April 4, 2017

Competition-Coaching Introduction L2T

Step 4:

Athletic components

Reference Material
for Dryland Workshop

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This section on Athletic Components expands on the information on the five basic Ss of training and performance outlined in section 2.6, and is directed at supporting you in your role working with children in the first three stages of athlete development.

This section will also provide you with materials that will assist you if you choose to work with athletes in the Training to Train stage and beyond. For more information on training zones and athlete development please make sure you register for the Athlete Development Matrix on CCC's website.

4.1 Aerobic Fitness (Stamina)

Aerobic fitness (stamina or endurance) is a global concept reflecting the ability to sustain a physical effort for a prolonged duration. More specifically, it is the body's ability to exercise whole muscle groups over an extended period of time at easy to vigorous intensities. While the development of stamina is a long and essential process for any endurance athlete, it is skill acquisition and refinement that are the focus of the Learning to Train (L2T) stage.

During this period athletes should be supported by activities that promote general conditioning and games that emphasize creativity and excellent technical execution. Practice sessions structured in this way will naturally develop the full spectrum of athletic components (skill, speed, strength, stamina, suppleness) required for the successful development of an athlete.

During the L2T stage athletes should be encouraged to take an increasingly systematic approach towards the development of their own fitness. The objective is to establish habits that will lay the groundwork for a healthy, active lifestyle and help them enjoy the sport at whatever level they later choose to participate.

If athletes wish to pursue the competitive stream of the sport, they will need to take this a step further when they reach the Training to Train (T2T) stage, and begin following a structured training program.

Optimal aerobic trainability begins with the onset of Peak Height Velocity (PHV), the major growth spurt during maturation. In females, this can occur at the end of the L2T stage or at the beginning of the T2T stage. In males, it occurs at some point during the T2T stage. The T2T stage is therefore very important for developing the aerobic capacity that is especially critical for the sport of cross-country skiing. This means athletes at the T2T stage will do a lot of skiing at easy to moderate intensities.

Although developing aerobic capacity doesn't become a top priority until the T2T stage, the information that follows is important for coaches of L2T athletes because it provides a base of understanding for developing programs and practice/training sessions that are appropriate for the different levels of maturity you are likely to encounter.

For more detailed information refer to the CCI-T2T (Dryland) Reference Material.

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Considerations for developing aerobic capacity during the first three stages of the LTAD progression are:

- **Active Start Stage** - organized physical activity and active play should be a part of a child's daily life.
- **FUNdamentals Stage** - aerobic fitness can be developed through the use of general aerobic activities two to three times a week. Introduce endurance-oriented activities through games and play.
- **L2T Stage** - aerobic fitness is increasingly important and by this stage athletes should be developing an active lifestyle and participating in aerobic activities three to four times a week. Utilize games, relays, etc. These sessions should involve a total of 30 minutes or more of easy to vigorous intensity exercise (with at least 10 -15 minutes of continuous effort during moderate exercise).

4.1.1 Guidelines for Developing Aerobic Fitness

Note: The following information on developing aerobic fitness is very general and must be adapted to the needs of the athletes you coach *according to their stage of development*.

- The effort should be dynamic and it should involve large muscle groups (e.g. running, hiking, cycling, swimming, cross-country skiing, etc.).
- To obtain benefit from the exercise, the effort must be sustained for at least 10 to 15 minutes, and the athletes have to be active for most of that time (e.g. moving as much as possible). At the same time there is an upper-limit that needs to be considered. Athletes at the L2T stage can sustain a vigorous effort for up to 20 minutes (activities such as running), and a low intensity (easy) effort for up to two to three hours (activities such as hiking).
- The speed of execution (i.e. the intensity) should vary, and the duration of the activity should depend on the speed at which it is done. For example, an athlete won't attain optimal health and fitness benefits during activities lasting less than 15 minutes unless the intensity is at least moderate (for the athlete).
- The same speed of execution may not result in the same intensity of effort for every athlete. It is important to recognize that the intensity of the effort may have to be individualized.
- The activity or exercise can be continuous (i.e. no rest periods) or intermittent (i.e. alternating periods of work and recovery).
- Fatigue may occur in the case of moderate to vigorous efforts (e.g. 30 minutes of cross-country skiing; 20 minutes of running). Therefore, activities lasting longer than 20 minutes need to include easy effort in order to be sustainable.

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4.1.2 Introduction to Energy Systems - How the Body Performs Work

Energy for the body to perform work comes from different fuel sources. The three fuel sources that the human body uses for this purpose are fat, sugar (carbohydrate) and protein. Since an individual's capacity to store each of these fuel sources is limited, and each one requires time in order to be turned into energy, all of them are engaged to varying degrees during every type of activity.

Although there are only three main sources, the body uses a variety of different processes to convert fuel into energy. Some of these processes use oxygen to release the stored energy required for the body to do work. Collectively, they are called "aerobic" because they occur in the presence of oxygen. In this situation the aerobic processes use oxygen to break down fuel sources (i.e. fat and sugar) and convert them into energy, which is used for the body's work (i.e. muscle contraction).

Processes that do not require oxygen to convert fuel into energy are called "anaerobic". As described below, each type of energy release has unique characteristics that will optimize its function in different circumstances. Working together, the aerobic and anaerobic processes provide a balanced and integrated energy supply for activities such as walking, sprinting and everything in between.

- Characteristics of the Aerobic Processes

- High capacity, because there is a large supply of the source materials - oxygen and stored fuel (i.e. fat). Aerobic work can continue as long as both are available.

- Low power (i.e. slow energy production), because there are many steps involved in getting the fuel out of storage and moving oxygen from the lungs to places where the energy is needed.

Characteristics of the Anaerobic Processes

- Low capacity, because there is a limited supply of usable fuel and the body produces waste products that are harmful to working muscles. As a result, these processes need to reduce their rate of energy production over time to allow for the waste products (such as lactic acid) to be cleared away.
- High power (i.e. fast energy production), because fuel is readily available where it is needed, and there are few steps required to convert the fuel to energy.

How Aerobic and Anaerobic Processes Work Together

- Both types of energy conversion processes provide some energy for all the activities we do. Neither one is ever turned off completely. However the rate at which each one operates varies depending on the intensity and duration of the activity.
- All the different activities an individual does (e.g. jumping, sprinting, jogging, walking) can be placed on this continuum of energy supply.
- Whether energy is released through aerobic or anaerobic processes, it is used by the body to perform different kinds of work (e.g. breathing, heart function). In sport the most common use of energy is the contraction of major muscle groups in order to produce movement.

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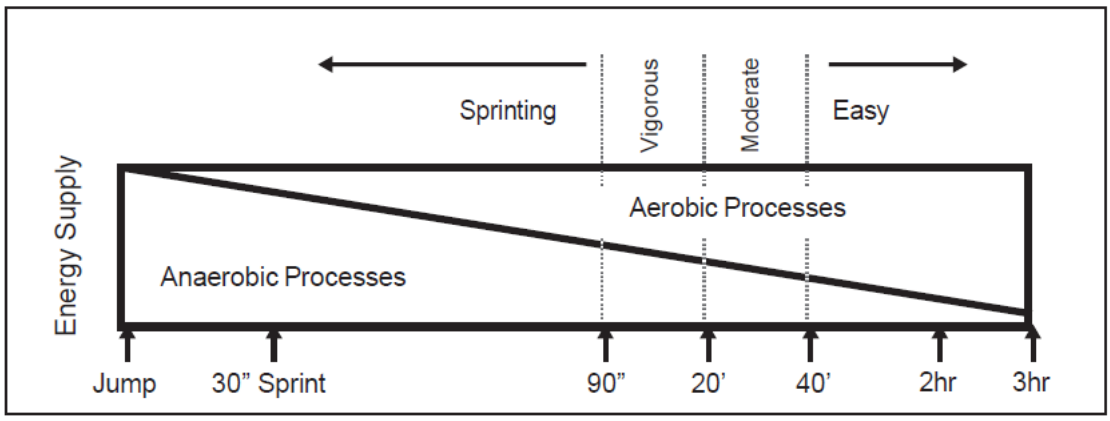
Figure 4.1

Schematic of the relative contribution of aerobic and anaerobic processes to total energy supply for maximal efforts of different lengths (adapted from Harre, 1982).



Muscle Structure and Function

- Every muscle in the body is composed of thousands of tiny fibres, each of which has aerobic and anaerobic processes constantly occurring inside of it.
- Some fibres, called Type I fibres, prefer to use aerobic processes and take a relatively long time to fatigue. These fibres are sometimes referred to as "slow twitch" because they prefer a slower energy supply and tend to produce low power in each contraction.
- Other fibres prefer to use anaerobic processes. These fibres are called Type II fibres and they fatigue more quickly than Type I fibres. Type II fibres are sometimes called "fast twitch" because they prefer a faster energy supply and tend to produce higher power in each contraction.
- Every major muscle (e.g. quadriceps, biceps) is composed of both Type I and Type II fibres, but each muscle contraction does not result in the contraction of every fibre in that muscle. The number and type of muscle fibres that contract depends on the force and power of the desired movement (see Figure 4.2).
- Low power output activities, like jogging, require a small proportion of the available muscle fibres for one contraction in a large muscle group. The nervous system signals different fibres for each contraction, using a cyclic recruitment pattern. Therefore each fibre has plenty of time to produce energy and clear waste products before it must contract again.

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Figure 4.2

Characteristics of Muscle Fibres	
Type I / Slow Twitch	**Type II / Fast Twitch**
Slower contraction	Faster contraction
Prefers aerobic processes and shares their characteristics	Prefers anaerobic processes and shares their characteristics
Fatigues slowly	Fatigues quickly
Used preferentially when repetitive contractions or low speed is needed	Used preferentially when high force and/or high speed is needed

Different exercise/training intensities reflect the recruitment of different muscle fibre types and different fuel systems. It is important for all athletes to train at a variety of intensities so that they train the proper recruitment patterns and energy systems and allow for proper recovery of the muscle fibres and energy stores.

4.1.3 Introduction to Exercise/Training Intensities

The following is intended to help coaches relate the above guidelines and theory to ski-specific situations. These four examples represent the different levels of effort or intensity that are common in cross-country skiing and each one relates to one of the four categories of exercise intensity shown in Figure 4.1 (“easy”, “moderate”, “vigorous” and “sprinting”). Moving at each of these intensities will affect the body differently. It is important, therefore, that athletes experience all of them through the course of the ski season.

- Travelling smoothly and easily along the flat, feeling fresh and full of energy. (Easy)
- Skiing up a moderate hill which makes you breathe a little harder, but still leaves you in control of your breathing and your technique. (Moderate)
- Skiing up a steep hill which strains your body and increases your heart rate and your breathing. (Vigorous)
- An all-out sprint up a hill, racing against someone who doesn’t let you pass easily. (Sprinting) Coaches should keep in mind that the priority of the L2T stage is to develop technique and aerobic fitness in as wide a variety of conditions as possible. Obviously, more practice time wil be spent at lower intensities and more recovery will be required after sprinting and steep hill climbing.

To determine the intensity of effort for each athlete, the coach should talk to them during the activity. A good guideline to follow would be:

- During easy exercise an athlete should be able to converse and breathing should not interfere with the control of speech.

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- During moderate and more intense exercise, as the effort increases, the need to breathe more frequently and deeply will increasingly interfere with a normal pattern of conversation as the effort increases.
- During sprinting athletes will not be able to speak more than one or two words as breath with be fast and rapid.

Training Zones

Exercise/training intensities can be categorized in many different ways and are often described as "zones". Zones can be divided into any number of finite categories, and they can be determined relative to many different physiological markers. Often, training zones are defined relative to maximum heart rate HR_{max} or perceived exertion (how hard a certain pace feels relative to an athlete's maximum level of effort). However, they can also be determined based on the relative contribution of the different energy processes described above (i.e. aerobic and anaerobic). As an athlete matures, physical and technical abilities become more refined and more specificity is needed in the definition of training intensities, which in turn requires an increased number of training zones, each with a specific purpose.

At the L2T stage, athletes are still developing the machinery required for the energy processes to function in a mature fashion. As a result, three intensity zones are sufficient to categorize all the different ski speeds and levels of effort at which an athlete will train. In later stages of athlete development, these zones will be sub-divided to provide more specific intensity targets. The descriptions below will provide coaches with an understanding of the general benefits of each training zone. They should also help coaches relate each zone to the common cross-country ski examples listed earlier in this section.

- **Endurance Training.** This is the level of exercise intensity that develops strong central cardio-vasular components - a large powerful heart that can efficiently transport blood to the working muscles. It includes "easy" and some "moderate" intensity exercises (see Figure4.1). Usually this takes the form of "long slow distance" work-outs or fun outings where conversation and socializing are a major part of the experience. How long "long" is depends on the stage of development (both physical and technical) that the athlete has reached. Throughout an endurance athletes' career, the majority of training time will be spent at this level of intensity. Athletes at the L2T stage of development can maintain this level of effort for 30 minutes up to about 2 hours.

- **Intensity Training.** This range of intensities also develops strong cardiovascular components and includes all "vigorous" exercise intensities. Some "moderate" exercise also provides an Intensity training effect because it involves enough anaerobic processes that it is more like "vigorous" exercise than "easy" exercise. Intensity training improves the efficiency of the exercising muscles and increases overall energy production capabilities. L2T athletes receive these benefits when they perform efforts that they can maintain for 90 seconds up to about 30 minutes. However, greater amounts of energy and longer recovery periods are required, so intensity training cannot be performed as frequently as endurance training. If used too often, intensity training can prevent the athlete from recovering appropriately and lead to overtraining. Nonetheless, it is appropriate for shorter training sessions, intermittent work, technique and ski speed development, and pre-race warm-up.

- **Sprinting.** This level of intensity includes all types of "sprinting" – from practicing race starts

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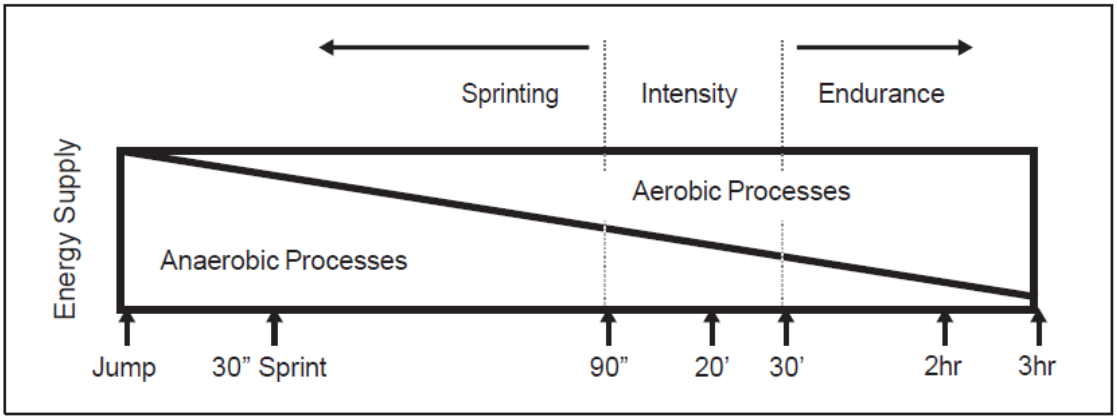
to sprint races that last up to 1.5 minutes. When athletes are “sprinting”, their ski speed will be as fast as possible for the given distance and their perceived effort will be very high, but their heart rate will not reflect their level of effort. Sprint intensities require levels of energy production that exceed the maximum rate of the aerobic processes.

Figure 4.3

Schematic of the range of intensities associated with each training zone. Intensity is defined by the fastest pace that can be maintained for the time frames shown (adapted from Harre, 1982).



4.1.4 Relating Maximum Heart Rate and Muscle Function to Training Zones

Maximum heart rate (HR_{max}) is the maximum number of heart beats per minute during a specific activity. It is affected by age (it slowly decreases as a person becomes older), height (taller people generally have lower HR_{max} than shorter people), genetics and training history (endurance athletes tend to have lower HR_{max} than power and speed athletes). Generally, HR_{max} is also influenced by the heart’s need to overcome gravity. Fully upright activities like running and skiing tend to produce higher HR_{max} than activities like cycling and swimming. Maximal heart rates in swimming and cycling are usually five to 10 beats lower than in cross-country skiing and running. As we usually determine zones from percentages of HR_{max}, it is important to note that training zones will likely be different for running and cycling. For athletes in the L2T stage of development, hearts are still growing and muscles are still developing, so HR training zones are difficult to apply accurately. For this reason, it is better to use average speed or perceived effort to determine training intensity. The table below shows how the different energy systems and muscle fibre types relate to the L2T-stage training zones and to perceived effort based on the rating of perceived exertion (RPE). Refer to Figures 4.5 and 4.6 for additional information on RPE.

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Figure 4.4

Training Zone	Endurance	Intensity	Sprinting
Energy Supply	Primarily aerobic processes	Primarily aerobic processes; with significant contribution from anaerobic processes	Primarily anaerobic processes; significant aerobic component in efforts ≥ 1.5 min
Muscle Fibre Recruitment	- Mostly Type I - Moderate force and power - Long rest cycle	- Mix of Type I & II - High force and power - Decreasing rest cycle	- Mix of Type I & II - Max power - Short rest cycle
% HR_{max}	~ 60 – 85%	~ 85 – 100%	N/A
RPE	8-12	13-16	17-20

Generally, aerobic activity for L2T-stage athletes should be done at 85% of HR_{max} or less, and a prolonged higher intensity effort should only last five to 10 minutes. On the other hand, athletes in the T2T stage of development should be more physically ready to engage in higher intensity and longer duration activities. More information on what is appropriate for athletes at that stage will be provided at the next level - the NCCP CCI-T2T (Dryland) Workshop.

Keep in mind that, regardless of developmental stage, an athlete's ability to converse during exercise is a good general indicator of exercise intensity. The transition from endurance training to intensity training usually occurs when the athlete is no longer able to speak more than two or three words without breathing interrupting speech.

4.1.5 Explaining It to Your athletes - What Happens When You Exercise?

Below are several examples you can give your athletes to help explain the basic physiological events that occur in their bodies when they exercise. You may also wish to use some of these examples as references when you are planning or evaluating a training session. For example, into which category do the planned activities fall? What training zone(s) will be utilized? How much time will the athletes spend performing these activities? How does this compare to the timeline shown in Figure 4.3 and the LTAD recommendations for the L2T stage of development?

- **Transition (rest to exercise; change in speed)**. When you first start moving, your energy systems will be working hard to adapt to the change in energy demand created by your change in pace (i.e. from sitting to jogging). Since the aerobic processes take longer to get going, the anaerobic processes will provide some energy to ensure that the overall demand is met.

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- **Steady State Endurance Training**. Once you have warmed up, your breathing and heart rate will stabilize and you will begin to feel comfortable. At this point you will be producing most of your energy using the aerobic processes, and each muscle fibre will get ample rest between contractions. This is because you have many more motor units available than required for the power you are producing. You are easily able to converse with your friends while you do this kind of training.

- **Steady State Intensity Training (a long steady hill climb)**. To move faster on the flats or to continue at the same speed when going up an incline, you will have to use additional muscle fibres to create the extra force you need. You will also use more anaerobic processes and, as a result, some waste products like lactic acid will be produced. Luckily, for the most part, you will still be using aerobic processes, including some that are very good at using up lactate. That will keep you from accumulating too much lactate in your muscles. If you continue at this speed, some muscle fibres will eventually fatigue, so others need to be recruited more frequently in order for you to maintain your power.

> Coach's Note: Depending on the age and training history of the athlete, this range of intensity can be maintained for 20 to 45 minutes in a single, exhaustive effort. However athletes at the L2T stage of development should only sustain this type of effort for a maximum of 20 minutes. Although the intensity training zone includes efforts that can be maintained for up to 30 minutes, the training benefit is maximized when coaches avoid performing "low end" intensity training.

- **Transition Intensity Training (interval training or time trial)**. When you are moving so fast that breathing is heavy and it's difficult to speak clearly, your muscle fibres will use even more oxygen because they are contracting more frequently. More Type II fibres will be recruited, which increases the amount of anaerobic energy production. If you maintain your speed, your heart rate will gradually rise until it reaches its maximum. Your anaerobic processes will produce waste products even faster and your aerobic processes will increase energy production until they are working as fast as they can. Even though a lot of the lactic acid being produced is being cleared from your muscles, it will accumulate rapidly. This range of intensity can be maintained for approximately five to 15 minutes in a single, exhaustive effort.

> Coach's Note: This type of training is NOT appropriate for athletes in the L2T stage of development. Athletes will naturally spend some time at this intensity during games, races and difficult terrain, but it should not be targeted specifically for training. It is also important to note that L2T athletes do not have the technical ability, muscle mass or metabolic machinery to produce a wide range of ski speeds during "high end" intensity efforts. Because of these developmental limitations, there is very little benefit to performing continuous training efforts that last between 90 seconds and five minutes.

- **Sprinting**. Huge amounts of energy are required in order to produce high forces with maximum speed. When you sprint, you will use a very large portion of the muscle fibres you have for each contraction. The aerobic processes will be too slow to provide much of the energy needed for this task, so throughout a sprint effort you will have to rely heavily on the anaerobic processes. As a result, high levels of waste products will accumulate quickly and muscle fibres will fatigue rapidly (because they get very little rest between contractions). Because your anaerobic processes are still developing, we say that sprinting can last up to 1.5 minutes. But as you know, it is impossible to run very fast for that long. True sprinting

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rarely lasts longer than 30-45 seconds, but what is happening inside your body is very similar when the duration is longer.

4.1.6 How Can Athletes Tell The Level at Which They Are Exercising?

At the L2T stage, there are many subjective indicators of intensity, including the level of exertion, how hard the person is breathing and the feeling of fatigue. Scales that allow athletes to rate their perceived exertion (like the RPE scale described in Figure 4.5) can be a valuable communication tool for coaches and athletes. In addition, the process of subjectively quantifying effort teaches the athlete valuable lessons in self-awareness.

In addition to helping athletes develop an awareness of the effort they exert in various situations, the concept of pace (average speed) should be introduced to L2T athletes so that they can begin to understand how speed is related to perceived effort, and how changes in terrain, snow conditions and technical efficiency influence both.

Figure 4.5 Borg Rating of Perceived Exertion (RPE) Scale

Exertion	RPE
No exertion at all	6
Extremely light	7
	8
Very light	9
	10
Light	11
	12
Somewhat hard	13
	14
Hard (heavy)	15
	16
Very hard	17
	18
Extremely hard	19
Maximal exertion	20

Figure 4.6 Modified Rating of Perceived Exertion (RPE) Scale

Exertion	RPE
Nothing at all	0
Very, very weak	0.5
Very weak	1
Weak	2
Moderate	3
Somewhat strong	4
Strong	5
	6
Very strong	7
	8
	9
Very, very strong	10

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Guideline for Developing Endurance

- ❏ Practices should contain a mix of endurance, actives. An individual practice can contain one specific focus (a long hike) or contain many differ activities (sprints, relays and a long bike ride)..
- ❏ As the optimal window of trainability for aerobic endurance occurs at this stage of development, coaches should include increasing endurance training stimulus as athletes improve grow and develop.
- ❏ The practice should whenever possible include a wide variety of terrain, training mode and locations to keep kids interested and challenged.
- ❏ Athletes should be encouraged to maintain or take up other sports that include an endurance component such as soccer or swimming.
- ❏ Athletes should perform some form of physical activity at least 5 times a week for more than 30min a session (this can include gym classes or unstructured outdoor physical activity.

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4.2 Flexibility (Suppleness)

Flexibility is the ability to conduct movements at certain joints with an appropriate range of motion.

There are a variety of stretching techniques that can be used to develop and maintain flexibility, but at all stages of athlete development the emphasis should be on static and dynamic stretching.

- **Static Stretching** - requires athletes to reach a full range of motion around a certain joint until they feel the muscle stretch. Once the optimal range of motion is attained, the stretch needs to be held for at least 20 seconds in order for the full benefit to be achieved. Note however that the stretch should not reach the point where it is quite painful to hold it. Static stretching should be performed after a proper warm up, workout or dynamic stretching.
- **Dynamic Stretching** - is swinging a given body part until a full range of motion is reached. Athletes should feel the stretching without going hard and/or far enough to damage the muscle fibres with the excessive swinging motion. Dynamic stretching is often used as a component of a warm-up routine prior to a high intensity workout such as a competition.

The window of optimal trainability for flexibility, for both boys and girls, occurs between six and 10 years of age - during both the FUNdamentals and L2T stages. Special attention should also be paid to flexibility during PHV (T2T stage). Refer to figure 2.5 in section 2.6 for more information.

Flexibility considerations for the first three stages of the LTAD progression are:

- **Active Start Stage** - provide unstructured and organized physical activity opportunities on a daily basis.
- **FUNdamentals Stage** – this is the window of optimal trainability for both boys and girls. Basic static and dynamic flexibility/stretching exercises should be introduced in an appropriate setting, with an emphasis on proper technique. Development can occur through participation in a variety of off-snow activities.
- **Learning to Train Stage** – this is the window of optimal trainability for both boys and girls. Flexibility should be further developed using stage-appropriate exercises in suitable settings. By the end of this stage static stretching should become a regular part of physical exercise and specific stretches for cross-country skiing movements can be introduced. Flexibility assessments should be done at least twice a year.

Muscles will tighten and shorten with exercise. Regular stretching is required if an individual is to remain supple and agile. Moreover, in order to execute proper ski technique, it is important for an athlete to be able to (1) move through a large range of motions, and (2) have a balance between muscle groups.

A good flexibility program will increase the length of the muscles, prepare the muscles for intense work and help in recovery. Repetitive high intensity will over time shorten the length of the muscles. However a good flexibility program before a competition or intense training session is not the same as a flexibility program designed for long term improvement – different methods are required for the different situations.

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Note: The following information on flexibility is very general and must be adapted to the needs of the athletes you coach *according to their stage of development*.

4.2.1 Guidelines for Developing Flexibility

The points below relate to the method of developing flexibility called static stretching.

- ❏ When stretching is done incorrectly or at the wrong time it can actually do more harm than good. It is essential therefore to understand the right techniques before you introduce a flexibility program.
- ❏ Flexibility exercises should be preceded by a light warm-up involving continuous, dynamic efforts (e.g. light running for five minutes).
- ❏ The exercises are performed without the help of a partner, and without the application of external force on the limb or joint.
- ❏ The muscle or muscle group must be stretched in a controlled and gradual manner, without any interruption of the movement, and until a slight tension is felt. Once the muscle is slightly stretched and relaxed, the athlete must hold the position for 20 to 40 seconds.
- ❏ Athletes should breathe slowly and deeply when performing a stretch.
- ❏ Exercises should be performed on both sides.
- ❏ Each exercise can be repeated two to four times during a practice session.
- ❏ Quick, sudden movements should be avoided when stretching, especially when the muscle is not sufficiently warm.
- ❏ For older athletes, the cool-down period of a practice session is conducive to performing flexibility exercises because (1) muscles are normally adequately warmed-up at that point, and (2) flexibility does not involve intense effort. While athletes are stretching, the coach can gather feedback concerning the practice session, and can provide his/her feedback or information as required.

Examples of stretching exercises for the main muscle groups are provided in sections 4.2.2 and 4.2.3.

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Why Stretch?

Stretching, because it relaxes the mind and tunes up the body, should be a part of everyone's daily routine.

Regular stretching will:

- ❏ Reduce muscle tension and make the body feel more relaxed.
- ❏ Help coordination by allowing for freer and easier movement.
- ❏ Increase the range of motion.
- ❏ Make muscles more supple (injury is less likely).
- ❏ Contribute to correcting problems with technique due to muscle imbalances and poor posture.
- ❏ Improve circulation.
- ❏ Feel good!

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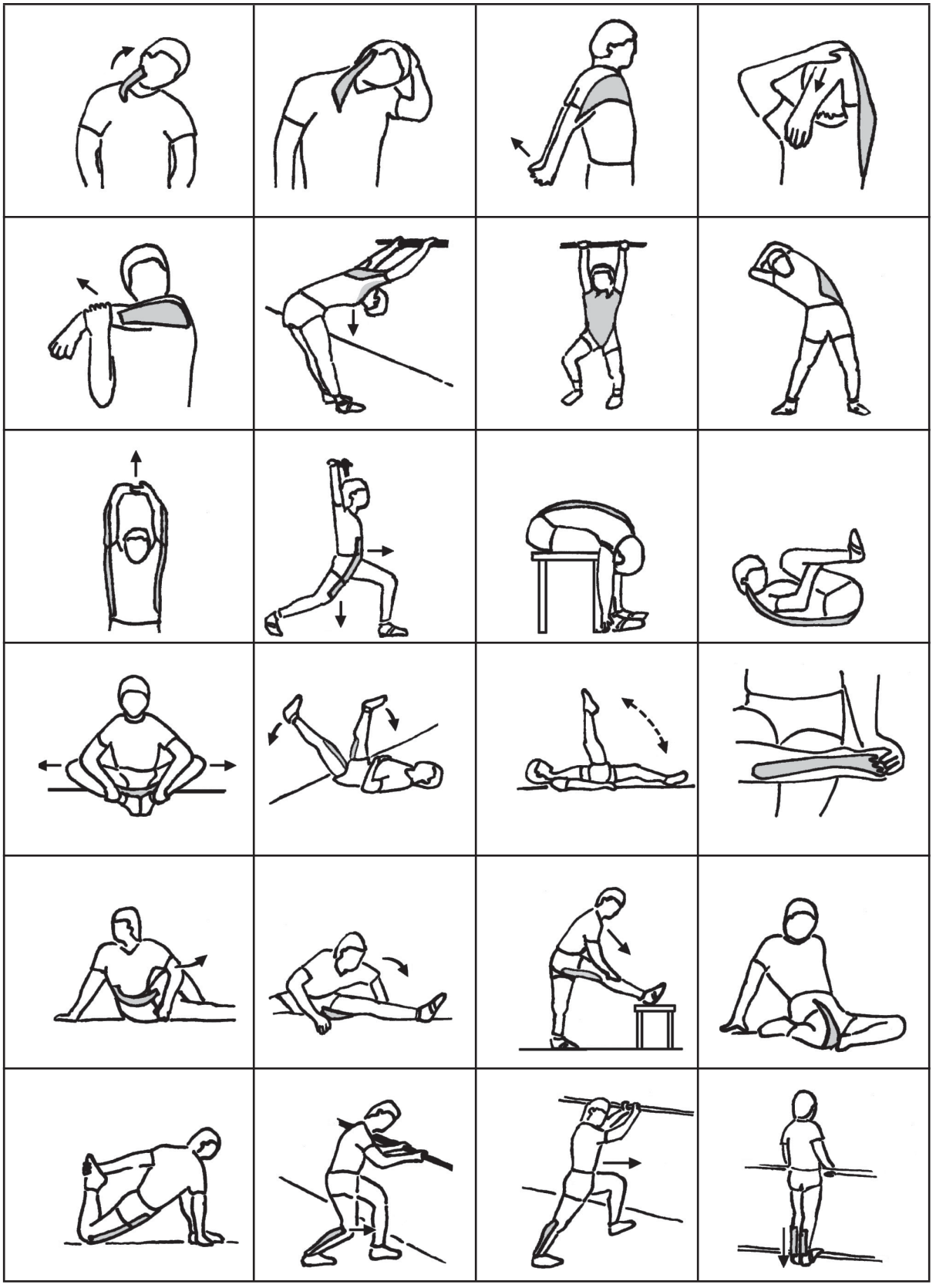
4.2.2 Basic Flexibility Exercises (Static)



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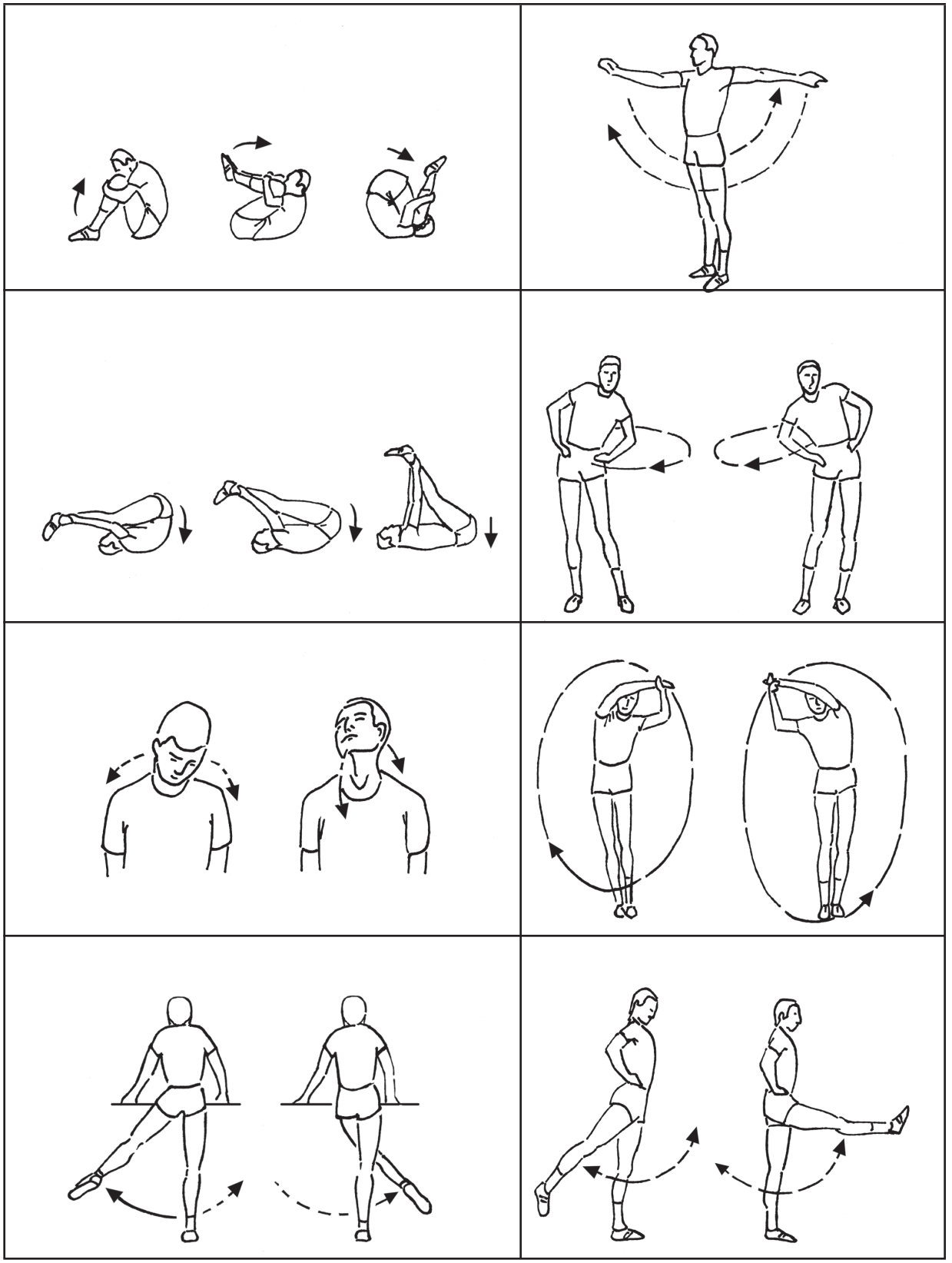
4.2.3 Basic Flexibility Exercises (Dynamic)



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4.3 Speed

Speed may be thought of as the ability to move a limb, limbs or the whole body at the greatest possible velocity. In addition, speed involves the capability to react to a stimulus or signal (such as a starting signal, stumble or fake/deke) in the shortest possible time.

Speed development includes linear, lateral, multi-directional speed, change of direction, agility and segmental speed. Speed may be incorporated as part of physical training and/or technical training depending upon the stage of development of the athlete or the sport specificity required.

For girls, the first speed training window occurs between six and eight years of age and the second window occurs between 11 and 13 years of age. For boys, the first speed training window occurs between seven and nine years of age and the second window occurs between 13 and 16 years of age. Refer to figure 2.5 in section 2.6 for more information. Note that there are two different systems being developed. The system referred to in the first window (Speed 1 – Central Nervous System) refers to short bursts of less than five seconds, while the speed referred to in the second window (Speed 2 - Anaerobic Alactic Power System) refers to 20 seconds or less.

Speed considerations for the first three stages of the LTAD progression are:

- ❏ **Active Start Stage** - not applicable.
- ❏ **FUNdamentals Stage** - window of optimal trainability (Speed 1) for girls - and also for boys during the second half of the stage. Develop linear, lateral and multi-directional speed with repetitions of duration of less than five seconds.
- ❏ **Learning to Train Stage** - window of optimal trainability (Speed 1) for boys at the beginning of this stage. Further develop speed for athletes of both genders by using specific activities that focus on agility, quickness and change of direction. Games should be utilized to develop speed just as they are utilized to develop skills and aerobic fitness.

> Note: The following information on developing speed is very general and must be adapted to the needs of the athletes you coach according to their stage of development.

4.3.1 Guidelines for Developing Speed 1

- ❏ To avoid injury, athletes should be warmed up before performing intense exercise.
- ❏ Activities aimed at improving speed should be scheduled at the beginning of the main part of the practice session, before the athletes are tired.
- ❏ Activities should be dynamic (i.e. movement and changes of position) and highly sport-specific. They must also closely replicate the particular movements for which increased speed is desired (adaptations are very specific).
- ❏ The volume and duration should be very low but the Central Nervous System (CNS), and to some extent the anaerobic alactic power system should be challenged.

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- ❏ Movements should be performed at maximal or near-maximal speed.
- ❏ The duration of the exercise should not be more than five seconds. Full recovery should be achieved between sets.
- ❏ Rest between the repetitions needs to be long enough to allow for sufficient recovery. This will enable athletes to perform more repetitions at a high speed. Rest intervals can be as many as 12-15 times longer than the activity period (i.e. five seconds of sprinting followed by 60 seconds of relative rest).
- ❏ The rest periods should consist of very light activity involving the muscles used during the work periods (i.e. a slow walk if the athlete was sprinting).

Additional Notes on Developing Speed

- ❏ The total number of repetitions must not be too high; approximately 10 -12 is the norm, as speed tends to decrease thereafter due to fatigue. It is a good idea to divide the repetitions into sets (i.e. two sets of five repetitions each).
- ❏ It is highly recommended that speed is trained on a regular and frequent basis - for example as part of the warm-up at every training session.
- ❏ CNS and metabolic fatigue are not present towards the end or immediately after a warm-up, making this an optimal time to train speed.
- ❏ Short acceleration with proper posture and elbow and knee drive, take-off speed and segmental speed should be trained regularly outside of the window of optimal trainability for speed.

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4.4 Skill

A skill is the ability to do something well. In the context of sport, a skill is a movement or a series of movements that is executed with competence. Children need to develop competency, first in movement skills and then in sport skills, in order to become physically literate.

- **Fundamental Movement Skills** - provide the base requirements for future advances in movement capacity. Refer to section 2.2 for more detailed information.
- **Fundamental Sport Skills** - such as running, gliding, jumping, catching, kicking, throwing and hitting are the building blocks for successful participation in most sports. Refer to section 2.2 of this Reference Material for more detailed information.

Fundamental movement skills and general sport skills should be further developed during the Learning to Train stage of development. It also should be noted that for optimal acquisition of sport-specific skills for cross-country skiing, all basic technique skills, both classic and skating, should be refined before the end of this period. Otherwise a significant window of opportunity is lost, compromising the ability of young athletes to reach full potential.

The window for optimal skill training begins at nine years of age for boys and eight years of age for girls, and ends at the onset of the growth spurt. Refer to figure 2.5 in section 2.6 for more information.

For detailed information on classifying sport skills, stages of skill development and planning guidelines for skill development, refer to section 10.2.

4.4.1 The ABCs

Agility, balance, coordination and speed are valuable in almost all sports. Developing the ABCs is an important part of physical literacy. There are a number of activities in which they can be learned and refined.

Some sports and activities are better at developing one or more of the ABCs than others. The key sports are as follows:

- Gymnastics is an excellent way for young children to learn and develop their agility, balance and coordination, while athletics (track and field) is a great way to develop speed and coordination.
- Skating and skiing provide excellent opportunities for the development of balance, coordination and speed, while soccer helps with speed, agility and coordination.
- In addition to developing confidence and safety in the water, swimming and synchronized swimming develop balance and coordination.
- Cycling and cross-country skiing are good ways to develop balance and the judgment of speed.
- Fundamental exercises designed to improve agility, balance and coordination on skis are listed in section 4 of the Community Coaching Reference Material. In addition, in section 5 of the CC Reference Material, agility and balance activities are incorporated into the Practice Plans for Levels 1, 2, 3 and 4.

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Note: The following information on developing skills is very general and must be adapted to the needs of the athletes you coach *according to their stage of development*.

4.4.2 Guidelines for Developing Balance

- ❏ Although their primary focus is slightly different, some coordination or general motor development activities may also contribute to the development of balance.
- ❏ In general, developing balance requires creating conditions in which athletes assume an unusual position or posture (e.g. stand on one foot; stand on one foot and crouch; jump on a low bench and stay in position; hop on one foot, on the spot, forward, backward) and are asked to maintain it for a specified period of time.
- ❏ It is also possible to develop balance by performing normal movements in unusual conditions, for instance walking backward, with eyes closed, on heels, on a slope or a narrow and unstable surface (by drawing a line on the ground or placing a rope on the floor), etc. However, it is important to avoid excessively difficult situations that could cause falls or injuries.
- ❏ The use of large exercise balls (a.k.a. stability balls) can also present interesting motor challenges and can help develop balance. By using such balls, athletes make simple everyday activities such as sitting, standing or trying to maintain a horizontal body position much more difficult. Again, it is necessary to take appropriate safety measures to minimize the risk of a fall.
- ❏ To improve static balance and stability, athletes must lower their centre of gravity (for instance by bending the knees or flexing the hips), make the base of support larger (for instance by widening the legs), increase the number of contact points on the ground if this is possible (for instance by putting one hand on the ground), and ensure the weight is evenly distributed on each contact point.

4.4.3 Guidelines for Developing Coordination

- ❏ The activity must involve a sequence of actions that are performed in a given order.
- ❏ The level of difficulty of an activity aimed at developing coordination is determined primarily by the number of movements or actions that must be performed. Beginners or children should not have too many movements or actions to perform in sequence (two or three are sufficient).
- ❏ The actions or movements can be general in nature, or specific to cross-country skiing, depending upon the desired goal. For young children, priority should be given to general coordination activities instead of sport-specific ones.
- ❏ Basic motor patterns must be mastered before the athlete tries a more complex sequence of actions. For instance, if athletes are not able to control basic motor patterns (e.g. running, jumping, rolling, turning, throwing and catching, jumping on one leg while maintaining balance, or lifting an arm and the opposite leg simultaneously), they should not attempt more advanced coordination activities.

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- ❏ Sequences of movement can be designed for specific body parts (e.g. arms only, or legs only), for several body parts at a time or for the entire body. Coordination activities can also take the form of agility games (e.g. “follow the leader”).
- ❏ It is important to ensure that the sequence of movements is correctly executed, as the neuromuscular system tends to memorize motor patterns as they are learned in practice. For this reason, movements should be performed at low speed or intensity during the initial learning phase, and then progressively accelerated to full speed.
- ❏ It is desirable to create conditions which require athletes to perform movements in various directions and/or use their weaker side.
- ❏ An activity can be made more challenging by:
  - ✓ Increasing the speed of execution.
  - ✓ Adding new movements.
  - ✓ Modifying the order in which the movements must be performed.
  - ✓ Combining various actions already mastered but performing them in an unusual manner (e.g. dribbling the ball while squatting; running in the snow, sand or water).
  - ✓ Adding restrictions (e.g. less time, less space, increased accuracy, unstable environment).
  - ✓ Adding uncertainty (e.g. performing the action with the eyes shut).

  These variations must be presented gradually, and only after the basic sequence of actions is mastered.
- ❏ It is better to repeat the movement sequences more frequently for less time than to repeat them less frequently for more time; in other words, learning will tend to be more effective if you have two five minute motor sequences four times a week than if you have one 40 minute practice session once a week.

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4.5 Strength

Strength is the ability of the muscles to generate force through a single maximal voluntary contraction. There are three types of strength.

- **Maximum Strength** - is the highest level of tension generated by a muscle or muscle group during a maximum contraction, regardless of the duration of the contraction.
- **Speed-Strength** - is the ability to perform a muscle contraction or overcome a resistance as fast as possible (normally, very brief efforts of 1-2 second).
- **Strength-Endurance** - is the ability to perform repeated muscle contractions at intensities below maximum strength (normally, 15-30 repetitions or more).

The window for optimal trainability (for strength) for girls is immediately after PHV or at the onset of the menarche (first menstruation). This begins during the Training to Train stage of development. For boys the window of optimal trainability is 12 to 18 months after PHV, and occurs during the Learning to Compete stage of development. Refer to figure 2.5 in section 2.6 for more information.

Because the emphasis on developing strength takes place during subsequent stages of athlete development, all that is required during the L2T stage is for athletes to develop some basic core strength (important for good body posture, balance and prevention of injuries) and some basic general strength, particularly in the arms (important for skiing but not normally developed through daily activities).

A summary of the strength considerations for the first three stages of the LTAD progression is as follows:

- **Active Start Stage** - not applicable.
- **FUNdamentals Stage** - develop strength using exercises that incorporate the child's own body weight. Include hopping and bounding activities, as well as the use of medicine balls and Swiss balls.
- **Learning to Train Stage** - further develop strength using exercises that incorporate the child's own body weight, as well as medicine balls and Swiss balls, ski-related hopping and bounding exercises or routines, and wheeling up gradients. Introduce basic core strength exercises.

In most sports the development of the various types of strength is difficult to achieve through participation in the sport or activity itself. In addition, certain guidelines must be followed to avoid injuries, particularly among children and beginners. To guide you in the introduction of strength training, the following considerations have been provided.

Note: Specific strength development methods and the related safety measures that must be considered and implemented when putting them into practice will be covered in later NCCP workshops.

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Note: The following information on developing core strength is very general and must be adapted to the needs of the athletes you coach *according to their stage of development*.

4.5.1 Guidelines for Developing Basic Strength

Examples of strengthening exercises using body weight and light weights are provided on the next page.

- ❏ In general, exercises involve localized muscle masses. In most of these exercises, the resistance is provided by the body weight of the athlete or by relatively light weights.
- ❏ It is recommended that athletes avoid heavy loads. Ensure that athletes are able to perform at least 12 to 15 consecutive repetitions of each exercise. Under such conditions, strength-endurance becomes the primary ability trained.
- ❏ The speed of execution must be moderate and controlled; athletes must end the exercise when the quality of execution starts to deteriorate.
- ❏ It is possible to use jumping or hopping exercises. As the speed of execution and muscle contraction are relatively high, these exercises will develop speed-strength (muscle power).
- ❏ Avoid exercises that could excessively overload the spine (compression stress).
- ❏ While developing strength, aim for muscle balance; for instance, develop both the upper and lower-body muscle groups, the muscles in front and behind body segments, and muscles on both the right and left sides.

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4.5.2 Basic Strength Exercises Using Body Weight or Light Equipment

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4.5.3 Core Strength Development

Core strength development (abdominal wall and lower back) is important for athletes participating in any activities or sports beginning at the L2T stage. The integrity of the abdominal wall and lower back is important for maintaining good posture, and strength development in this area is a prerequisite to other kinds of strength training. As well, the ability to absorb high loads from other kinds of strength training, the ability to transmit forces from the upper body to lower body (and vice versa) and injury prevention are aided by a strong abdomen and lower back. Imbalances in strength and flexibility in the core can lead to injuries in the legs, hips and lower back and can cause problems with technique.

Simply put, core strength (and flexibility) is similar to tightening all the nuts, oiling the chain and truing the wheels on a mountain bike. Athletes can acquire the most expensive additional frames and components, but this will do them little good if their seat and handlebars are loose, or their chain is rusty and their wheels are wobbly. Having a tight seat post and handlebars may not win them any races but having loose ones can cause them all kinds of problems. In other words, the more biking athletes do, the greater the potential for problems if their equipment is loose. And the more training they do, the greater the potential for problems if they have poor core strength.

Recommendations for Introducing a Core Strength Program for Children

The following information can be used as a starting point for a long term development plan for core strength.

- Before introducing core strength exercises it is important to evaluate your athletes' physical and mental maturity. See "Pre-Core Strength Development Evaluation" below. If athletes are unable to complete these exercises correctly, they require additional work on their basic movement skills (ABCs) before proceeding further.

- **Learning to Train Stage -** core strength exercises are introduced to help develop coordination and technique. Begin by asking athletes to lie flat on their back and press their lower back to the floor by tilting their pelvis. Encourage them to relax. Progress with this exercise to the point where they can keep their lower back flat for 15 seconds. Following this a simplified version of the core routine can be implemented by substituting the lower abdominal exercise with the pelvic tilt coordination tests, and by reducing the duration of each exercise to 15 seconds. Practice once a week.

- **Training to Train Stage** - programs will differ depending on the developmental age of the individual athlete, but generally, by the beginning of this stage, all athletes should be systematically following a core strength program - up to two to three sets with breaks between sets. Practice once a week. Later in this stage practices may increase to three times a week in off-season and once a week during the competitive season.

- Don't invest too much time trying to develop a perfect program. Focus instead on ensuring that the exercises are implemented perfectly and consistently.

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Evaluation (for Children) Before Beginning Core Strength Development

All tests should be performed without shoes to test the stabilizers of the foot and ankle.

- ❏ Static Stand (hip flexed) - appropriate for use with all ages:
  - ✓ Stand erect on one foot.
  - ✓ Flex the hip and bend the knee of the supporting leg.
  - ✓ Hold this position for ten seconds.

  Observe the ability to hold the position with as little shaking or lateral deviation as possible.

- ❏ Single Leg Squat - appropriate for use with all ages:
  - ✓ Squat bending at the ankle, knee and hip.
  - ✓ Hold lowest possible position for ten seconds.

  Observe the depth of the squat and the ability to hold the position with as little shaking or lateral deviation as possible.

- ❏ Hop for Distance - appropriate for use with all ages:
  - ✓ Hop maximum distance.
  - ✓ Hold the landing (like a gymnastics landing) for 10 seconds.

  Compare the distance achieved with the right and left legs; check the ability to hold the landing position for ten seconds; check if the athlete lands bending at the ankle, knee or hip using all three joints.

Some Key Concepts

- ❏ Focus on ensuring that the exercises are implemented perfectly and consistently.
- ❏ These exercises are to be done slowly. Slow movements will maximize the use of abdominal muscles, whereas fast movements will use hip flexors. Proper positioning of the feet and lower back will ensure the targeted muscles are used.
- ❏ The target time for each exercise is one minute. If the exercise is too difficult to do with proper technique for one minute, change the exercise in the appropriate manner to reduce the difficulty as the athlete fatigues so that you can maintain exercising for one minute. For example, in the lower abdominal exercise where the legs are maintained in a straight position off the floor, it is better to bend the legs at 30 seconds if fatigued than it is to quit. However, it is important not to progress to the next level of difficulty in the exercise until the proper technique can be maintained for the entire minute.
- ❏ Several exercises have progressions or slight variations. Use them to provide variety but don't change them until athletes have learned the exercise properly.
- ❏ There are four exercises that are done in a five exercise circuit. For most athletes the lower abdominal exercise is done twice in one circuit. For a few of the upper abdominal exercises it is done twice. Refer to the monitoring of core strength to determine which series of exercises to do.
- ❏ Following is the suggested progression that should be used. Begin with Level A. When

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athletes are able to complete this level maintaining good technique, then move to Level B. As there are different degrees of difficulty for each exercise, you can create numerous variations of this exercise. In the following example, each exercise is to be done for one minute, with no breaks between exercises.

A. two sets – two minute break between sets.
B. two sets – one minute break between sets.
C. two sets – no break between sets.
D. three sets – no break between set one and set two, two minute break between set two and three, and eventually progressing to five sets with no break between sets.

❏ The suggested order of exercises in one set of the circuit.

Normal or Curved Back	Flat Back
Lower Abdominal	Upper Abdominal
Lower Back	Lower Back
Upper Abdominal	Lower Abdominal
Lower Abdominal	Upper Abdominal
Torso Rotation	Torso Rotation

Most people have a normal or curved lower back (lumbar region of the spine). A field test to determine the curvature of the back is to stand backwards against a wall with heels, rear end and shoulders touching the wall. If an athlete is able to stick a hand in the space between his/her lower back and the wall and the fit is snug, the athlete has a normal curvature. If there is room for "free play", the lower back is considered to be abnormally curved. If it is difficult to insert the hand, the lower back is considered flat.

❏ A core strength program should be practised a minimum of three times a week. If the athletes' time is limited it is better for them to do one set three times a week as opposed to doing three sets once a week.

Note: Unless athletes have good core strength, the more training they do, the greater the potential for injury.

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Core Strength Exercises

❑ Lower Abdominals

Lie on back, keep lower back on floor at all times, head flat on floor. Turn toes in.

Level of Difficulty

Level 1 Bend one leg bracing foot on floor. Raise other leg straight taking three seconds up and three seconds down with no pause at the bottom.

Level 2 Raise both legs to 75°, hold for one minute, bend knees as fatiguing.

Level 3 Same as Level 2, keeping legs straight for entire minute.

Level 4 Raise both legs to 60°, hold for one minute with legs straight.

Level 5 Raise both legs to 45°, hold for one minute with legs straight.

Level 6 Raise both legs to 45°, scissor kick, spell letter with feet etc.

Level 7 Raise both legs to 30°, mix of static and dynamic movements.

Level 8 Raise both legs to 15°, mix of static and dynamic movements.

❑ Lower Back

Alternating Arms and Legs

- ✓ Lie on stomach, keeping hips down and palms up.
- ✓ Lift alternate arm and leg with hips down.
- ✓ Raise for two seconds, hold for two seconds, lower two seconds with no pause at bottom.

or

Modified Reverse Crunchie

- ✓ Stand with slight bend in knees holding light weight close to body.
- ✓ Curl head down until hip starts to rotate (hands about to knees) and then up.
- ✓ Down in five seconds and up in five second.
- ✓ Try to curl by one vertebra at a time.

❑ Upper Abdominals

Elevated Leg Crunchie

- ✓ Lie on back, with legs off the ground with knees and hips bent at 90°.
- ✓ Keep tongue pressed against the roof of mouth, toes pointed in toward each other and heels out and lower back on floor.
- ✓ Curl up slowly – up two seconds, hold two seconds, down two seconds with no pause at bottom.

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Level of Difficulty

Level 1 Hands on floor.

Level 2 Hands crossed on chest. Level 3 Hands to ear.

Level 4 Hands to spine between shoulder blades.

Level 5 Arms straight back.

Level 6 Arms straight back with weights.

❑ **Torso Rotations**

- ✓ Lie on back, knees and hips bent at 90° (similar to upper abdominals position).
- ✓ Hands on ear.
- ✓ Rotation is to be in trunk, not the neck.

Level of Difficulty

Level 1 Rise up for two seconds, rotate right for two seconds, rotate left for two seconds, hold in middle for two seconds and down for two seconds with no pause at bottom.

Level 2 Same as Level 1 but when rotating trunk right, rotate legs to left and when rotating trunk to left, rotate legs to right.

Monitoring Core Strength

Core strength can be monitored through a combination of abdominal strength tests and the progression attained in the core strength circuit exercises. In the early stages of core strength development, the abdominal test results will likely be more informative. With some experience in training and with the athlete recording normal scores for the abdominal test, circuit monitoring becomes more informative. These tests are more convenient to do on a solid table than on the floor.

❑ **Coordination Test**

This test is an exercise to test (and practise) the ability of athletes to flatten their back on the floor while they raise and lower their legs. The inability to do so will likely give a false reading in the following lower abdominal test (i.e. the lower abdominal test may indicate weak lower abdominals, whereas the strength may have been sufficient and it was lack of coordination that caused failure).

- ✓ Athlete lies flat on back with knees bent at 90° and feet flat on table, hands at side.
- ✓ Tester puts hand between lower back and table.
- ✓ Athlete pushes down on lower back while lifting knees to chest and back.
- ✓ Pressure on the tester's hand must be maintained throughout the test.

❑ **Lower Abdominal Test (do not do this test if the athlete has lower back pain)**

- ✓ Athlete lies on back – legs straight, arms bent, hands near head, elbows on table.

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- ✓ Pelvis should be tilted so lower back is pressed against table (tester should put hand under lower back to feel if pressure is even).
- ✓ Athlete lifts legs to 90°, then slowly lowers legs without lifting lower back off the table.
- ✓ Tester marks the angle where lower back lifts off the table.
- ✓ See Table #1 for interpretation of test results.
- ✓ Many athletes will score low in this test.

Table #1 - Interpretation of Abdominal Tests		
Grade	**Lower Abdominals (deg. off ground)**	**Upper Abdominals**
50%	75°	Flexes vertebral column, but cannot complete sit-up with forearms extended forward.
60%	60°	Flexes vertebral column, and holds it flexed while coming upright with forearms extended forward.
70%	45°	
80%	30°	Flexes vertebral column, and holds it flexed while coming upright with forearms folded on chest.
90%	15°	
100% NORMAL	0°	Flexes vertebral column, and holds it flexed while coming upright with hands clasped on ears.

❑ **Upper Abdominal Test**

- ✓ Athlete lies on back – legs straight, toes turned in.
- ✓ Head should be tilted up, athlete should put tongue on the roof of mouth (stabilizes neck).
- ✓ Athlete does a complete sit-up, first by flexing (rounding) back, then by lifting trunk up (lower back is the last part of the back to come off the table).

- ✓ Degree of difficulty is controlled by the hand position. The easiest position is when the forearms are reaching forward; next more difficult when the forearms are folded across the chest; and finally most difficult when the hands are against ears and elbows are extended away from body (athlete should not move elbows forward).Athlete keeps toes in and head tilted up throughout.

- ✓ See Table #1 for interpretation of test results.

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❑ **Standing Against Wall Posture Test**

Athlete stands with heels, rear end and upper back against wall. The tester sticks his/her hand in the space between lower back and the wall.

- ✓ If the hand is too snug (tester can barely get the hand in), the athlete tries the upper abdominal circuit.
- ✓ If the hand is too loose (lots of room for the fingers to move), the athlete tries the lower abdominal circuit.

For more detailed information on strength training for cross-country skiers, refer to the CCI – T2T (Dryland) Reference Material.

We recommend that all coaches register for the Athlete Development Matrix on CCC's website. You will be able to access more information on training plans, energy systems and athlete development to help your coaching as athletes progress through your program.

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