular contraction. The anaerobic alactic and lactic acid systems resynthesise ATP without oxygen, and are therefore termed anaerobic (i.e. without oxygen) energy systems. The aerobic system resynthesises ATP with the use of oxygen, which is why it is termed the aerobic (i.e. with oxygen) system.

The three energy systems overlap and work together to provide energy for activity, e.g. a 100m sprint on the track requires energy predominantly from the anaerobic alactic system (90% alactic and 10% lactic); a 100m swim event requires energy from all three systems (20% alactic, 55% lactic, and 25% aerobic); while a marathon runner derives energy primarily from the aerobic system (4% lactic, 96% aerobic). The intensity, duration, and work/rest ratio determine the energy systems used during activity. Mary sports require a combination of the energy systems.

For example, a soccer player uses repeated high intensity, short anaerobic bursts of energy for kicking and sprinting to the ball, as well as low to moderate energy requirements for jogging around the field (energy contributions are approximately 30% alactic, 20% lactic, and 50% aerobic). However, the goal keeper plays in a relatively set position and requires energy from the three systems in different proportions (approximately 70% alactic, 15% lactic, and 15% aerobic).

Worksheet for Energy Systems – Touch Player			
Activity	**Duration**	**Intensity (1 – low, 5 – high)**	**Energy System**
Retiring	5 metre	3-4	Anaerobic alactic
Forward sprints	3-4 sec	5	Anaerobic alactic
Support play	15-20 sec	2	Aerobic
Repeated sprints	20 sec	4	Anaerobic lactic

Fig.1 Worksheet for applying the energy systems to training.

APPLYING THE ENERGY SYSTEMS TO TRAINING

Figure 1 demonstrates how a sport, Touch for example, can be broken down into physical components (e.g. 5m sprints), and the physical components can be analysed with respect to energy systems supplying the activity (e.g. 5m sprints = anaerobic alactic energy system). This type of analysis can be very useful in designing sport-specific training programmes.

NUTRIENTS SUPPLYING THE THREE ENERGY SYSTEMS

Chemical energy from the food we ingest resynthesises the atp stores within our body and supplies us with the energy necessary for activity. Carbohydrates, fats, and protein provide the body with energy, while vitamins and minerals help the body harness the energy. Refer to table 2 for a brief description of the energy-supplying nutrients.

	Carbohydrate (CHO)	Fat	Protein
Importance to physical activity	• Main fuel for intense activity. • Secondary fuel for prolonged exercise of low to moderate intensity.	• Main fuel for prolonged low to moderate intensity activity.	• Important building block for muscle and tissue. • Provides limited amounts of energy.*
Energy system it primarily supplies	• Anaerobic alactic. • Lactic acid. • Secondary fuel for medium to low level activity.**	• Aerobic system (some CHO used to help burn fat for energy*).	• Anaerobic alactic and lactic acid systems under unusual circumstances.*
Sport-specific examples	Netball, rugby, cricket, volleyball, running 5000m, cycling (4000m track, individual pursuit).	Marathon running, road cycling, multi-sport.	Netball, rugby, cricket, volleyball, running 5000m, cycling (4000m track, individual pursuit), if CHO stores are depleted.*
Common foods supplying these nutrients	Breads, cereals, fruit, vegetables, pasta, rice.	Dairy products, oils, meats, nuts.	Meat, fish, poultry, eggs, dairy products, nuts, legumes.

Table 2. Sources of energy for ATP resynthesis.

Note:

*Protein is not known as a main source of energy for performance as it supplies a negligible amount of energy under normal circumstances. In unusual cases of illness, starvation, or depleted carbohydrate stores during intense exercise, protein can rebuild to form glucose to provide energy for the anaerobic alactic and lactic acid systems.

**It is believed that fat requires a small amount of carbohydrate to help its transformation to energy. Therefore, a limited amount of carbohydrate is required to burn with fat in the aerobic energy system. This is why it is necessary for athletes to replenish their carbohydrate stores in both anaerobic and aerobic sporting events.

***Fat is an important source of energy, and most people have enough fat stored in their body to supply themselves for hours of activity. It is therefore recommended that fat intake is limited to prevent health problems associated with high fat diets.

Vitamins and minerals are important nutrients for maximum sports performance. Although they do not provide energy directly for movement, they help with energy transfer within the body, repair of tissue, red blood cell formation, and transportation and usage of oxygen. It is believed that an adequate supply of these nutrients is obtained from a balanced diet.

Water is important to maintain the fluid balance in the body. The body requires water for almost all of its cellular reactions, as well as for regulation of core body temperature. An athlete can lose 1-2kg of body fluid during intense activity accompanied by profuse sweating. This loss equals one to two litres of water that should be replaced, while it is being depleted, to ensure maximum performance and avoid dehydration and heat stress. Note that there are problems with rehydrating, i.e. athletes can lose 1-3kg an hour, but can only rehydrate and regain approximately 1kg an hour. Once the body has lost about 2% of body weight through dehydration, a decline in performance will result.

GENERAL TRAINING PRINCIPLES

The following training principles are founded on and supported by scientific research and should be applied to training programmes to ensure continual improvement in performance. The training principles are applicable to cardiovascular, strength, and flexibility training.

1. FITT Principle

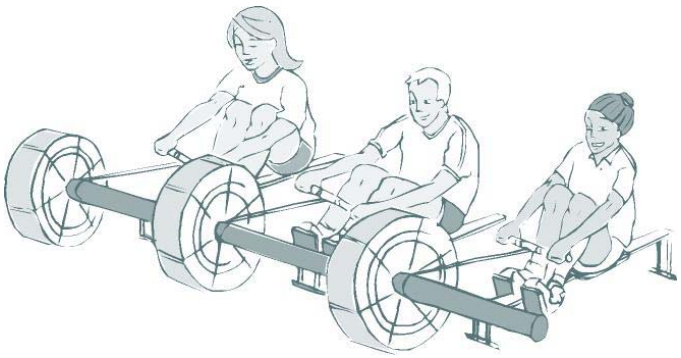
The FITT principle of training describes the frequency, intensity, time, and type of activity involved. All four components must be addressed when designing and progressing a training programme.

- **Frequency** — the number of times per week the athlete trains (e.g. three times per week).
- **Intensity** — the intensity of the training session (e.g. running pace). Intensity can be accurately determined by monitoring heart rate and ratings of perceived exertion.
- **Time** — the total duration of the exercise (e.g. 10 second sprint repeats; two hour cycle).
- **Type** — the mode of training incorporated (e.g. plyometric jump training).

2. Overload and Progression

To overload the body means to train the body at a higher level than normal. By training at a higher level than normal, the body adapts physiologically to the new level, and physical performance can be increased. The overload must be continually and gradually progressed as the athlete adapts to the current level. A progressive overload involves manipulating the FITT principle. This may include increasing either the frequency, intensity, time, or type of exercise, e.g. progressive overload in time: increasing a runner's total running duration by 10% every two weeks during their long runs; or progressive overload in intensity: using heavier weights on a bench press exercise.

It is not advisable to increase all aspects simultaneously, as this often overloads the athlete and may result in overtraining and/or overuse injuries. Similarly, if the overload is excessive, symptoms of overtraining appear and performance deteriorates.



3. Specificity

Training sessions should be specific to the movement, muscles and energy systems of the sport.

Muscles respond specifically to stimuli placed upon them, so training and practise should be as closely related to the performance requirements as possible. For example, if a rugby back wants to become faster and more agile, they should perform maximal sprints and shuttles incorporating raw speed and change of direction. Completing 3km runs will train the aerobic system but will not train the rugby back for maximal speed and agility development. Some events, where the predominant energy system is anaerobic alactic, require an aerobic base, e.g. 400m runners. These athletes spend a large percentage of their training time doing aerobic work which underpins their performance on the track.

An exception to the rule of specificity is in the case
of injury, where athletes are not able to train as specifically as they would like. For example, a runner with a stress fracture in the lower leg may resort to water running during rehabilitation. This form of activity is not as specific as running itself, but is the next best option while the athlete is unable to run.

4. Individual Differences

Every athlete is unique, and will respond differently to physical training. Gender and genetic endowment account for a large portion of an athlete's ability, and will determine the training response to a programme as well as the ceiling, or upper limit to their ability. Furthermore, some athletes are more prone to overuse injuries than others due to differences in training tolerance. You need to be aware of these differences when designing training programmes.

Athletes often neglect the principle of individual differences when they ask a better athlete what they do for training, then attempt to follow their programme, despite the differences between them in training background, work and emotional stresses, genetics, and body type. The individual must always be taken into account when designing or adapting training programmes. Junior athletes sometimes attempt to replicate what senior world champions are doing, rather than looking at what these people did as juniors and adapting it to their own needs.

5. Reversibility and Maintenance

'Detraining' occurs fairly quickly when a person stops training, with reductions in physical ability seen after one to two weeks of no training. Fitness levels can be

maintained by one to two training sessions per week. The maintenance sessions should be at a higher exercise intensity, but lesser duration than that used previously to build fitness.

The principles of detraining and maintenance are applicable to an injured athlete. Many athletes sit out completely for four to six weeks, depending on the injury, and have a difficult time returning to their activity mid-season because of their loss of strength and fitness. You should arrange alternative training sessions for injured athletes to preserve as much strength and conditioning as possible.

6. Tapering

Tapering is fine tuning performance so that the athlete or team arrives at their most important competitions in peak form. If the athletes have been training hard, the taper should start approximately
two weeks prior to the main and most important event. The duration of the training gradually decreases, while the intensity stays up. If the season's schedule includes weekly games or events, the training should be hardest and longest at the beginning of the week and gradually decrease until the competition. Practises the day before events should be light, so as to prevent fatigue during the event.

7. Warm-Up

A warm-up prepares the body for exercise, and is thought to decrease the risk of injury during training and performance. A warm-up increases blood flow to the active tissues, increases body temperature, and allows the cardiovascular system to gradually increase from a resting to an active state.

The warm-up should be specific for the intensity
of the session to follow, and should include a gradual progression in exercise intensity, and mobilisation of the muscles that will be used during the activity. A 10 minute warm-up is often enough for training, but warm-ups of up to 30 minutes are used prior to important games and events.

8. Cool-Down

The cool-down is important after strenuous exercise to help circulate the blood through the active muscles to remove any lactic acid and other by-products that may have accumulated.

A cool-down incorporates 5-10 minutes of the sport-specific activity (e.g. running, skating, swimming,
x-country skiing) at a self-selected pace, and is often followed by a period of light stretching.

Some athletes take longer to recover from training and competition than others, particularly older athletes. Options should be provided for them, which may include an aerobic workout, massage, shower, sauna. These options may also apply to cooling down. You need to remember that athletes need to cool down and recover both physically and mentally.

Energy System	Frequency	Intensity	Time	Type
Anaerobic Alactic System	2-3 x per week 48 hours' recovery between high intensity sessions.	100% effort Set goals for athletes so that they are motivated to put 100% effort into the training (e.g. give time goals).	Intervals of 1-10 seconds	Sport specific The activity should be sport-specific (e.g. incorporate backward sprints for touch rugby).
Lactic Acid System	2-3 x per week 48 hours' recovery between high intensity sessions.	80-85% effort Intensity usually established by determining a target time (e.g. 400m running intervals at 73 seconds each).	Intervals of up to 3 minutes	Sport specific
Aerobic System	3-6 x per week • Beginners start at 3 x per week. • Progress frequency gradually. • When training four or more times per week, alternate hard and easy days. • Always have minimum of one rest day a week.	60-80% maximum Use heart rate monitoring or ratings of perceived exertion to accurately determine intensity.	Intervals of 3-60 minutes – continuous or discontinuous Increase time 10% per week if necessary.	Sport specific • Aerobic sports. • Anaerobic sports to help with recovery.

Table 3. Guidelines for training the energy systems (applying the FITT principle).

TRAINING GUIDELINES FOR THE ENERGY SYSTEMS

Guidelines have been developed for optimal training of the energy systems. The training guidelines are determined from years of scientific research in the area of exercise physiology, and are modified as new research provides more knowledge in the area. The training guidelines are designed to train athletes to their full potential, without overtraining them and predisposing them to overuse injuries. The training principles are used in conjunction with the guidelines to design optimal training programmes for athletes.

CONTINUOUS AND INTERVAL TRAINING

- **Continuous training** involves steady aerobic exercise performed over a sustained period of time. It is most applicable to aerobic performance, or to those wanting to increase their aerobic base to aid recovery from anaerobic activities, e.g. swimmer going to the pool and swimming a 1000m time trial.
- **Interval training** involves spacing work and rest times so that the training is discontinuous. Interval training can be used with aerobic and anaerobic energy systems. The intensity of the training determines the energy system required, and therefore, the time that the interval can be sustained.

e.g. aerobic intervals: a cyclist completing four sets of three minute sprints with $1^1/2$ minutes of easy cycling in between the sets,

e.g. lactic acid interval training: a cyclist completing 10 sets of 30 second sprints with $1^1/2$ minutes easy cycling between sets.

Both continuous and interval training have their merits. The nature of interval training allows a higher quality training session, because the rest allows recovery between sets so that each set can be done at a high intensity.

WORK/REST RATIO

The work/rest ratio refers to determining the rest time taken between intervals when training the energy systems. The work time is the time to complete the interval or activity (e.g. 40 seconds for a ladder drill, or 'suicide' in basketball), while the rest time is the time between intervals. Table 4 provides a brief description of the optimal work/rest times for the three energy systems.

The rest is usually referred to as active or passive rest. 'Active' rest would be continuing the activity at a self-selected easy pace between the higher intensity training. An example of active rest would be to jog slowly between 400m intervals. Passive rest would be standing fairly stationary between the intervals. It is believed that active rest between lactic acid energy system intervals is important for flushing the lactic acid out of the muscle.

	Anaerobic Alactic Energy System	**Lactic Acid Energy System**	**Aerobic Energy System**
Work/Rest ratio	1:10	1:3 or 2:1 if aiming for lactate accumulation.	2:1 1:1
Sport-specific example: basketball	• 10 box jumps (six seconds): rest one min … repeat. • Court sprints (6-10 sec):rest one min … repeat.	• Suicide shuttle run (30-45 sec): rest 1.5 mins … repeat. • Training drills lasting 4-5 mins: rest two mins … repeat.	• 1km run (4-5 mins): rest two mins … repeat.
Recommended type of recovery between intervals	Passive (e.g. standing between box jump intervals).	Active (eg. easy jog between the shuttle runs).	Active (e.g. run four mins, walk or jog two mins).

Table 4. The recommended work/rest ratios to use while interval training.

ANAEROBIC THRESHOLD

Lactic acid begins to accumulate in the active muscles and the blood as athletes work at close to their maximum level. The intensity of effort at which the build-up begins to interfere with performance is termed the anaerobic threshold. Determining an individual's anaerobic threshold is an important step in helping to define their required training intensity. Training below anaerobic threshold will develop primarily

The aerobic energy system, while training above the anaerobic threshold will train primarily the anaerobic lactic acid system.

Intense exercise for longer than 10 seconds requires energy through the lactic acid system, and results in the formation of lactic acid. The lactic acid energy system buys time for the reformation of energy through ATP. If the intensity of the exercise decreases over time, there will be a decrease in the lactic acid formation, and the exercise will be able to continue. Light exercise will not cause an accumulation of lactic acid but moderate to heavy exercise will result in accumulation. Lactic acid will start to accumulate at approximately 55% of an untrained person's maximum aerobic capacity, and at approximately 70-85% of a trained person's maximum aerobic capacity.

The anaerobic threshold (onset of Blood Lactate Accumulation) is when the lactic acid accumulation exceeds the removal, and lactate begins to accumulate. It is often thought of as the threshold between where one is exercising aerobically (i.e. energy production through the aerobic energy system) and anaerobically (i.e. energy production through the anaerobic systems). Aerobic training will allow the athlete to train and compete at a higher percentage of their maximum aerobic capacity before they reach their anaerobic threshold. Anaerobic training will increase the ability of athletes to generate a lot of lactic acid, as well as increasing their tolerance of a high level of lactic acid accumulation.

DEVELOPING TRAINING PROGRAMMES

In order to provide a good training programme for your sport, it is essential that you are able to determine the importance of each energy system for the sport. This may simply require a trained eye to analyse the competitive situation, a knowledge of the three energy systems, and a knowledge of their contribution to each aspect of the sport. In some cases, you may need to refer to other coaches or specialist sport scientists for help. Good programming will cater for individual differences, and for the needs of different positions within a team.

You, as a coach, have a role in developing your athletes' energy systems, and in determining which component(s) require special effort. Identifying weaknesses and building on these often results in greater improvements in performance than attempting to further improve an athlete's strengths. A knowledge of how to test the various components of the three energy systems may help to identify an athlete's weaknesses, and combined with a knowledge of the principles of training and how to train the three energy systems, may help to improve upon them. There are also a variety of methods available to try to gauge an athlete's training intensity. Information gained from physiological tests may also be useful in monitoring performance throughout a season, and may give some indication as to whether the training programme is working or not. The tests may also provide incentives when setting goals; refer to Figure 6.

Numerous tests have been devised to evaluate skill and agility, and muscular, aerobic, and anaerobic performance. For most coaches, field testing is a viable and less expensive alternative to the more sophisticated laboratory testing. Field testing allows athletes to be tested using the same mode of exercise, and in the same environment in which they would normally train and compete, e.g. swimmers swimming, sprinters sprinting etc. Field testing is economical in terms of expense and time, and therefore may be repeated on a regular basis. This enables you to build up a picture of each of your athletes and what is happening to them.

After having carefully analysed your sport and determined the essential physical requirements, you may design specific assessment routines and personal profile

charts for your athletes. Testing does not need to be complicated to be effective. A number of suitable field tests are explained in the following manual:

Handcock, P. & B. Knight, (eds) 1994. Field Testing Manual for Sports, New Zealand Sport Science and Technology Board in conjunction with Coaching
New Zealand, Wellington (now SPARC).

PHYSICAL PREPARATION & GYMSPORTS

Conditioning and strength are integral parts of all gymsports, used to assist general physical preparation of the whole body for the gymsport and also for specific skill development.

Breaking physical preparation down further, we can look at three areas:

- Body postures — Postural/whole body strength
- Joint Actions — Body segments = upper body, lower body
- Whole body actions — Co-ordination

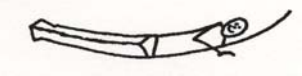
POSTURAL/WHOLE BODY STRENGTH

A fully stretched body position is the most difficult to maintain, yet it is used in all gymsports. Athletes should therefore be taught the following body shapes and have them reinforced in every session:

- Dish

- Arch

- Side arch



Adding movement increases the difficulty of the exercise, and likens the exercise more to practical use in skills where movement into, and during these body shapes will take place.

Rocking in each position takes the exercise to a new level of difficulty.

- Rotation or rolling from dish to side to arch positions with no rest, feet and shoulders must not touch the floor.

MIDDLE BODY PREPARATION

The prime stabilizers in this area require extra attention, notably:

- Stomach — abdominals
- Side — external and internal obliques
- Back — erector spinae

ABDOMINALS

OBLIQUES

ERECTOR SPINAE

BODY SEGMENT STRENGTH

All gymsports require extensive upper and lower body development. It is important that the general actions of the upper and lower body are identified along with the muscle groups involved.

PHYSICAL PREPARATION - UPPER BODY

- **Deltoids, Trapezius, Pectorals, Dorsal Group**

EXERCISE SUGGESTION	EASY	MEDIUM	HARD
Handstand	Against wall for time (20 - 1 min)	Handstand walk Handstand combination (tuck, straddle, step to handstand)	Handstand balance for time
Planche lift with resistance 	Light weight	Medium weight	Heavy weight
	Young boys and girls need lots of repetitions rather than heavy weights.		

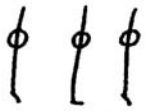
- **Shoulders**

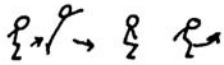
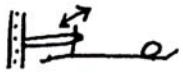
EXERCISE SUGGESTION	EASY	MEDIUM	HARD
Press handstand	From straddle stand feet raised  (Coach assist)	From straddle stand 	From straddle L-Sit on buck, bench, parralettes, Fx.
Stoop through on pommel	Tuck legs through (i) (ii)  (iii) (iv)  And back again	Pike through, as with tuck except straight legs	From back support on handles, pike through, to straddle L-Sit. (i) (ii)  (iii) 
Penguin walk P-Bars	Forward 	Forward, turn, backward without getting off P-Bars	Forward, backward with resistance on ankles
Seal walk	Forward and backward (i) (ii) 	Vary distance and reps.	In back support position forward and backward (i) (ii) 
Planche Lowers	Step handstand, lean forward, lower body slowly to front support. Does not have to be in handstand to start  ∴ Gymnasts who cannot balance in handstand, **can** do this exercise.		

- **Triceps and Biceps**

EXERCISE SUGGESTION	EASY	MEDIUM	HARD
Push-ups	Elbows to side (90º to body)	Elbow close to side of body	With feet raised
Dips	Reverse dips (hands on bench, feet on floor) 	Dips on P-Bars	Dips with Resistance (weight on ankles)
Chip-ups	(i) (ii)  in L-hang, with feet supported	Rev grip in hang	Top grip in hang
Pull-overs	Bar at chin height Feet push off box	Bar at chin height	From hang
Rope climb	Feet on, up and down	Feet on up Feet off down	Feet off up and down

- **Physical Preparation – Lower Body**

EXERCISE SUGGESTION	EASY	MEDIUM	HARD
Step ups	Onto small raised surface, changing legs each step. x20 - 30 (i)  (Buck/Mats Built-up)	Same, one leg first x20 - 30 then other leg x20 - 30	Onto higher surface with exaggerated push through ankles
Rebounds along floor	Legs straight, punch through toes. (i) (ii) (iii)  Very fast tight bounces. Forward and backward. Arms on chest help to maintain posture.	With arm swing, maintain posture. Most important to isolate all movement to ankles.	With arms raised above head. 
Stride rebounds (between angled beat boards) **See Safety* Note**	 Legs straight, fast changes will take some time to get used to.		Same equipment set up; Gymnast jumps from one board to other. Keep weight centred.

EXERCISE SUGGESTION	EASY	MEDIUM	HARD
Rebound from Board to raised surface	 From box, step onto beat board, immediate rebound onto soft Mat. Same arm swing as vault	Higher landing surface 	With resistance on waist (½ - 1kg)
Bounding	90° knee bend, stretch jump forward and land. Hold position, repeat. No further than 90° knee bend. 	Same on soft Mats	With resistance on waist
Hamstrings	With a tube 	With resistance 	With partner  Partner resists movement direction
Squats with resistance	While having a place in a comprehensive programme, this type of exercise should be carefully controlled, expert advice from higher level coaches should be sought first.		
Tuck Jumps	On spot	Zig zag over obstacle (foam blocks, low pommel)	With resistance around waist.
(General) Sprint	25 -30 metres	With resistance on ankles (½ kg)	Towing tyre  or 30 - 50 metre sprint

CO-ORDINATION ACTIVITIES

As well as conditioning the various body segments we must also ensure athletes develop the co-ordination of all muscle groups to move together as they do or should do, during performance. Whole body action occurs during all dynamic skills therefore sequences or combinations of movements can help to work the body as one unit, and continue to condition and strengthen the body in the correct areas. For example:

Straddle Walk / Combination, P-Bars

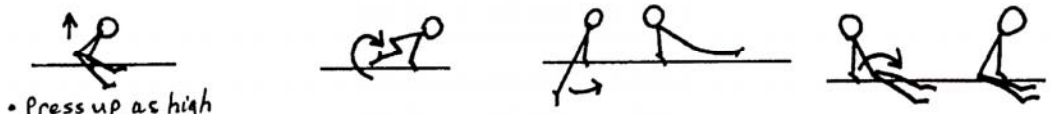
1. Easy

(i) From straddle sit, press up as high as possible

(ii) Bend legs over rails

(iii) Swing forward

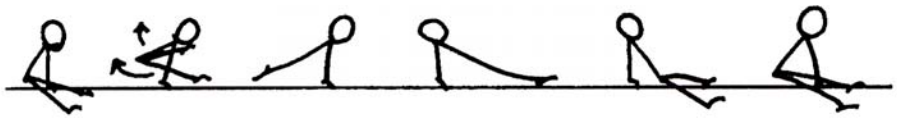
(iv) To straddle sit on bars, reach over legs with hands, repeat from position No (i).



- Press up as high as possible

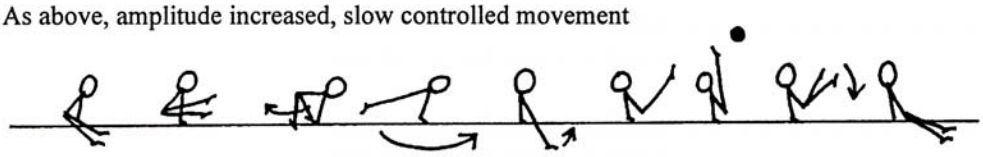
2. Medium

(i) As above with straight legs



3. Hard

(i) As above, amplitude increased, slow controlled movement



Similar Combination on Floor

From front support on floor, slight jump, straddle legs around to straddle L-sit, press back to front support if possible.

(i) (ii) (iii) (iv) (v) (vi)

While strengthening and conditioning, this type of activity is fun.

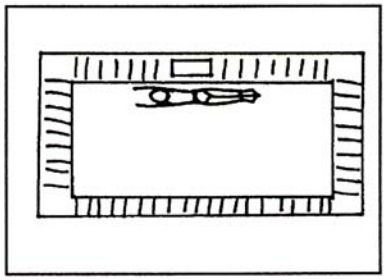
- Provides challenge
- Co-ordination development
- Conditioning
- Use in games/different activity to normal training format
- Is not coach intensive! Coach free to monitor

Whole Body Actions

Can be developed on tramp

Forward Body Snap (I) (ii) (iii)

Initially coach may need to shape gymnast while bouncing. Use a built-up platform with coach standing between tramp frame and tramp bed/mat. Remove some springs to create space!

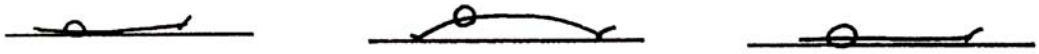


Platform under springs
Springs x3 out

Backward Body Snap

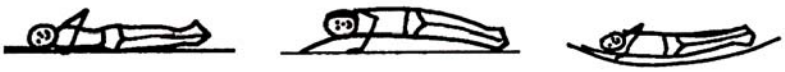
- Note: Chest stays in, hips rise
- One unbroken line through shoulders, hips, ankles and body rigidity is paramount through each movement

(i) (ii) (iii)



Above is more difficult, chest tends to open, rather than hips.

Sideward Body Snap (i) (ii) (iii)



K.C.P - in each exercise gymnast should be supporting on tramp with hands and feet only.

PERIODISATION

You need to develop a training plan that encompasses a year, or even more than one year, if applicable. This training plan is known as periodisation of the training year. A periodised training plan takes the goals of the athlete or team into consideration, the time they have available to devote to training, and incorporates the training principles and guidelines into a master plan that covers a calendar year or longer.

Periodising the training year involves organising the programme into periods that take into consideration the stage of the competitive season the athletes are in and at what stage of the season they want to attain maximal performance. For example, the provincial basketball competition in New Zealand begins in May, and finishes with the National Championships in August. A team that is a candidate for the National Championships will structure its year with a build-up leading into the August championships. All games until that time will be played with individual and team development in mind.

Programme periodisation is important physiologically and psychologically for athletes, as it means that the training is constantly progressing and changing over time. This prevents boredom and promotes motivation for the athletes to progress into the next phase of training. Dividing the year into manageable segments helps you as a coach to tackle a large, sometimes overwhelming job of coaching, and makes planning and goal setting easier.

The components of an annual plan include:

- the periods of training that the season is divided into,
- the weeks of the year filled in, in conjunction with the training periods,
- chronological listing of the competitions, with the importance of each competition noted beside it, and
- the physical preparation, psychological preparation, skills, tactics, and physiological, medical, nutritional, psychological, and technical assessment.

It sounds confusing, but when broken down into segments, the job is made much easier. Figure 4 at the end of the module provides an example of a periodised training plan for netball.

TERMINOLOGY

- **General Preparation**

General preparation refers to the point in the year that an athlete begins to develop a training programme with a specific end point in mind. For example, a netball player may be strength training and running (longer runs and sprints) in an attempt to build their strength and cardiovascular fitness in preparation for netball trials.

- **Specific Preparation**

Specific preparation refers to the point in the season that includes sport-specific training. This will involve high intensity team or individual sessions to work on the skills and fitness required by the sport. All training during this period is designed to prepare athletes for the competitive season so that they are ready to perform well at the first competition.

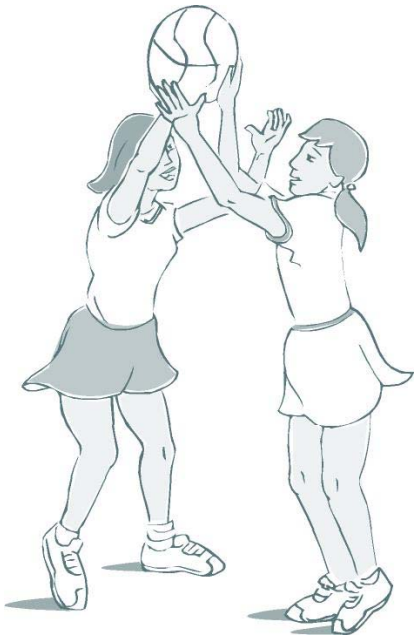
- **Competitive season**

The competitive season is when the main competitions take place. This includes local leagues, finals, and national finals (if applicable). Training should take into consideration the competitions, with the most important events marked on the

calendar, and all training and other competitions leading up to this event.

- **Transition**

The transition, off-season, or 'time off', directly follows the final competition of the season, and is characterised by a break from the specific training. Athletes should be encouraged to participate in 'active rest', getting a break from their specific training and competition, but keeping active so that they don't lose fitness and gain body fat. The off-season is important for healing and rehabilitation of injuries, as well as for a psychological break.



GENERAL GUIDELINES FOR DEVELOPING A PERIODISED PROGRAMME

1. List your Competitions

List all the competitions during the season in the order they are approaching (A = 1st competition,
B = 2nd competition etc.). Rank the importance
(peak index) of these competitions on a scale of 1 to 5 (1 = most important, 5 = least important).

Figure 2 at the end of this module provides an example of a sheet that you can fill in to list the competitions chronologically, and rank their importance. Figure 3 at the end of this module provides an example of a completed sheet listing the competitions and the importance of each competition.

2. Design a Periodised Training Programme

Transfer this information onto the blank periodised training plan work sheet. On the top of the training plan you will read the periods of training.

Figure 4 at the end of this module provides an example of a completed periodised training year for netball. Figure 5 at the end of this module provides a sheet that you can fill in to periodise your own sport into a training year.

3. General Preparation

Determine the number of weeks that will be considered general preparation for the

sport.
A general guideline is to designate between 12 and 24 weeks for this phase.

4. Specific Preparation

Determine the number of weeks that will be considered specific preparation for your sport.
A general guideline is to designate between 6 and 12 weeks for this phase.

5. Competitive Season

Determine the length of the competitive season based on the competitions listed in step 1. The competitive season should incorporate all of the competitions if they are lumped into a season. If the competitions are spread throughout the entire year, designate the most important ones leading up to the most important championships.

6. Transition

Determine the length of the transition period, from the end of the competitive season.

7. Set Rough Training Guidelines

Decide approximately how much time will be set aside for training each week, in each of the training periods. This decision should be a reflection of the number and seriousness of the competitions, and the training athletes are expected to do on their own, outside of practise time. Remember to take into account other aspects of the athlete's life, such as work, social, and other time commitments outside the sport.

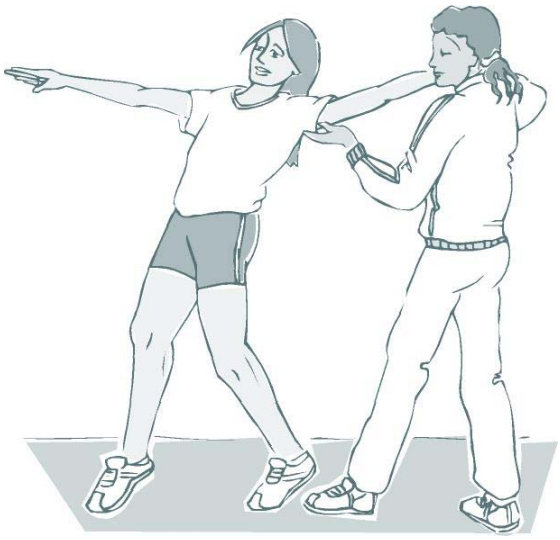
Figure 6 at the end of this module provides an example of a completed plan for netball goal shooting, incorporating the general training periods.

8. Design Specific Training Programmes

As you approach each season, it is important to specify and revise the training guidelines. Remember to programme in rest days and rest weeks to avoid overtraining. The training programmes should take into consideration the training principles and guidelines.

9. Prepare for Competition

Specific preparation for competitions will differ, depending on when and how the competitions specific to the sport are organised. The number of competitions and the structure of competitions leading to the most important ones vary between sports. For example, runners generally have competitions scattered throughout the year, while rugby is designated as a winter sport, and has competitions throughout that time period. Training principles and guidelines are helpful for designing training around this period.



ASSIGNMENT REQUIREMENTS

1. The body utilises three energy systems, explain how these three systems overlap using examples from your gymsport.
2. Explain the application of the general training principles and guidelines to your gymsport, with specific sport examples for each energy system.
3. Develop a Physical Preparation programme for your GymSport and the coaching community you are working with. Your programme should address needs in each of the 3 areas listed below:
   - Body postures
   - Joint Actions
   - Whole body actions
4. Explain the principles of periodisation, and how they apply to your gymsport. Develop a periodised training programme for your gymsport, using the sample sheets as guidelines.

5.

PRIORITIES			
DATE	COMPETITION/GAME	CODE (A-Z)	PEAK INDEX (1-5)*

*1 = most important, 5 = least important.

Fig.2 Worksheet for listing yearly competitions.

PRIORITIES			
DATE	COMPETITION/GAME	CODE (A-Z)	PEAK INDEX (1-5)*
1 June	vs Heriot	A	3
8 June	vs Gore	B	3
17 June	vs Rakaia	C	4
24 June	vs Wainuiomata	D	4
5 July	vs Riversdale	E	3
8 July	vs Naseby	F	2
10 July	vs Duntroon	G	1
23 July	vs Waihi	H	2
1 August	vs Waimakariri	I	2
6 August	vs Ranfurly	J	1
14 August	vs St Bathans	K	1

*1 = most important, 5 = least important.

Fig.3 Example of a filled in worksheet for listing yearly competitions for netball.

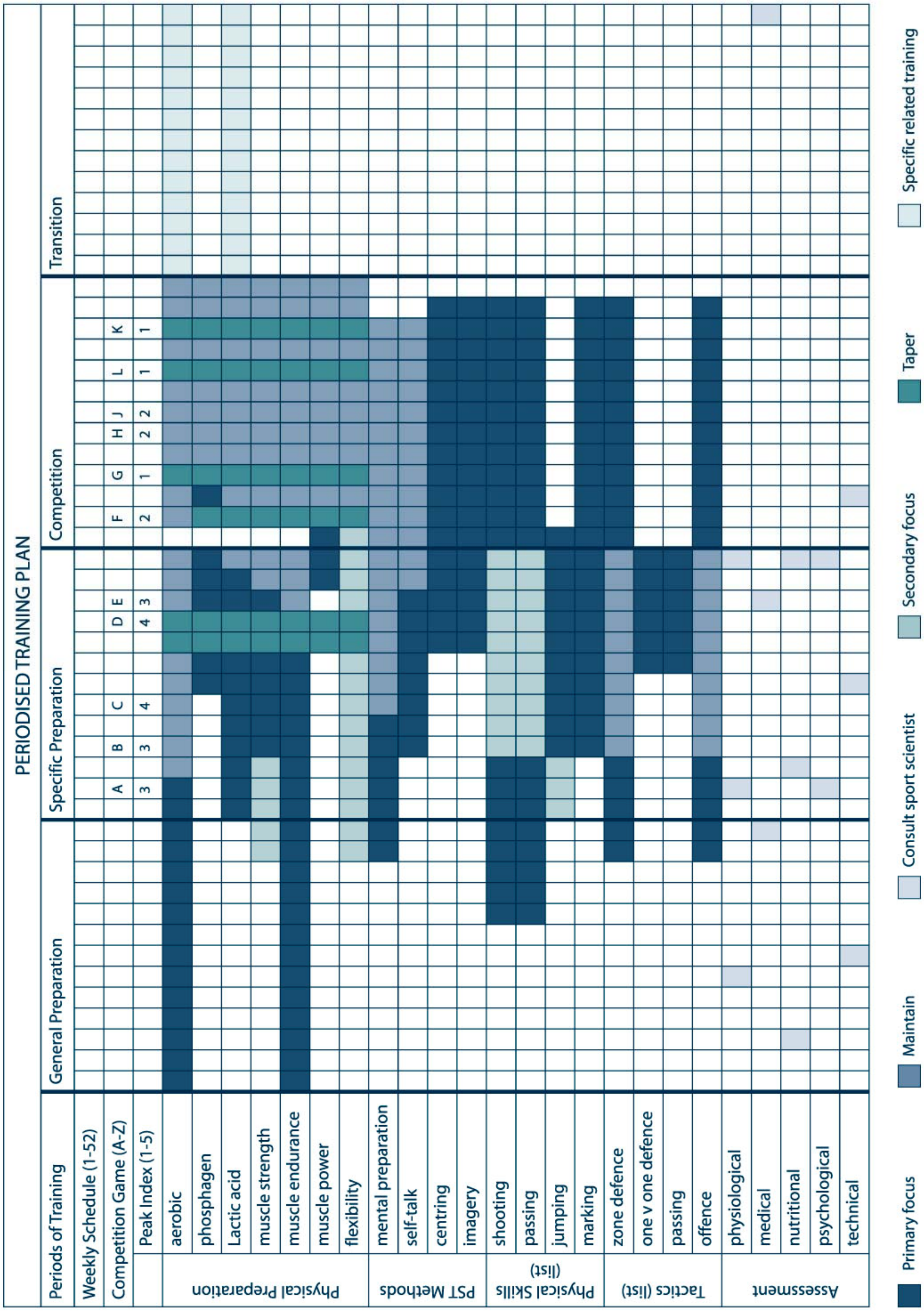


Fig.4 Example of a periodised training year.

PERIODISED TRAINING PLAN

Periods of Training					
Weekly Schedule (1-52)					
Competition Game (A-Z)					
	Peak Index (1-5)				
Physical Preparation					
PST Methods					
Physical Skills (list)					
Tactics (list)					
Assessment	physiological				
	medical				
	nutritional				
	psychological				
	technical				

■ Primary focus ■ Maintain ■ Consult sport scientist ■ Secondary focus ■ Taper ■ Specific related training

Fig.5 Blank sheet of a petiodised training year to be completed by coaches.

EXAMPLE OF GOALS, TARGET DATES, AND INTENDED ACTIONS FOR ALL TRAINING PERIODS

TRAINING PERIOD	GOAL	TARGET DATE	ACTION
General Prep	a) decrease 400m run time by 5 secs. b) succeed with 85% of shots at goal. c) decrease time to reach a state of complete relaxation by 30 secs.	31 May 31 May 31 May	3 sessions per week of 4 sets of 400m runs at 85-90% of best pace. Spend 15 mins at the end of team practise on shooting drills. 2 sessions per week spend 30 mins in quiet room practising centring/relaxation method.
Specific Prep	a) decrease 50m run time by 0.5 secs. b) succeed with 90% of shots at goal. c) increase the number of positive self-talk comments in a practise session by 10%.	31 May 31 July 31 July	2 sessions per week of 3 sets of 50m runs at 90-100% of best pace. Spend 20 mins at the end of team practise on shooting drills. Make a positive self-talk statement 4 times during each drill at team practise.
Competition	a) decrease time to reach a state of complete relaxation to one breath. b) succeed with 95% of shots at goal.	31 July 1 August	2 sessions per week use centring drills during breaks in training. Spend 15 mins at the end of team practise on shooting drills.
Transition	a) decrease maximum steady- state heart rate to 172 beats/ min for 45 min run.	3 February	3 runs of 30-45 mins per week.

All of the goals, target dates, and actions given in this example are well-stated. However, the time required each week to take all the action to achieve all of the goals is far greater than the time normally allocated for training. If athletes try to do too much too soon, they will get nowhere fast.

Fig.6 Example of a completed plan for netball goal shooting, incorporating the training periods.

REFERENCES

Ackland, J. & Reid, B.(1994) The Power to Perform: A Comprehensive Guide to Training and Racing for Endurance Athletes. Reed Books, Auckland, New Zealand.

Bompa, T.O. (1990) Theory and Methodology of Training: The Key to Athletic Performance (2nd ed.)
Kendall Hunt Publishing, Iowa.

Handcock, P. & B. Knight (eds) (1994) Field Testing Manual for Sports. New Zealand Sport Science and Technology Board in conjunction with Coaching New Zealand, Wellington.

Hodge, K., Sleivert, G. & McKenzie, A. (1996) Smart Training for Peak Performance: A Complete Sport Training Guide for Athletes. Reed Publishing (NZ) Ltd.

ACKNOWLEDGEMENTS

Figures 1 to 6 are reproduced with permission from:

Hodge, K., Sleivert, G. & McKenzie, A. (1996) Smart Training for Peak Performance: A Complete Sport Training Guide for Athletes. Reed Publishing (NZ) Ltd.