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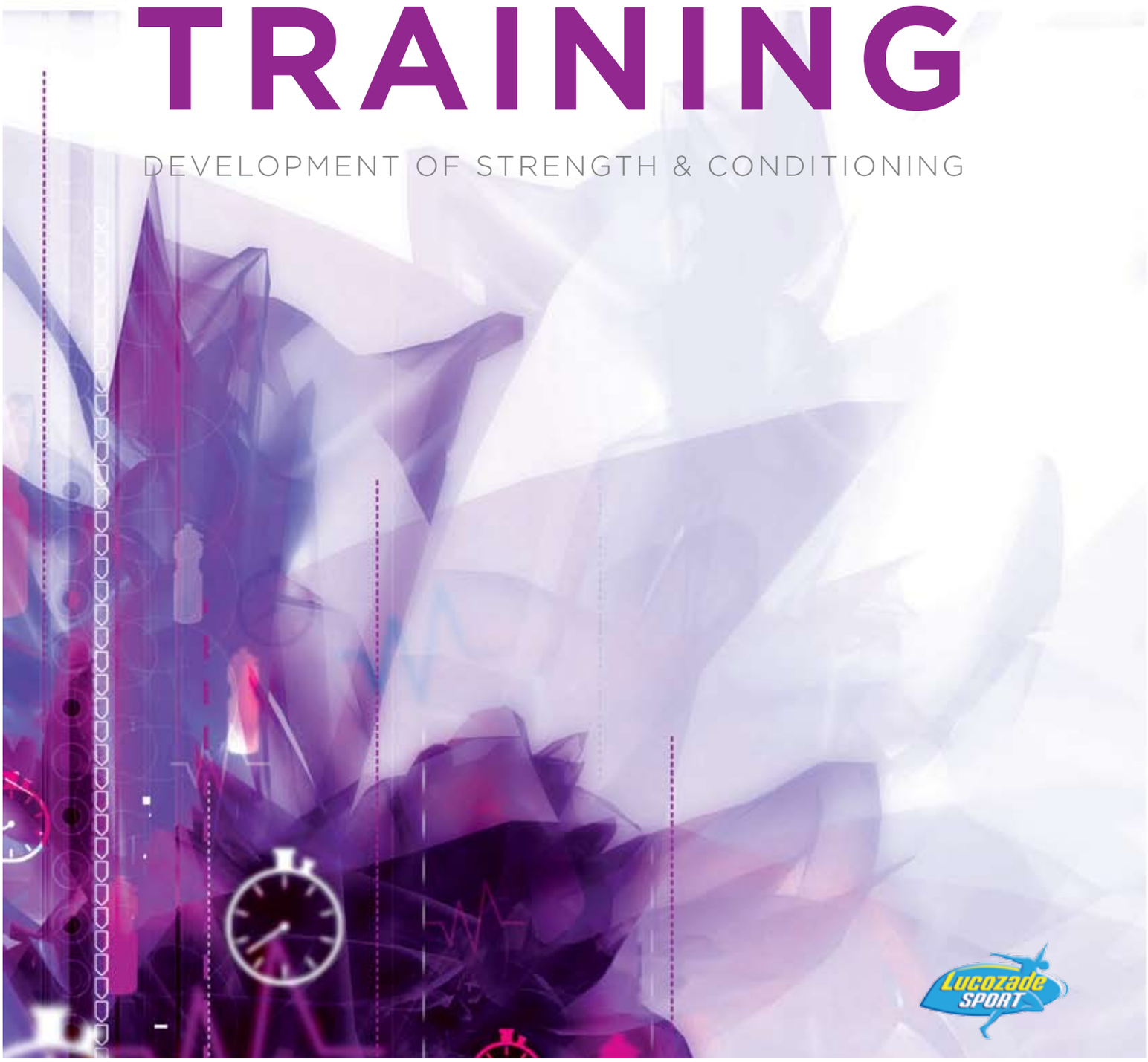
CIRCUIT TRAINING

DEVELOPMENT OF STRENGTH & CONDITIONING



Lucozade SPORT

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CIRCUIT TRAINING:
DEVELOPMENT OF STRENGTH AND CONDITIONING

"Great athletes are not born, they are made."

- Seb Coe

Strength and conditioning training is central to successful athletic performance. It involves the development of aspects of fitness such as cardiovascular endurance, muscular endurance and power.

Athletes need good levels of strength and conditioning to help them attain their sporting goals. For maximum benefit, conditioning training methods need to be applied in an effective manner.

Circuit training is one such training method used in a strength and conditioning programme, and in this fact sheet we provide information related to the correct design and implementation of a circuit training programme. Effective programme design and implementation can result in improved athletic performance.

ONE:
WHAT IS CIRCUIT TRAINING?

"Circuit training is a method of fitness training that is designed to develop general, all-round physical and cardiovascular fitness."

- Scholich (1990:40)

Morgan and Adamson at the University of Leeds first developed circuit training in the 1950s. It is a versatile training method as it can be adapted for many different situations, sections of the population and fitness requirements, and can be used at any time of the year. While the exercises are normally laid out in a circular pattern, the pattern can be varied for motivational purposes to that of a star, square, semi-circle, V-shape, line or zigzag.

The athlete and his or her background, the sport, the time of year and the facilities available will dictate the type of circuit that is designed and implemented. Circuit training can be designed to develop a number of fitness components, including cardiovascular endurance (CVE), muscular endurance (ME), power, and anaerobic endurance. All of these components of fitness are extremely applicable to team sports.

In addition, sport-specific circuits can be designed to address the specific skill and fitness requirements of a sport. Information related to the design of the various types of circuit is contained in this fact sheet. The instruction and delivery of circuit sessions is a key element in the effectiveness of this training method, and important relevant information is also provided at the end of the fact sheet.

Explanation of Terminology

- **Cardiovascular endurance:** Ability to utilise oxygen during exercise. It is the ability of the heart, blood vessels, blood and respiratory system to effectively supply fuel and oxygen to the working muscles, and then the ability of the muscles to utilise this oxygen and fuel to allow sustained exercise.
- **Muscular endurance:** Ability to repeatedly exert a force at a sub-maximal level.
- **Anaerobic endurance:** Ability to sustain repeated short bouts of high intensity exercise. It is the ability of the muscle groups to work without oxygen.
- **Strength:** Maximum force a muscle or group of muscles can produce.
- **Power:** The rate at which work can be done. It is the speed at which strength can be applied or the rate at which force can be developed. These guidelines are for the selection and sequencing of exercises for an ME, CVE, power, anaerobic and sport-specific circuit. For all types of circuit, adaptations and progressions should be provided to the athletes for each exercise, to cater for any mixed ability that may exist within the group.

TWO:
CIRCUIT TRAINING DESIGN GUIDELINES

Muscular Endurance Circuit

This type of circuit is typically used during the pre-season. Balancing muscle groups is the central focus when selecting exercises.

- Include exercises that cover the upper, middle and lower sections of the body.
- Include exercises that work the front and back of the body, i.e. opposing muscle groups, such as quadriceps and hamstrings.
- Lower-body ME activities need to include:
  - Forwards and backwards movement, e.g. lunge
  - Up and down movement, e.g. step-up
  - Right and left movement, e.g. side-lunge.

The sequencing of the exercises is important. Vary the muscle group area that is worked from one exercise to the next. A common sequence to use is an upper-body exercise followed by a middle-body exercise and then a lower-body one. This selection and order of an ME circuit will avoid excessive fatigue in the muscle group and help to maintain good technique, resulting in a reduced risk of injury and a better training effect.

These guidelines are for the selection and sequencing of exercises for an ME, CVE, power, anaerobic and sport-specific circuit. For all types of circuit, adaptations and progressions should be provided to the athletes for each exercise, to cater for any mixed ability that may exist within the group.

Exercises	Time on (s)	Time off (s)	No. of circuits
1. Press-up/modified press-up	30	15	2
2. Sit-up	30	15	2
3. Dumbbell squat & shoulder press	30	15	2
4. Bent-over row	30	15	2
5. Back extension	30	15	2
6. Multi-lunge	30	15	2

Cardiovascular Endurance Circuit

Like the ME circuit, a CVE circuit would tend to be used during the pre-season. It uses many of the movements that are typical of an aerobics session. The movements include dynamic actions using large muscle groups.

- Include on-the-spot and off-the-spot exercises; an example of an on-the-spot exercise is knee-lifts and an off-the-spot exercise would be running shuttles.
- Include high and low impact exercises
- The exercises selected should be balanced as follows:
  - Side to side movement
  - Up and down movement
  - Forwards and backwards movement.
- Alternate between the different directions of movement.
- Alternate between the high and low impact exercises.
- Keep the athletes active during the time off (e.g. walking or stepping side to side).

An example of a CVE circuit suitable for beginners is as follows (90 seconds recovery between circuits):

Exercises	Time on (s)	Time off (s)	No. of circuits
1. Jumping jacks	30	10	2
2. Shuttles	30	10	2
3. Knee lifts	30	10	2
4. Zig-zag running	30	10	2
5. Skipping	30	10	2
6. Grapevine	30	10	2
7. Step-up	30	10	2
8. V-step	30	10	2

Combined CVE and ME Circuit

In many cases, the goal of the circuit is to improve CVE and ME simultaneously. This aspect of fitness is generally targeted and developed during the pre-season, and can be achieved by designing and conducting a combined CVE circuit and ME.

- Include both ME and CVE exercises in the circuit; for equal emphasis, include the same number of CVE and ME exercises, to focus more on ME, have a greater percentage of ME exercises and vice versa.
- Alternate between the CVE and ME exercises.
- When selecting the CVE and ME exercises, adhere to the guidelines outlined previously.
- For ME, use compound exercises as opposed to isolation exercises to target as many muscle groups as possible. Compound exercises involve many joints moving and numerous muscle groups working simultaneously, e.g. back squat or step ups
- If CVE is the more important aspect of this circuit, consider avoiding floor-based ME exercises, such as sit-ups and back extensions during the circuit because the heart rate would decrease too much. Instead, do these exercises at the end of the session.

An example of a combined CVE and ME circuit is as follows (90 seconds recovery between circuits):

Exercises	Time on (s)	Time off (s)	No. of circuits
1. Squat and shoulder press	30	10	2
2. V-step	30	10	2
3. Bent-over row	30	10	2
4. Jumping jacks	30	10	2
5. Lunge	30	10	2
6. Shuttles	30	10	2
7. Step-up and front raise	30	10	2
8. Knee lifts	30	10	2

Medicine Ball Power Circuit

Medicine balls are weighted balls that can be used to develop power. They range in size from 1 kg to 10 kg. With beginners it is recommended to use a lighter weight, such as a 3 kg medicine ball.

Medicine ball exercises can be included in a circuit by themselves or incorporated into a sport-specific or anaerobic circuit. They are very useful for mimicking the skills and patterns of movement of a sport, such as the hand-pass in Gaelic football or the rugby pass. When designing a medicine ball circuit, adhere to the guidelines for the selection and sequencing of an ME circuit.

An example of a medicine ball (MB) power circuit is as follows (three minutes recovery between circuits):

Exercises	Repetitions	Time off (s)	No. of circuits
1. MB single-arm pass	6 each arm	30	2
2. MB twister	6 each side	30	2
3. MB kick	10	30	2
4. MB slam down	10	30	2
5. MB V sit-up	15	30	2
6. MB drive and push	6 each leg	30	2
7. MB overhead throw	10	30	2
8. MB knee lift	6 each leg	30	2

MB chest pass, MB sit-up, MB squat jump and MB hamstring flick are additional exercises that can be incorporated into a medicine ball circuit.

Anaerobic Circuit

The most appropriate time to use an anaerobic circuit is just before and during the competitive season. An anaerobic circuit should only be used with athletes who have a good overall level of fitness and who participate in a sport with a high anaerobic demand.

The aim of such a circuit is to develop power, speed and anaerobic endurance. It stimulates the body to develop the anaerobic energy systems through bouts of maximum-intensity, short-duration exercises.

- Exercises tend to be more plyometric and explosive in nature, e.g. squat jumps, and should involve the major muscle groups in the legs; a plyometric exercise is a jumping type exercise designed to develop explosiveness and speed, e.g. hopping, squat jumping.
- The intensity level is high and the heart rate should be somewhere between 80% and 95% of the maximum heart rate.
- The technical proficiency of the exercises and the speed of movement are vital; while the exercises should be performed in an explosive, quick manner, it is important not to sacrifice technique for speed.
- Due to the high level of technical proficiency demanded during an anaerobic circuit, the time on is low and the time off is high.
- The ratio of time off to time on is 2:1 or 3:1 depending on the anaerobic demands of the sport; keep active during the time off by doing low impact on-the-spot aerobic exercises, e.g. sidestepping with hands on hips.
- Include exercises that work opposing muscles groups and alternate between upper, middle and lower parts of the body.
- Include exercises that are relevant to the muscles used in the sport and the manner in which they are used in the sporting context.
- Monitor athletes throughout the circuit through observation and measurement of heart rate; if the quality of the exercises is too low encourage the athlete to do the exercise at a higher level, if this does not change the quality reduce the time on.

An example of an anaerobic circuit is as follows (four minutes recovery between circuits):

Exercises	Time on (s)	Time off (s)	No. of circuits
1. Pyramid sprints	15	30	2
2. Tuck jumps	15	30	2
3. Treadmills	15	30	2
4. Line ankle jumps	15	30	2
5. Burpees	15	30	2
6. Fast knees	15	30	2
7. Ankle jump pattern	15	30	2
8. Scissors jumps	15	30	2

Squat jump, tuck jump pattern, line tuck jump and split jump are additional exercises that can be incorporated into an anaerobic circuit.

Sport-specific Circuit

To meet the specific requirements of a sport, it is advisable to design a circuit that is sport-specific. In addition to being specific to the sport that the athlete is involved in, a circuit should be related to the age (chronological and training), fitness levels (in particular the fitness weaknesses) and desires / aims of the athletes.

Certain factors need to be considered, as follows, when designing a sport-specific circuit:

- Skills involved in the sport.
- Fitness requirements of the sport; which of these requirements is most important? Will this change depending on the time of year?
- Actions or movements involved in the sport, for example, jumping movements in Gaelic football, getting up off the ground quickly in rugby.
- Major muscle groups used in the patterns of movement involved in the sport.
- Time of year, i.e. pre-season or competitive season.

The term 'sport-specific training' implies that exercises should mimic as much as possible the actions of the body during participation in a given sport. Specificity should not, however, be overemphasised when selecting resistance exercises because it could lead to imbalances. Consequently, finding a balance between general and specific exercises would be appropriate in a circuit.

An example of a sport-specific circuit for Gaelic footballers is as follows (two minutes recovery between circuits):

Exercises	Time on (s)	Time off (s)	No. of circuits
1. Squat jump to catch	30	15	2
2. Zig-zag running with soloing	30	15	2
3. Press-up	30	15	2
4. Shuttle running with soloing	30	15	2
5. Lunging with ball in front	30	15	2
6. Bent-over row	30	15	2
7. Split jump	30	15	2
8. Sit-up	30	15	2

THREE:
PROGRESSIVE OVERLOAD AND VARIATION IN CIRCUIT TRAINING

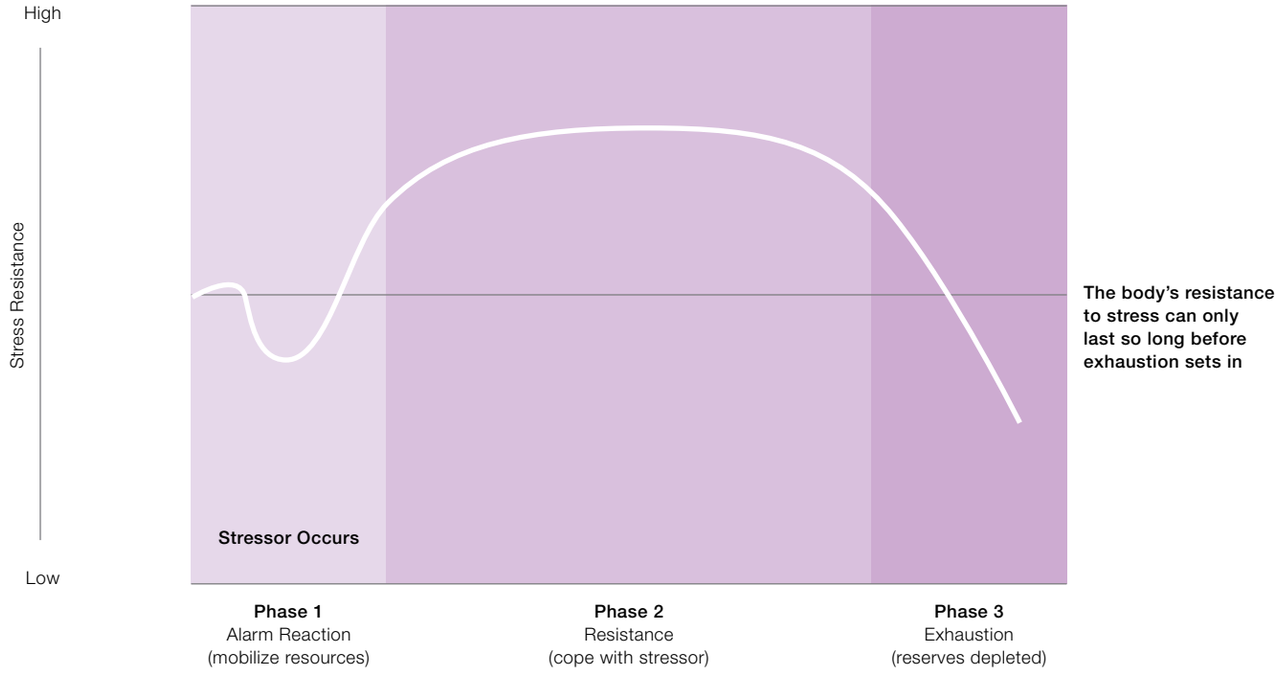
The principles of progression and overload are important to consider when planning a circuit training programme. According to Williams (1993:18), the principle of overload indicates "your body systems must be stressed beyond their normal levels of activity if they are to improve."

The three main dimensions of overload are intensity (how hard?), time (how long?) and frequency (how often?). These dimensions are altered to ensure overload occurs, e.g. increasing the 'time on' for each exercise.

The principle of progression deals with the manner in which this overload is applied. Dick (2002:218) highlighted the importance of this principle when he said that it is "necessary to provide a progressive heightening of the stressor to oblige the body to seek a higher status of adaptation." The stressor is the exercise stimulus; circuit training in this case.

It is necessary to apply this principle to circuit training to ensure that physiological adaptations continually occur. The principle is related to Selye's (1956) General Adaptation Syndrome (GAS) model, which refers to the manner in which humans react to stress. Selye's GAS model contains three stages: Alarm, Resistance and Exhaustion (refer to figure 1).

Figure 1: Selye's General Adaption Syndrome Model



During the alarm, or shock, phase, the body experiences a new or more intense stress, such as during the first circuit training session of the training year. The response to the new stimulus is generally shock, and the athlete experiences soreness, stiffness and a temporary drop in performance.

During the resistance phase, however, the body begins to adapt to the repeated stressor. Initially the body will return to a normal functioning level and if the stressor continues, the physiological changes will go to a higher level. This phase of adaptation is often called super-compensation.

If the stressor is continually applied or the intensity continually increased for prolonged periods, the athlete will reach the exhaustion phase. At this point physiological functioning drops below that which would be considered to be normal functioning levels, i.e. the athlete underperforms. The athlete is now beginning to over-train, and the same symptoms experienced during the alarm phase will reappear.

Selye's GAS model has to be applied to the principle of progressive overload to ensure that the athlete reaches the super-compensation phase, while avoiding the exhaustion phase. The following guidelines relate the application of this principle to circuit training.

Progression in circuit training is achieved by altering the frequency, intensity or time dimensions of overload. Specifically, progression is achieved by:

- Increasing the number of repetitions of each exercise
- Increasing the amount of time on
- Increasing the number of circuits
- Increasing the degree of difficulty of each exercise
- Decreasing the time off between exercises
- Reducing the recovery time between circuits
- Making the recovery time more active
- Increasing the resistance of the exercises by altering the body position or using weight.

The manner in which these guidelines are applied depends on the goal of the circuit. If CVE is the goal, progress will be achieved by, for example, decreasing the time off between exercises and reducing the recovery time between circuits. Increasing the degree of difficulty and the resistance of each exercise or the number of repetitions is appropriate if ME development is the objective.

Guidelines for the application of these methods of progression are as follows:

- Change only one variable at a time
- Increase the time on before adding resistance
- Decrease the repetitions of each exercise or the time on when adding another circuit
- To avoid overtraining and the exhaustion phase of Selye's GAS model, incorporate weeks where the level of intensity of the stressor is reduced (these weeks are often termed down weeks).

An example of a progression plan for eight circuit training sessions where the focus is on CVE and ME is outlined below. The sessions in italics are the down (recovery) week sessions, where the intensity is reduced. The progressions from session to session are highlighted in bold.

Session Number	Time on (s)	Time off (s)	No. of circuits	Comments
1	20	15	2	
2	**25**	15	2	
3	25	**10**	2	
4	*25*	*10*	*2*	6 exercises only. Down week.
5	20	15	**3**	
6	**25**	15	3	
7	**30**	15	3	
8	*30*	*15*	*2*	Number of circuits reduced. Down week.

You could progress by incorporating more difficult exercises and / or increasing the resistance of each exercise. Remember the level of difficulty of the exercises varies for the individuals engaged in the circuit.

For anaerobic circuits, the above methods of progression and the guidelines for the application of these methods would not apply. Quality and speed of movement is central to the effectiveness of an anaerobic circuit, so more is not necessarily better. The progression guidelines for an anaerobic circuit are the opposite of the above guidelines. You progress by ensuring that the exercises are performed at maximum intensity and that the speed and quality of the exercises are increased.

The guidelines are as follows:

- Reduce the time on to increase the quality of the movement
- Increase the time off
- Reduce the number of exercises
- Reduce the number of circuits.

FOUR:
INSTRUCTION AND DELIVERY OF A CIRCUIT TRAINING SESSION

To ensure that circuit training sessions are well planned and implemented in a safe environment, the following guidelines should be followed:

- Screen athletes at the start of the session for illnesses and injuries.
- Include a warm-up at the start of the session and a cool-down at the end.
- Ensure that the room is properly ventilated.
- Check that the equipment is safe, e.g. collars tight on dumbbells.
- Ensure that the exercises selected and the progressions are not only appropriate to the experience and fitness levels of the athletes but also safe.
- Check the athletes' clothing; avoid wearing long tracksuits, heavy cotton clothing and jewellery, check to ensure that shoelaces are tied.
- Ensure that the floor surface is safe; if the surface is hard, use gym mats for any exercise where the body is in contact with the floor.
- Know where the nearest First Aid kit is and who is qualified to provide first aid, if required.
- Monitor the athletes throughout the session.
- Ensure that the athletes' technique is correct at all times.

The following is a list of instructional guidelines related to circuit training. These should be followed to ensure that the sessions are implemented in the correct manner and that the athletes gain the desired training benefit.

- **Planning:** Be prepared and plan in advance; have equipment and exercise station cards ready, have the circuit laid out in the appropriate pattern (circular, star, zigzag, square, etc.) before the start of the session.
- **Professionalism:** Be professional with regard to appearance, punctuality, competency, organisation and instruction.
- **Manner:** Be enthusiastic, friendly, approachable, considerate, positive and discrete.
- **Voice:** Be clear and distinct; project your voice, especially over music, vary pace and tone to emphasise important coaching or safety points.
- **Verbal instruction** (coaching points): Coaching points should be meaningful, concise and direct; they should be specific to the movement and non-technical.
- **Visual instruction** (demonstration): A demonstration of an exercise will increase learning. During a second demonstration, highlight important points that the athletes should adhere to, then conduct the demonstration and question the athletes on the points that you asked them to look out for. Allow immediate practice after the demonstration.
- **Positioning:** Be in a situation where you can see everyone during the circuit training session; stay on the outside of the group and move around.
- **Observation:** You need to observe the following during the circuit:
  - Technique of the exercises
  - Athletes getting into difficulty
  - Safety aspects. For example, have an athlete's shoe-laces opened?

Monitor athletes: This has to be done throughout the session to ensure that the athletes are gaining the training benefit while not getting into difficulty, it can be done by monitoring athletes' heart rates, breathing rates, appearance and exercise technique; you can simply ask them how they feel and/or use the rate of perceived exertion scale.

Feedback/correction of faults: Provide feedback and encouragement throughout and at the end of the session. Make sure you observe the athletes' technique when carrying out the exercises, and if a fault occurs, correct it. Try to avoid just telling the athlete what the fault was. Give the correction rather than the fault. Always try to be positive before giving this correction. This is known as constructive criticism.

FIVE:
FACT SHEET SUMMARY

This fact sheet has highlighted a number of methods and issues related to circuit training and its use and design. The following is a list of the salient points for consideration when deciding to incorporate circuit training into your training regime.

- Circuit training can be used to develop various aspects of strength and conditioning, for example CVE and power.
- Circuit training is a versatile training modality that allows many people to train at the same time and can be used throughout the training year. The type of circuit used depends on the training phase.
- Specific guidelines exist for the different types of circuits. These should be adhered to in order to optimise the training benefit for the athlete.
- The principles of overload and progression need to be applied to circuit training to ensure that the athletes achieve overload to stimulate adaptation to occur.
- Effective instruction and pedagogical principles need to be used to ensure that circuit training is conducted in a safe and enjoyable environment, where the athletes are gaining the desired training benefit.

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