



Competition-Coaching Introduction L2T

Step 3:

Technique Development Theory



**Reference Material
for On Snow Workshop**





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This section on the theory of developing technique complements the information provided in section 4 of the NCCP Community Coaching Reference Material and section 5 of this Reference Material, and is directed primarily at supporting you in your role as a coach working with children in the Learning to Train (L2T) stage of development.

3.1 Overview

Objectives for the L2T stage of athlete development are:

- ❑ to further develop fundamental movement skills and general overall sport skills (otherwise a significant opportunity is lost, compromising the ability of the young athlete to reach full potential);
- ❑ to further develop good ski technique habits through repeated practice and the use of games that reinforce the technique being taught; and
- ❑ to refine all basic cross-country ski skills by the end of this stage.

Cross-Country Skiing – A Sport for Life

Technique is influenced by a multitude of factors that include an athlete's level of skill and conditioning, as well as terrain, equipment, wax and weather conditions. Moreover, as athletes develop, their technique evolves. As they grow and become stronger they need to adjust their technique to their new capabilities.

The intent of Section 3 is to present some of the theory that underpins cross-country technique. It is important that coaches possess a clear and common understanding of this theory to support the instruction and refinement of cross-country ski technique as explained in detail in Sections 4 (Skating) and 8 (Classic and Downhill).

CCC has created technique videos demonstrating technique standards for L2T athletes and a series of videos on drills and exercises for developing skiers. These videos can be found on the Athlete Matrix on CCC's website. Coaches are encouraged to review these videos to help them get a better handle teaching technique to developing athletes.

Fundamental Concepts and Terminology

Although at a basic level cross-country skiing is easy to learn, competent instruction and a significant amount of practice are required in order for skiers to reach an advanced level of technique. The reality – not always acknowledged – is that cross-country skiing is extremely technical.

The technical doctrine for cross-country skiing incorporates several concepts and terms

that recur throughout the explanations of the various techniques as presented in Sections 4 and 8. The most important of these are defined below:

- ❑ **Body Positioning.** Body positioning refers to how the various parts of the body are held in order to allow a skier to execute cross-country ski techniques effectively. The basic overall body position that serves as a start point for most cross-country ski techniques is known as the general athletic stance (see detailed description below). The specific body positioning for each individual ski technique is described in section 4 (for skating techniques) and section 8 (for classic and downhill techniques).
- ❑ **General Athletic Stance.** The general athletic stance is an overall “good” body position for athletic endeavour. It is the starting position for learning or practising most cross-country ski techniques. Its principal features are also present in many ski techniques in motion. The general athletic stance includes the following:
 - ✓ **Feet.** The athlete’s weight should be over the balls of the feet. The feet should be approximately shoulder width apart. If the weight is too far forward, it will be difficult to produce a forceful kick. If the weight is too far back, it will be difficult to apply force quickly enough to be forceful and will also impede forward momentum as the centre of mass will be back.
 - ✓ **Ankles.** Ankles should be “supple” and should exhibit good flexion. The degree of bend in the ankles is crucial in directing force application in such a way that the skier is propelled forward and down the trail rather than up into the air. The degree of ankle bend will be largely dependent on the terrain. Steeper terrain will require a greater amount of ankle flexion. Also, the degree of ankle flexion will be dictated by the amount of force an athlete will need or want to apply.
 - ✓ **Knees.** In order to keep the weight positioned over the feet so force can be transferred to the ski, the knee angle must work in conjunction with the ankle angle. The knees must be supple and “relaxed”. A common problem is for a skier to struggle to get proper ankle flexion. What then tends to happen is the skier has a knee angle that is much greater than the ankle angle, which places the skier’s weight behind the feet. The weight being back leads to a plethora of problems like poor weight transfer, poor ability to glide as increased load is placed on the quadriceps, and a diminished force-producing moment.
 - ✓ **Hips.** The hips should be “high and forward”, and tilted posterior (like your tail is tucked between your legs). “High” means that the knees are only slightly flexed and the legs, therefore, are relatively extended, placing the hips in a higher position than would be the case if the knee angle was greater. “Forward” means that the hips are over the balls of the feet, so that the weight is evenly distributed over the front part of both feet. While skiing, having the hips too far forward or back results in inefficient propulsion and weight shift.
 - ✓ **Core/Back.** In the general athletic stance, the core should be in a naturally rounded position, effectively mimicking a “soft C”. The depth of the C will be dependent on terrain, with most skiers adopting a shallower C with the

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increasing steepness of terrain. This position will assist in maintaining hips over the feet, relax the lower back and help position muscles of the core in force-producing movements.

- ✓ **Arms/Shoulders.** The shoulders are released. The arms should hang free and loose beside the body. The pendulum action of the arms from this position should be smooth, easy and relaxed.
- ❑ **Balance.** Balance is a critical underlying component of all techniques. Balance is the state of equilibrium or “being steady”. A skier is balanced when his/her centre of gravity is aligned over the base of support. The smaller the base of support, the more difficult it is to maintain balance. As cross-country ski techniques frequently require the skier to balance on a small base of support - most often a single ski that is in motion over less than level terrain - maintaining good balance is indeed a challenge. Good balance is an essential precondition to proper weight shift and long glide, two of the key characteristics of good technique. Therefore, correct body positioning over the weighted (i.e. gliding) ski (or skis, in Double Poling and part of One-Step Double Poling) is extremely important. For more information, see the text on “Principle #1 – Stability” at section 3.2.2.
- ❑ **Weight Shift.** Weight shift is the transfer of full body weight from one balanced body position to another. Consistent with the concept of balance, the body position that results from a full weight shift is characterized by alignment of hips and knee directly over the ball of the foot of the weighted (gliding) ski or skis. Weight shift is a dynamic action that contributes to forward momentum. It is accomplished and assisted by the specific body movements/motions of a particular technique.
- ❑ **Glide.** Glide is the forward movement of a skier on a weighted ski or skis, caused by the force created by body movements/motions and weight shift. Better - or better controlled - weight shift and good balance over the gliding ski or skis serve to enhance the glide action.
- ❑ **Body Movements and/or Motions.** Body movements or motions are the biomechanical actions required to execute a technique (e.g. poling, kicking, upper body compression, etc.). They may be commonly described as skills.
- ❑ **Timing.** Timing is the inter-relationship, in sequencing and time, between the specific body movements/motions required to perform a technique properly.
- ❑ **Rhythm**
 - ✓ Rhythm means that the right things (body positioning and body movements/motions of a particular technique) happen at the right times (timing). Good rhythm cannot be achieved without good balance.
 - ✓ The importance of rhythm as a critical component of good cross-country technique cannot be too strongly emphasized. Athletes with good rhythm will pick up the other components of technique quickly, but athletes who lack rhythm will have difficulty developing a smooth and efficient technique no matter how perfectly they execute the individual movements.
 - ✓ It is essential for young athletes to develop good balance and a sound feel for the rhythm of a technique. These skills are the foundation on which ski technique is

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developed and should have been an important focus during the FUNdamentals stage of development. By the time athletes have reached the L2T stage, they should be able to build on these basic skills and learn to ski with greater efficiency.

- ❑ **Tempo.** Within the rhythm of a particular technique, tempo is the pace at which a technique is executed. Generally the basic rhythm of the technique remains the same when tempo is increased or reduced. Tempo may be increased to generate greater speed, particularly in situations such as sprint competitions or the end of races. Tempo is also affected by terrain – e.g. tempo must increase in order to maintain a Diagonal Stride on a medium to steep incline.

❑ **Good Technique**

- ✓ A technique model creates a standard towards which all athletes strive. In the sport of cross-country skiing this model is generally based on the technique of high-level international athletes competing in various snow conditions, with graduated benchmarks that are appropriate for the progressive stages of athlete development.
- ✓ Good technique requires the athlete to use body positioning and body movements/motions that are within certain ranges. In other words, there is no precise position or movement that can be categorized as the only one that will result in good technique. For each skill there is a small range which will result in the athlete having equally effective technique. Very often this range will be determined by morphology differences between skiers (length of body segments, total height, etc.).
- ✓ However, there is little latitude for deviation in respect of the rhythm of a technique. Rhythm is a characteristic signature of a technique that is fundamental to its proper execution.
- ✓ When teaching technique, it is normally better to work on the components of a skill and improve them individually before integrating them into the overall technique with its underlying, characteristic rhythm.

❑ **Efficiency**

- ✓ Efficient cross-country skiers perform a particular technique by executing a series of movements that are sequential, organized in a definite order and united in a whole. Further to this, in order to achieve maximum efficiency, skiers need to execute these movements with the essential timing and balance that will permit them to achieve a fluid rhythm and flow in their skiing.
- ✓ Research on energy use in cross-country skiing indicates that highly skilled athletes transfer potential and kinetic energy between body parts much more efficiently than less skilled athletes. Efficient technique means there is little wasted energy and effort. Therefore, athletes need to minimize extraneous movements and maintain a “quiet” body positioning in order to move down the track in the direction of travel as efficiently as possible.
- ✓ The ability to ski with a “quiet” body position is significantly dependent on the balance, coordination, strength and flexibility of the athlete. For this reason the NCCP Community Coaching Workshop emphasized the development of both balance and coordination skills on skis, and the NCCP CCI-L2T (Dryland) Workshop introduced core strength development (i.e. the abdominal and back muscles in the

lower torso). Core strength stabilizes the body, which improves balance and allows athletes to use their power more effectively.

- ❑ **Individual Style.** Individual style is the result of the adaptations each athlete makes to the basic body movements in a technique. This occurs because of his/her unique body dimensions, muscular capabilities and/or beliefs about technique. In this regard, cross-country skiing is like many other sports, in that even among elite practitioners there are visible differences in how the basic components and principles of technique are executed to achieve efficiency and success (e.g. differences in the swing of a professional golfer or a major league baseball player). However, the common denominator amongst sports is that all of the components of technique must be present and all principles observed in order to produce a successful result. A coach's challenge is to focus athletes' attention on the proper integration of components and principles into technique, while recognizing that the resulting technique will not always look the same. Efforts to have all athletes ski in an identical fashion would be impractical and potentially counter-productive.
- ❑ **Aerobic Fitness.** There is a strong relationship between athletes' ability to maintain good technique during a competition, their aerobic fitness and their personal performance. Good technique allows athletes to conserve energy, which in turn allows them to continue longer at the same speed than a less skilled athlete. A higher level of aerobic fitness will allow the athlete to maintain good technique longer. Therefore the combination of good technique and fitness is important in order to achieve the best performance.
- ❑ **Force.** Force is a pull or a push causing motion. Force is optimized by the use of the proper rhythm (body positioning plus body movements plus timing) for a specific technique. It can be increased by increasing a skier's strength and flexibility (refer back to section 4 of the NCCP Community Coaching Reference Material for further information on strength and flexibility).
- ❑ **Power.** Power is generated by force, which is dependent on body positioning, body movements, timing, strength and flexibility. The generation of power is further enhanced by a skier's tempo, and the ability to sustain it is determined by aerobic fitness.
- ❑ **Velocity.** In bio-mechanical terminology, velocity is the measure of how fast a body (e.g. a skier) is moving. Velocity is the result of good technique - appropriate for the prevailing track and terrain conditions - being correctly executed in the individual style of a particular athlete. More force and higher tempo normally result in increased velocity.
- ❑ **Speed.** In bio-mechanical terminology, speed is the measure of how quickly a body movement or motion is executed. Speed of movement is a contributing factor in force production. While the distinction between velocity and speed is interesting from an academic perspective, it is unlikely that the accurate use of this terminology will gain much traction in popular usage within the cross-country skiing community. Accordingly, coaches should be prepared to see the two terms used interchangeably, even within doctrinal publications.
- ❑ **Pre-Loading.** In skating and classic techniques, pre-loading is the action of quickly extending the "push" leg just before flexing the leg to load it for the push (i.e. kick) phase of the technique. Pre-loading serves to optimize the rebound effect of the elastic

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property of both the thigh muscles and the camber of the ski. For Diagonal Striding in classic technique, pre-loading is also required to compress the ski camber to a state that will allow for the grip wax to contact and adhere to the snow. The pre-loading action is similar that of a diver jumping up on the springboard before diving, an action that “charges” the springboard with as much energy as possible; the springboard then returns the energy to the diver, thus propelling the diver higher up in the air. Execution of the whole pre-loading sequence must be well-timed and swift in order to preserve the transfer of elastic energy throughout the propulsion phase.

Coaching Tip: Balance is vital and rhythm is more important than technical finesse.

3.1.1 Acquisition of Skills

In order to become technically competent, athletes need to spend time on skis in addition to the structured skill development sessions offered by their club. The more they practice, the sooner they will develop a good skill level!

When recommending additional practice time to the parents of young athletes, however, it is important for coaches to explain that spending time on skis for the purpose of improving technique (repeated practice) is not the same as skiing long distances – the emphasis needs to be on quality rather than quantity. This is often misunderstood, resulting in children skiing kilometer after kilometer, while reinforcing poor technique habits. The latter situation occurs when a skier is unable to retain correct technique because he/she is tired.

The repetition of incorrect or sloppy technique for long periods of time is exactly what you wish to avoid. Repetition can ingrain a bad habit as well as a good one, and undoing a bad habit is a difficult and time-wasting process.

The following are some points on the acquisition of skills that may be useful in explaining the distinction between repeated practice and simply skiing long distances.

- ❑ In order for athletes to retain new skills they must ski more than once a week; to significantly improve their skills they must spend time on skis several times a week.
- ❑ Individuals improve their performance and attain an expert level not as an automatic consequence of more experience with an activity, but rather through structured learning and effortful adaptation.
- ❑ The effects of extended and deliberate practice are more far-reaching than is commonly believed. Performers can acquire skills that circumvent the basic limits on working memory capacity and sequential processing. Deliberate practice can also lead to anatomical changes resulting from adaptations to intense physical activity. The study of expert performance has important implications for our understanding of the structure and limits of human adaptation and optimal learning.
- ❑ If skiers have practiced their sport incorrectly, they are unable to change and adapt (later), and then they cannot move on to further improve technique execution. It is essential that they are taught the right methods from the beginning and that these methods are accurately replicated and reinforced in practice.
- ❑ Practice doesn't make perfect – practice makes permanent. Only perfect practice makes perfect permanently.

3.2 Biomechanics

3.2.1 Skill Phases

In general, skiing skills can be broken into four phases:

- ❑ **Preliminary Movements.** These are the movements that an athlete undertakes when getting ready to perform a skill.
- ❑ **Force Producing Movements.** These are movements that an athlete executes to produce force for the purpose of propulsion. This is the most significant phase in the execution of a skill.
- ❑ **Critical Instant.** This is the point that determines the effectiveness of a skill. Ideally, the athlete has applied the right amount of force, in the right direction and at the right time - at the critical instant! At this point an athlete cannot do anything to alter the skill's effectiveness – any changes must be made prior to this.
- ❑ **Follow-Through.** This refers to the body movements that occur after the critical instant. In cyclical skills the follow-through is part of the preliminary movement of the next cycle of the technique. Follow-through actions may also provide useful information about the critical instant and force producing phases.

3.2.2 Biomechanical Principles

There are five biomechanical principles that are particularly relevant to the analysis of cross-country ski skills. By referring to these principles you will be better able to analyse technique and make accurate observations about what changes are necessary to improve performance.

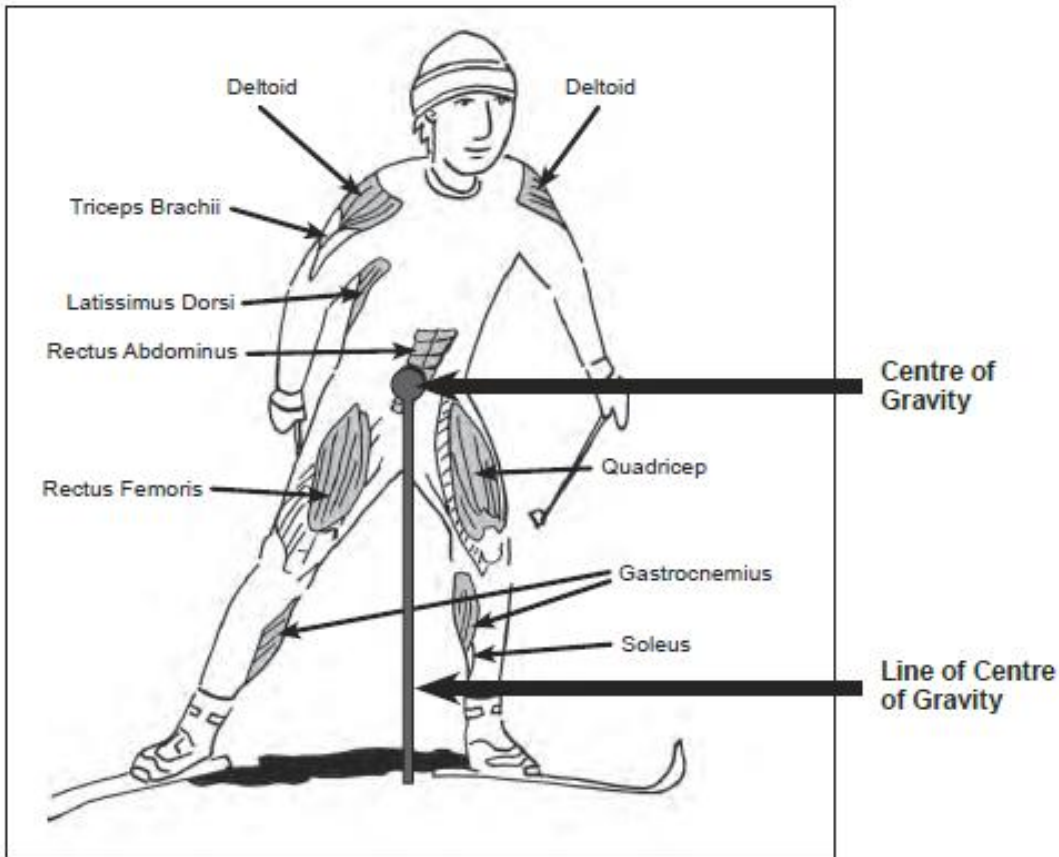
Principle #1: Stability

Stability refers to a state in which an object (e.g. a skier) is steady or in balance (i.e. in equilibrium). It also refers to the capacity of an object to return to equilibrium or to its original position after having been displaced. Recognition of the two interpretations of “stability” is critical to understanding the mechanics of cross-country ski technique. In essence, while it is important to achieve a state of balance in certain phases of ski technique, a skier can - and should - also be stable when moving between positions of balance (or stability). The ability to remain stable – whether in balance or not – is a matter of control, with control being exercised through properly executed technique.

The following bullets summarize important underlying concepts or definitions relevant to stability:

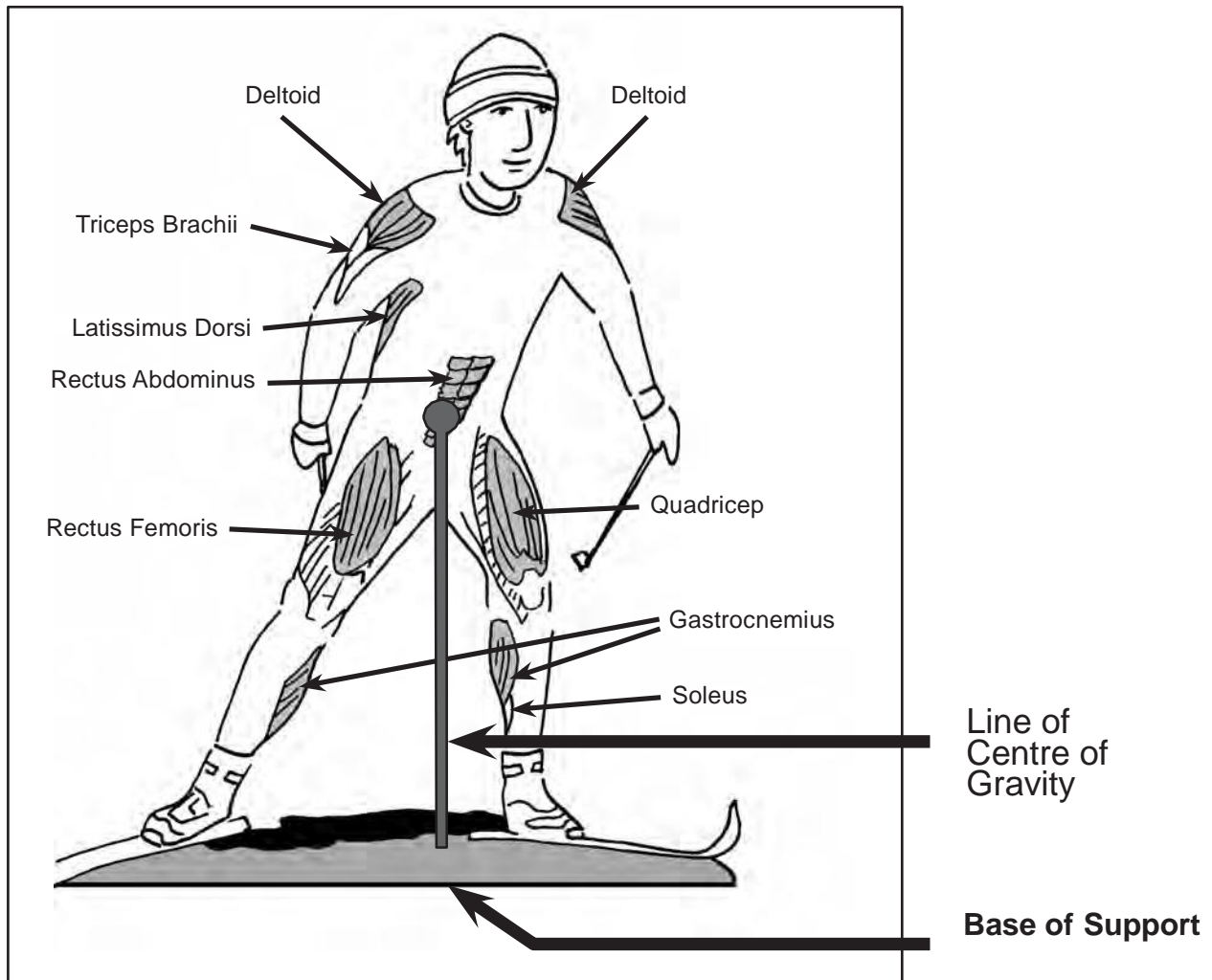
- ❑ The **centre of gravity** is the imaginary point at which the mass of the athlete or object may be thought of as being concentrated. See Figure 3.1. The lower the centre of gravity, the more stable an athlete will be.

Figure 3.1



- ❑ The **base of support** is the area bounded by the supporting limbs (in cross-country skiing, the legs). See Figure 3.2. The larger the base of support, the easier it is for an athlete to be stable and the more margin for error there is in establishing and maintaining stability.
- ❑ The **line of gravity** is an imaginary line passing straight down through the centre of gravity to the ground.
- ❑ The centre of gravity must be within the base of support for the athlete to be balanced. In other words, the line of gravity must fall within the base. If an athlete's centre of gravity moves outside of the base of support, or if it deviates sufficiently to one side or other of the line of gravity, balance will be lost. However, loss of balance is not necessarily undesirable, nor does it imply that stability will be lost as well. It is often necessary and/or desirable to "lose balance" in order to initiate weight shift and create momentum. Provided that the loss of balance occurs in a controlled manner and results in a return to a balanced position at the end of a movement, stability is retained.

Figure 3.2



In the sport of cross-country skiing, the relevance of the Principle of Stability is pervasive:

- ❑ In executing most cross-country skiing skills, skiers must both move and try to maintain their stability. By moving the centre of gravity within the base of support or even outside of it, skiers voluntarily create a state of disequilibrium to initiate weight shift and facilitate movement. Good ski techniques comprise the controls that ensure that stability is not lost (i.e. equilibrium/balance is re-established at the completion of a movement).
- ❑ For example, when skiers swing their hands forward and step up the hill onto a new gliding ski in the Offset technique, they are clearly in a provoked state of disequilibrium. Until the new gliding ski is on the snow and weight has been shifted onto it they are falling forward and to one side because their centre of gravity is outside the base of support (i.e. the pushing ski). This position of temporary instability facilitates the shift of weight to the side they are leaning toward. Provided that their movements are controlled and result in a balanced position over the new gliding ski – albeit only briefly – the skiers will have remained stable throughout the action and forward movement will have been enhanced.

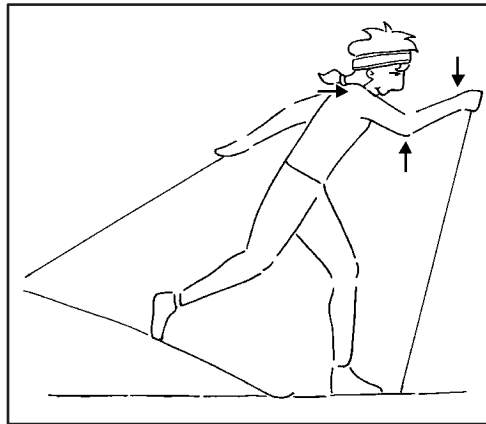
- ❑ The Principle of Stability is particularly important in cross-country skiing because the base of support is more often than not a single narrow ski that is travelling over terrain that is constantly varying. Skiers must be able to balance on this narrow and shifting base. But equally they must be comfortable in the “off-balance” state that exists between positions of balance, because technique dictates that a balanced position on a single ski will be held only briefly before a transition to the other ski must be initiated. The dual challenges of balancing on a narrow base of support and constantly managing disequilibrium/imbalance between balanced positions place a huge premium on sound technique. For this reason, cross-country skiing is a highly technical sport.
- ❑ In skating techniques, athletes who lack good balance and/or good technique will not be able to control their weight shift and will often spread their feet apart to widen the base of support. The tendency – caused by a skier’s instability - to adopt a wide stance must be resisted and overcome. This requires the development of good technique through knowledgeable coaching and properly executed practice.
- ❑ Skiers who lack stability in downhills will often broaden their base of support by spreading their skis wider apart. For downhills, all skiers should also bend their knees and flex at the waist to improve stability by lowering their centre of gravity. Aerodynamics will be improved at the same time.

Principle #2: Use All of the Joints

The production of maximum force requires the use of all the joints that can be used. In the sport of cross-country skiing, skiers rarely, if ever, apply maximal force, but want to utilize all the appropriate joints in order to maximize technique effectiveness (see Figure 3.3).

- ❑ A **force** is a push or pull that causes motion. It is usually measured in Newtons (N).
- ❑ **Velocity (or Speed)** is the measure of how fast a body is moving. Velocity is usually measured in metres per second (m/s).
- ❑ **Acceleration** refers to the rate of change of velocity and is a measure of how consistent velocity is. Acceleration is usually measured in metres per second per second (m/s^2).
- ❑ The more joints an athlete uses in a movement, the more muscles he/she can contract and the more force he/she can exert. For example, when executing the poling action in a Diagonal Stride movement, the athlete should engage several joints sequentially:
 - ✓ The action should be initiated at the hip joint with a slight crunching action of the upper body using the core muscles.
 - ✓ The pole is then pushed backward by the shoulder muscles.
 - ✓ The pole is pulled back using the elbow joint, engaging the triceps muscle.
 - ✓ And the wrist joint completes the action with a final thrust to the rear.

Figure 3.3

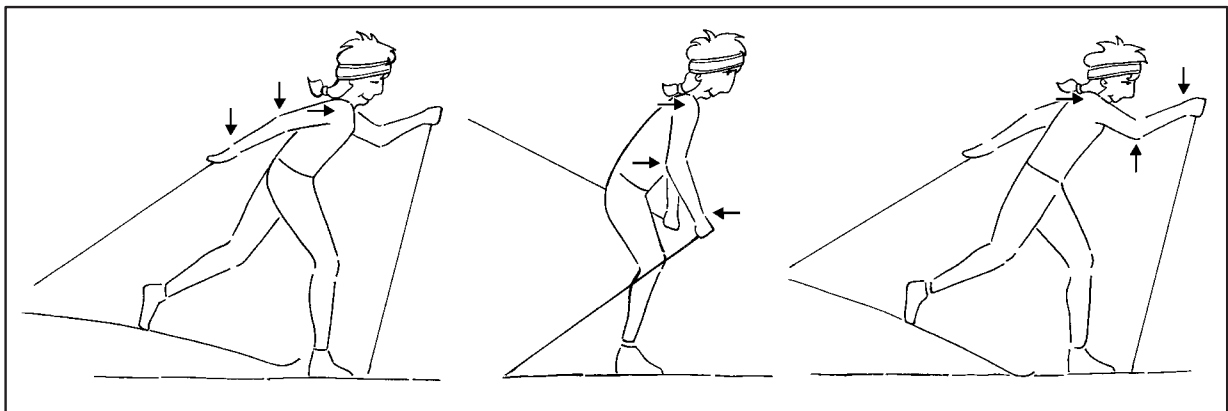


Principle #3: Use the Joints in Order

The production of maximum velocity requires the use of the joints in order - from largest to smallest. Leaving out one joint will reduce the force of the action.

- ❑ Most cross-country ski skills require a large amount of force and the development of large velocities in the limb segments. As a result, Principles #2 and Principle #3 are both important to this sport.

Figure 3.4



Principle #4: Increased Impulse Equals Increased Velocity

An “impulse” is made up of (1) the force applied, and (2) the length of time the force is applied. The longer and more powerfully the force is applied, the more velocity increases.

- ❑ Cross-country skiers can increase the length of time that a force is applied, and therefore the impulse, by applying the force through a greater **range of motion** in their joints. In general, the fastest cross-country skiers have longer stride lengths (greater impulse), but similar stride rates, to less skilled skiers.

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- ❑ **Joint range of motion** refers to the amount of movement at a joint. This is measured in degrees ($^{\circ}$).
- ❑ Cross-country skiers need to improve/maintain their **flexibility** through routine stretching in order to maximize the potential range of motion in their joints (e.g. hips, knees, ankles).
- ❑ Cross-country skiers can improve the amount of force they can produce in their joints through strength training and general aerobic conditioning. This in turn will increase their velocity.

Principle #5: Movement Usually Occurs in the Opposite Direction to the Applied Force

This principle is related to Newton's Third Law of Motion, which states that every action has an equal and opposite reaction.

- ❑ In cross-country skiing, however, movement down a ski trail is not this simple because snow is slippery. For example, when executing classic technique it would be ideal if an athlete could push back with the foot the same as when running. Instead, because snow is slippery (even with good wax), it is necessary for the athlete to push down into the snow as well as back down the track.
- ❑ In addition, some forces operate in directions opposite to the force of movement. In cross- country skiing, air resistance and snow friction are important factors that need to be minimized in order to maximize speed. For example:
 - ✓ athletes can minimize the effect of air resistance by drafting behind another athlete, or by tucking on the downhill sections of a course; and
 - ✓ wax technicians can prepare skis to reduce the natural friction of the skis on the snow.

3.3 Observation Planning and Preparation

The following section on Observation Planning and Preparation complements the information on Observation, Intervention and Feedback provided in sections 5.4.3, 5.4.4 and 5.4.5 of this Reference Material.

3.3.1 Observation Planning

An observation plan outlines when, where and how you should position yourself to observe your athletes when teaching technique. A good plan is essential for detecting and correcting skills effectively.

To develop an observation plan you need to:

- Pull out the appropriate technique checklist for a particular session and determine the key elements you intend to observe.
- Select your scanning strategies.
- Select your observation position.
- Decide on the number of observations.

Key Elements

The key elements for both the skating and classic techniques are outlined in the Technique Checklists provided in section 3.4. When choosing which ones to use, keep in mind that they should support the main goals for that session.

Coaching Tip: To execute an effective observation, the coach must be knowledgeable about both the phases of the skill in question and the key elements.

Scanning Strategies

Scanning strategies are designed to help you observe the key elements, decide which parts of the body to focus on, and determine whether or not you need to observe several key elements at the same time.

Tips to help you develop an appropriate scanning strategy:

- Begin by scanning the overall technique. This will give you the general picture of an athlete's performance. Then focus on the key elements.
- The points on which you focus will affect what you see. For example, if you try to get a general impression of the whole, you will probably NOT get a clear impression of how any particular body part is moving, and vice versa.

Coaching Tip: For technique sessions, encourage your athletes to wear clothing that makes it easier to observe the joint positions – i.e. they should not wear bulky clothing.

Observation Position

Your observation position, or the place from which you watch a skill, is one of the key components of sound observation. The best position for viewing will vary from skill to skill and from key element to key element.

Tips to help you select an effective observation position:

- Position yourself at a right angle to the plane of the athlete's motion. This is the best vantage point for most skill observation.
- Move around - different viewpoints can tell you different things.
- In order to observe overall technique, observe several repetitions of a technique, and overcome problems associated with the speed as the athletes move across your field of vision: position yourself at a distance.
- In order to focus on the individual phases of a skill: position yourself quite close to the athletes.
- If orientation is important, choose settings with horizontal or vertical referencelines.
- To help block out distractions, set the session up away from large, busy areas, and then position yourself so that they are behind you.

Number of Observations

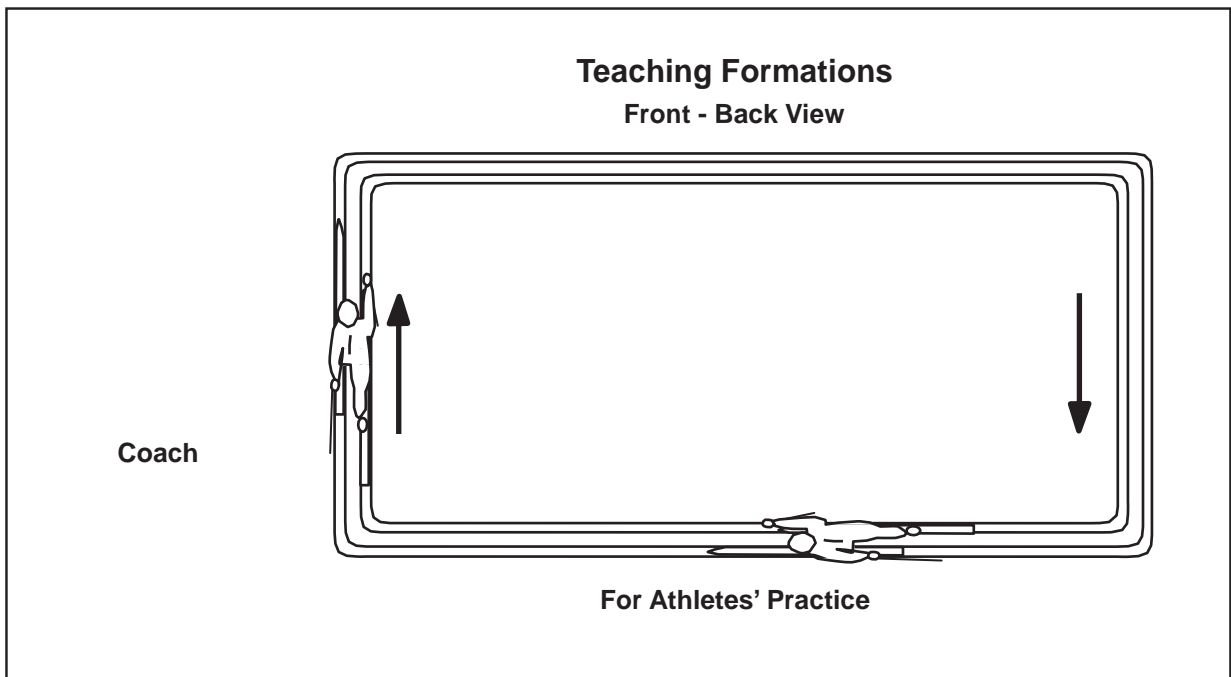
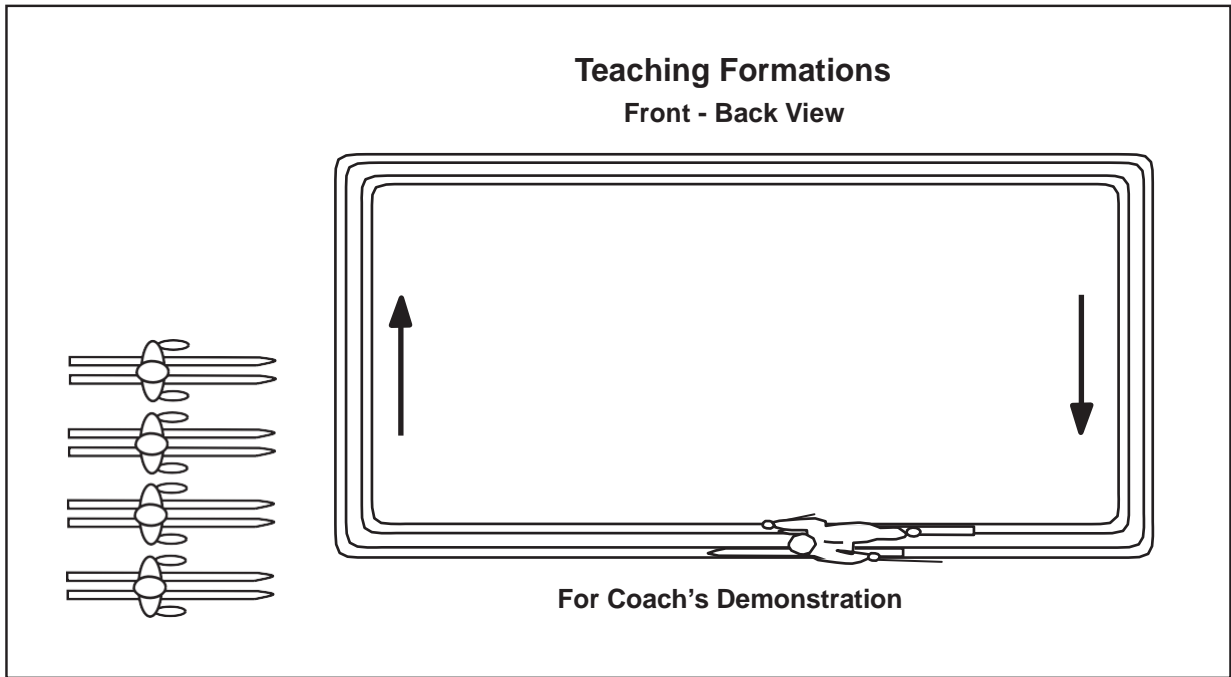
The exact number of observations depends on the skill in question. Ideally, you should observe the athlete as many times as it takes to get the information you need to communicate what he/ she needs to improve on.

3.3.2 Teaching and Observation Formations

When teaching on-snow sessions to athletes in the L2T stage of development and younger, it is important to keep the athletes active so that they stay warm and attentive. For this reason having your athletes line up and complete a skill one at a time is usually less than ideal. The preferred approach is to utilize ski playgrounds or small loops where athletes can be continuously active and you can take them aside one at a time to work on their technique.

There are occasions, however, when a group approach to teaching on-snow sessions is appropriate. Following are some examples of formations and grids that can be useful for teaching skills in those situations. One of the benefits of using formations is that it increases your control over those being taught by restricting their movements to a specific area.

Coaching Tip: A coach must develop the ability to distinguish the individual style of an athlete from good/poor technique.



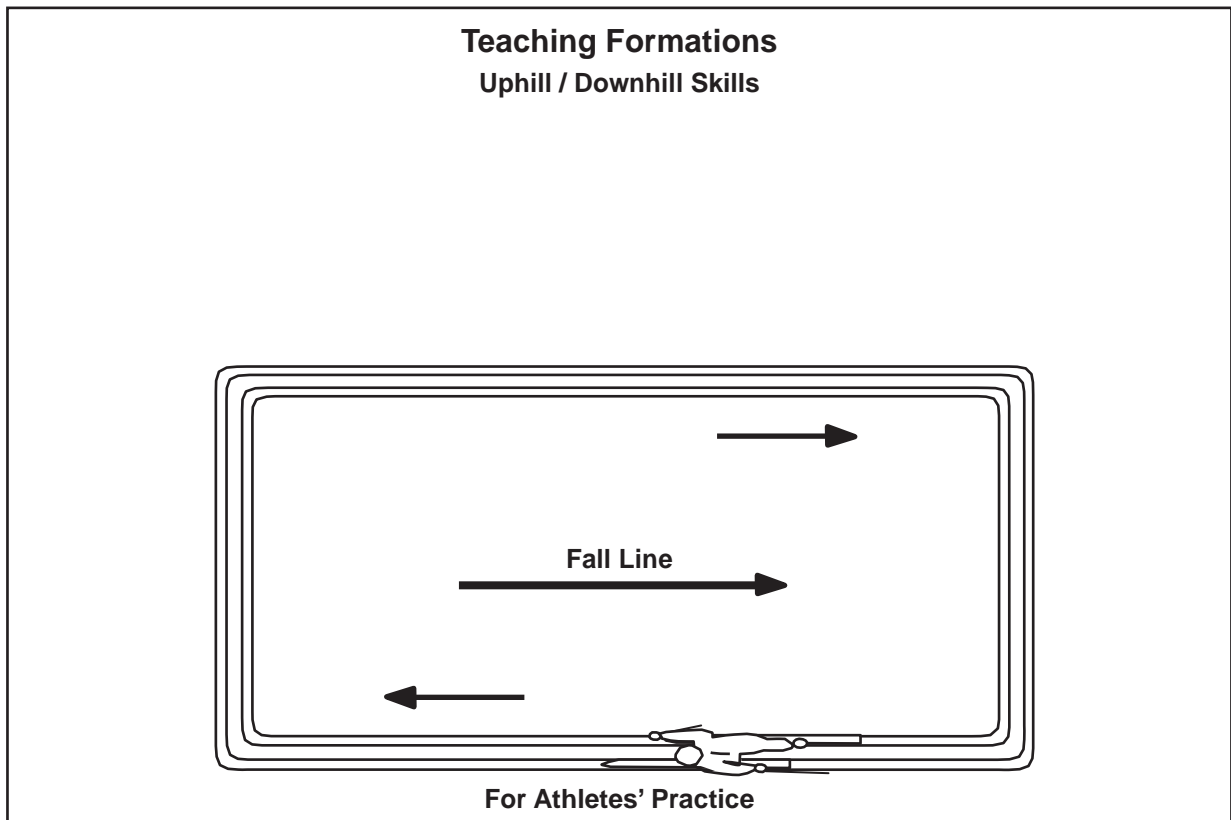
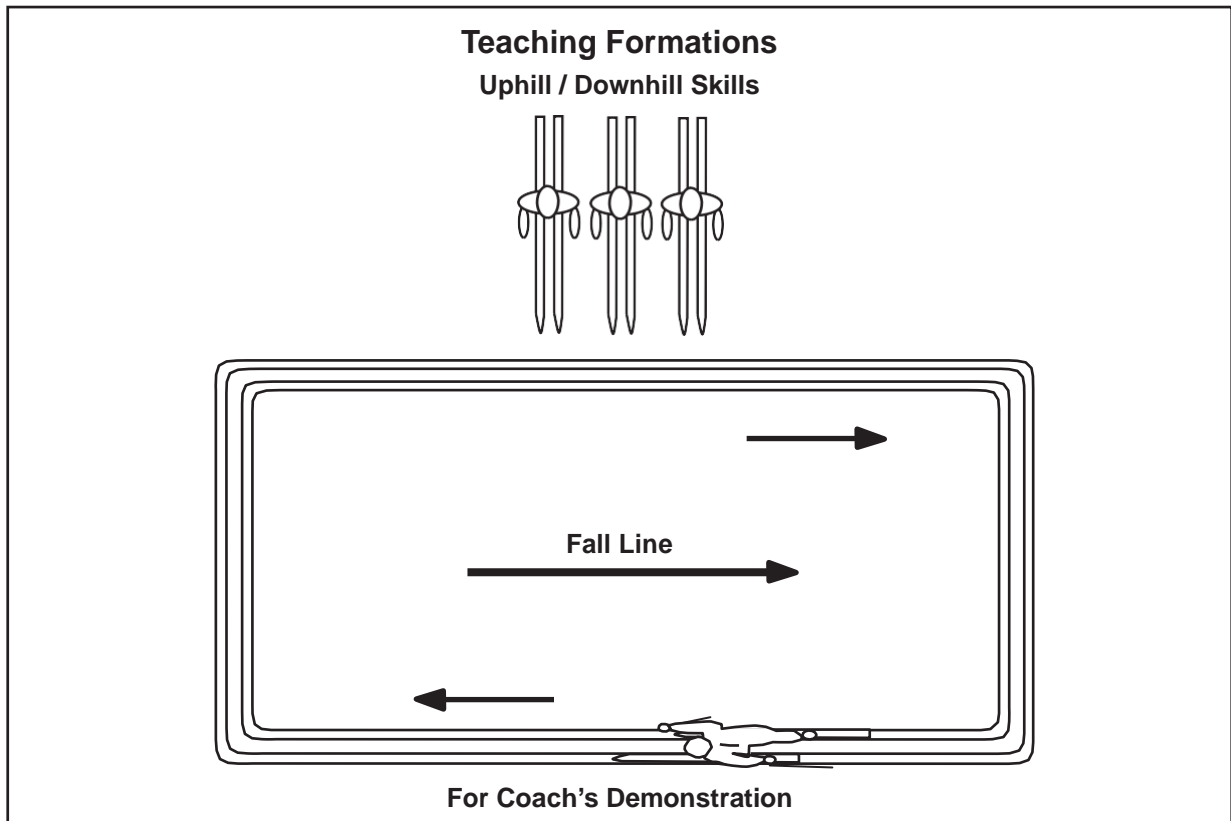
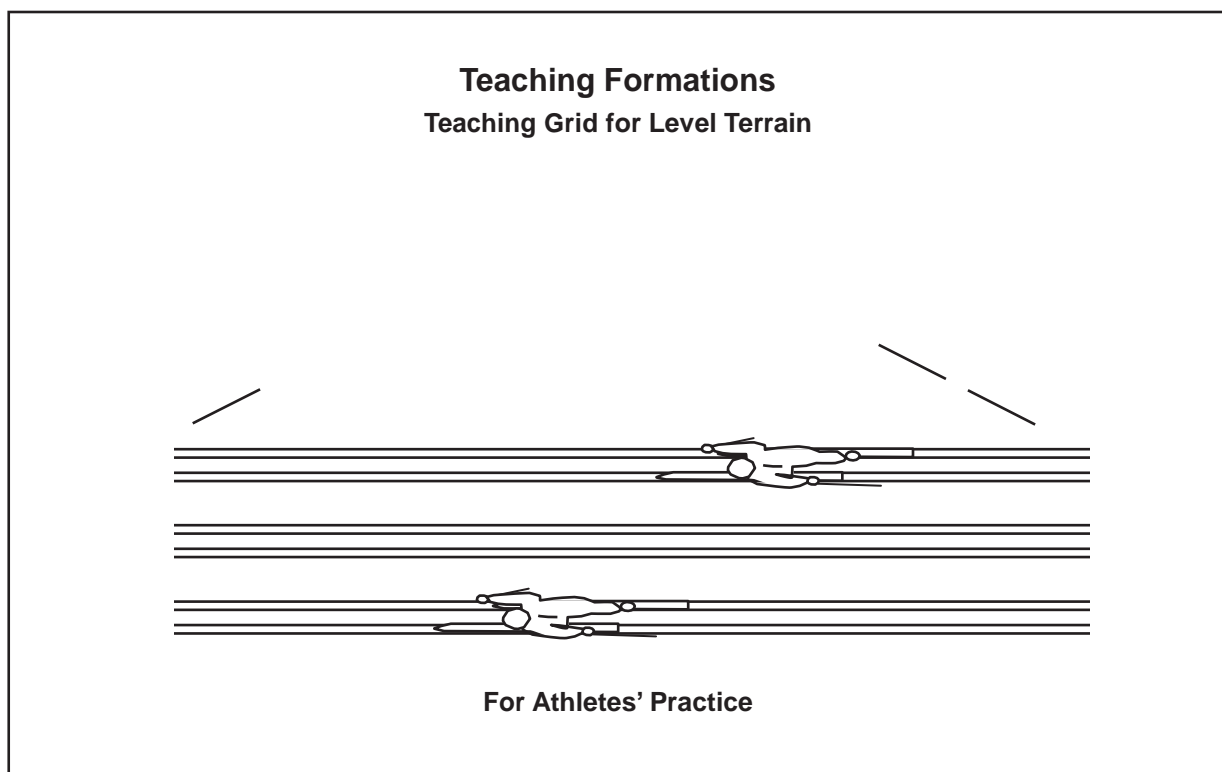
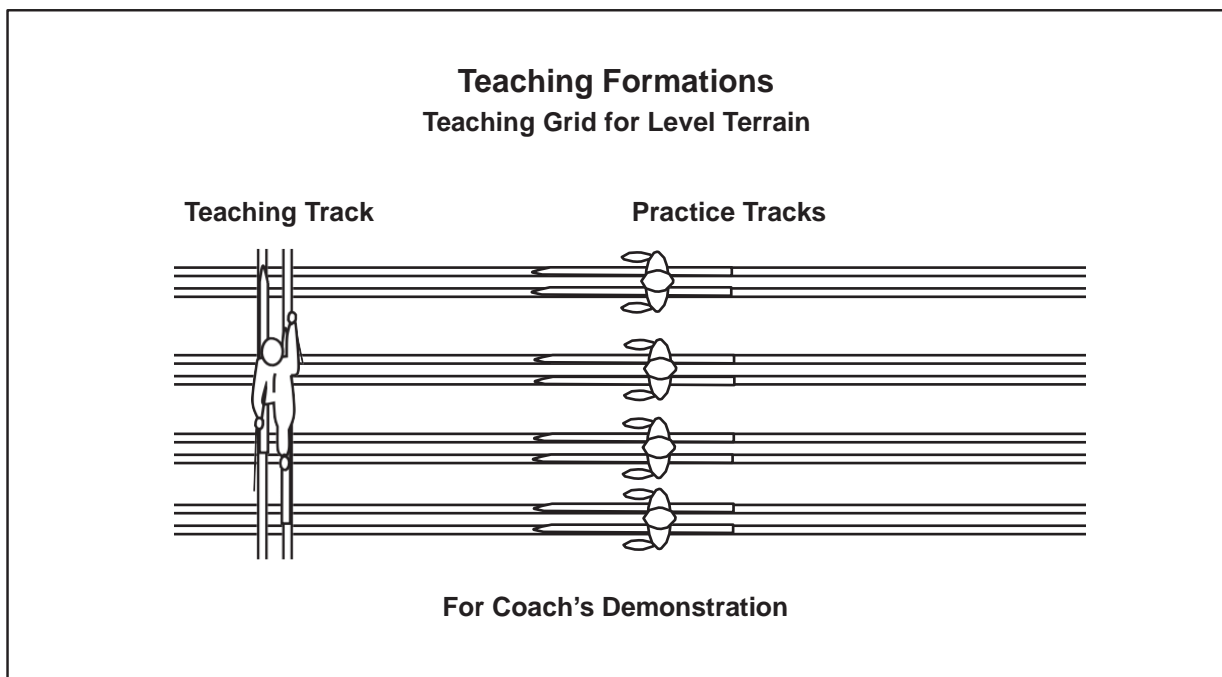


Figure 3.7



3.3.3 Effective Use of Video

A video camera is an essential tool for analyzing an athlete's technique precisely and explaining the desired action clearly. It can significantly improve the effectiveness of your teaching. Today cameras on smart phones and tablets are sufficient to provide athletes with feedback on their technique. Specifically a camera can be used to:



- subjectively analyze a skier's technique; subjective analysis can be carried out by making general visual assessments;
- objectively analyze a skier's technique; objective evaluations can be made by creating some background reference markers and counting the number of video frames covered between the markers or measuring skier body angles with respect to the markers;
- visually point out where improvement is needed and where improvements have been achieved;
- present role models with excellent technique;
- present a split screen sequence in which skilled and novice skiers ski side by side during the various phases of a technique (the skilled skier could range from an international level athlete to a young role model from the same age range as the observing skier); and
- create a technique record tape for individual skiers to show their improvement over a period of time.

Tips for Successful Video Recording

A camera can be a powerful tool if it is used effectively. With a little practice, you should be able to produce clear and informative images for both yourself and your athletes. Following are some tips to get you started:

- Decide prior to the session what the objectives are, what technique you would like to analyze and where you will position yourself (or your assistant coach if an assistant is doing the camera work).
- Before you leave home, inventory the equipment to ensure you have packed everything you will need.
- Give your athletes clear instructions as to what you want them to do when you are filming them, including when and where you want them to start and stop skiing.
- If filming from the side, select an open area where you can move well back from the ski tracks. This will give you the longest sequence of frames (without angles that distort the image) as the skiers pass by. Use the zoom or proper position to create a large skier image on the screen.
- Organize the session to minimize the amount of time the athletes will be waiting in a line up.
- If the objective of the session is to give athletes on-the-spot feedback on their

performance, you can keep the group skiing (and practising what they just learned) in a continuous loop while this is taking place. The athletes can be pulled aside for one-on-one feedback as needed. Ensure the athletes leave enough space between each other to allow you to film them individually.

- ❑ If the objective is to hold an indoor video session at some later point in time, you may choose to use a tracked/packed area that is approximately 40 metres in length. If you have a group of six athletes, you would position three at one end of the ski track(s) (to your left), and three at the other end of the ski track(s) (to your right). Next place one ski pole beside the track - 10 metres in from the athletes on your left, and a second ski pole 10 metres before the athletes on your right. The first athlete to ski past you can be from either side. When that athlete is three quarters of the way down the track (passing the ski pole farthest from their starting point), the second skier (from the opposite end of the track) should be passing the same ski pole, but going in the opposite direction. The camera should follow the athlete that is between the two ski poles. With this arrangement the camera follows whichever athlete is between the two markers (ski poles) and the camera action is continuous. If you are filming classic technique, it is best (but not necessary) to have two parallel tracks.
- ❑ If filming from the front, make sure there are no angles and that the image fills the screen.
- ❑ Adjust the zoom or reposition as the skier moves towards you.
- ❑ If possible, arrange your position so that the sun is behind your back when you are filming.
- ❑ When filming technique, you should ask your athletes to remove their bulky warm-ups (weather permitting) and ski in their ski suits. Bulky clothes cover up subtle movements and hide the angles being analyzed.
- ❑ At times it may be useful to have your athletes ski at close to race pace, so that you can analyze their technique when they are skiing at a higher speed.
- ❑ Use of coaching software and apps are encouraged to enhanced playback and analysis of technique.
- ❑ If using a smart phone for video work ensure the screen is large enough to view the skiers properly and bright enough in sunny conditions to be effective. Tablet sized screens are recommend whenever possible.

Coaching Tip: For athletes in the L2T stage of development, it is preferable to use a camera in on-snow situations where the athletes have the opportunity to practice a technique immediately after seeing themselves on camera, and where interaction with the coach is one-on-one, and not in front of their peers.

Conducting Effective Indoor Video Sessions

Reviewing technique on video in an indoor setting can be very useful if the session is managed well. On the other hand it, if it is not managed carefully, it has the potential to create issues with some of your athletes. Following are some suggestions to help you conduct successful indoor sessions:

- ❑ Create a positive, low-stress environment.

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- ❑ You may wish to begin each session using pre-selected footage of a high-level athlete or other good role model performing the same technique, or (depending on how much time you have to prepare for the session) a split screen sequence in which the skilled skier and the athlete in question ski side by side during the various phases of a technique.
- ❑ One option is to preview the video ahead of time, make a list of the order in which you would like to see the athletes (pin it on the door), and jot down some notes about the things you would like each of them to work on. Start with two athletes in the room, and as one finishes and leaves the room they are asked to send in the next one. The athletes in the group that are not in the room can be working on something else while they are waiting their turn. This approach works well in camp situations.
- ❑ In the above situation, the video footage of the athlete receiving the feedback should first be reviewed at normal speed, and then at slow speed.
- ❑ Another option is to have sessions with one to five athletes. If there are more than two athletes present, you may wish to begin by viewing the entire tape at normal speed, allowing them to observe the whole group.
- ❑ Allow the athletes to participate in the process. Encourage involvement by asking him/her questions such as: "What do you think you are doing correctly? What do you think you are doing better than last time you skied or saw yourself ski? What do you think you can do to improve your technique the next time you ski?"
- ❑ Focus on constructive feedback – what the athlete should work on to improve his/her technique - not on what is being done wrong.
- ❑ End individual feedback with a positive statement of what you liked most or what they have improved on most since the last session.
- ❑ Praise in public, critique in private, and always keep in mind that some athletes are more sensitive than others.
- ❑ Whenever possible, go directly back onto the snow and work on the necessary corrections. The sooner the feedback can be acted upon the better.
- ❑ Share the video on youtube or other services for the athlete to view at home (make the link private)

Video Equipment Care

Following are some tips for trouble-free usage of your camera:

- ❑ Smart phones and tablet batteries do not last long in cold weather. When heading outdoors keep these devices under your coat close to body heat to keep them warm.
- ❑ Bring chargers and any video attachments needed to display on video on a large screen indoors.
- ❑ Remember to store smart phones in a warm dry environment when not in use.

3.4 Skill Criteria and Checklists

To assist you in managing the skill evaluation and awards aspects of the program, sample Skill Checklists and a Progress Report Chart have been included at the end of this section. These checklists are intended to serve as examples only. It is strongly recommended that you develop your own system for tracking the progress of your athletes

3.4.1 Track Attack Technique Stickers

The Track Attack program is designed for skiers who are usually between the ages of 10 and 12, and who are in the "Learning to Train" stage of development. The enrolment kit of the Track Attack program includes a Buff, and program award all-weather stickers, which can be placed on ski equipment. The focus of the Track Attack program is to help participants become technically competent cross country skiers and use their skills to explore a wide range of ski activities. With regards to technique, there are 6 technique stickers athletes can achieve. Full descriptions of each sticker and how in can be achieved can be found on CCC's website in the [Athlete development section](#).

Diagonal Stride Technique Checklist

This technique should be practiced and assessed on flat or gradually rising terrain with set tracks. In recreational skiing, Diagonal Stride is used when skiing in these types of situations. In competitive skiing, Diagonal Stride is most frequently used on uphill segments of the course; Double Poling and One-Step Double Poling are used on flat terrain.

Below is the list of the most important skills and benchmarks that make up perfect execution of the diagonal stride technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of the diagonal stride technique, please check the following technique videos from CCC's Athlete Development Matrix:

- [Side view](#)
- [Front view](#)

Skills	Yes	No
The skier commits weight fully to the gliding/supporting ski in gliding phases.		
The glide leg is extended just before becoming the pushing leg to generate a powerful pre-loading motion.		
Forward body lean comes from a flexed ankle so that the middle of the hips are over toes at initiation of leg push.		
Complete extension of the leg and arm at the end of their respective pushes.		

On pole plant, hands are at or below shoulder height with a 90 degree angle at the elbow		
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Double Poling Technique Checklist

In recreational skiing, Double Poling is used for variety and maintaining speed on flat terrain, and for speed and efficiency on gradual downhills. In competitive skiing it is used in similar terrain, but for the purpose of generating speed and power.

Below is the list of the most important skills and benchmarks that make up perfect execution of the Double Pole technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of Double Poling, please check the following technique videos from CCC's Athlete Development Matrix:

[Side view](#)

[Front view](#)

Skills	Yes	No
The hips, upper body and arms are well forward and high to load the poles on pole plant (poles are planted at or in front of bindings)		
The skier pulls down the poles; engaging the back shoulder and core and arm muscles.		
Legs are slightly flexed on pole plant, with flex increasing noticeably – but not excessively - during the poling action.		
Upper body compression ends before the horizontal position.		
At pole plant, the shafts are nearly vertical, with the grips slightly ahead of the pole tips to allow for lag time before applying significant force onto the poles.		
Poles are planted parallel to each other and at shoulder width for maximal power transfer into poles (straight back and down).		

One Step Double Pole Technique Checklist

The One Step Double Pole classic technique is usually used on flat terrain or gentle uphill. One Step Double Pole is the technique used when the skier's speed is too great for an effective Diagonal Stride and too slow for Double Poling. It is a powerful technique that incorporates both a strong leg push and a strong poling action. The skier must first be able to

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execute the Diagonal Stride and Double Pole techniques correctly, as the main components of these techniques are combined in the One Step Double Pole technique.

Below is the list of the most important skills and benchmarks that make up perfect execution of the One Step Double Pole technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of One Step Double Poling, please check the following technique videos from CCC's Athlete Development Matrix:

[Side view](#)
[Front view](#)

Skills	Yes	No
As the kick is initiated, the push leg is fully weighted with the weight shifting dynamically to the striding leg as the push ends.		
The upper body and arms are well forward and high to load the poles for pole plant (poles are planted well in front of the binding of the gliding ski).		
There is a pre-load of the push leg before the push.		
Arms and legs are moderately flexed on pole plant.		
Upper body compression ends well before the horizontal position (i.e. there is less compression than in Double Pole).		

One Skate Technique Checklist

The One Skate technique requires a poling action (arm push) with each leg push. This technique should be practiced and assessed on a packed, gentle downhill slope. For recreational skiing, One Skate is used on flat or gentle downhill terrain to maintain speed. In competitive skiing, One Skate is a powerful, dynamic technique used to accelerate on flats and gradual uphill. It is the fastest technique in many situations and is used extensively by racers.

Below is the list of the most important skills and benchmarks that make up perfect execution of the One Skate technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of One Skate technique, please check the following technique videos from CCC's Athlete Development Matrix:

[Side view](#)
[Front view](#)

Skills	Yes	No
The skier plant the poles when feet are closest together.		
The skier assumes a high position for the initiation of the pole plant.		
The pole plant action and the leg push are completed almost simultaneously as the skier's weight shift to the gliding ski is completed.		
The follow-through of the arms generally stops just past the hips (but varies with tempo and terrain).		
During the recovery of each leg, the foot passes underneath the hip of that side (feet come close together).		
Maximum legpush on each side resulting in full extension of the pushing leg.		

Two Skate Technique Checklist

Two Skate is the technique used when the slope of the terrain varies from flat to slightly downhill and the skier has already generated quite a bit of speed. It is a technique that is commonly used when the skier is interested in maintain speed as opposed to accelerating. This technique should be practiced and assessed on flat gradual up/downhill terrain.

Below is the list of the most important skills and benchmarks that make up perfect execution of the Two Skate technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of Two Skate technique, please check the following technique videos from CCC's Athlete Development Matrix:

[Side view](#)

[Front view](#)

Skills	Yes	No
Timing is the same as for the One Skate, with poles being planted when the weight shift is initiated.		
The skier assumes a high position for the initiation of the pole plant on the poling side – hips are high, legs relatively straight, upper body is erect with slight forward lean.		
Body compression results in a lowering of the body by the end of the poling motion (more than for one skate because of the the faster speed and longer gliding phase).		

The follow-through of the arms and hands is longer than for One Skate because of two leg for one poling motion (arms usually fully extended back).		
During the recovery of each leg, the foot passes underneath the hip of that side (feet come close together).		
Maximum legpush on each side resulting in full extension of the pushing leg.		

Offset Technique Checklist

Offset is the technique used to climb hills in skate skiing, when a skier’s speed is too slow to use One Skate technique efficiently. This technique should be practice and assessed on a gradual and increasingly steeper uphill terrain, as much as the strength of the skier permits.

Below is the list of the most important skills and benchmarks that make up perfect execution of the Offset technique. L2T stage skiers are not yet expected to perform each of those skills perfectly, but they should be able to perform the technique well overall, i.e. with ease for a prolonged period of time.

For visual benchmarks of Offset technique, please check the following technique videos from CCC’s Athlete Development Matrix:

- [Side view](#)
- [Front view](#)

Skills	Yes	No
Both poles are planted as the new gliding ski touches the snow.		
Double Pole- type motion on the lead side with staggered (offset) pole plant.		
Knee and hip are driven up the hill and are aligned over the gliding ski.		
Ankle, knee and hip joints are flexed as required by terrain.		
Maximum leg pushes on each side resulting in full extension of the pushing leg.		
At the completion of the leg push, the ski is raised slightly off the snow. The tip and tail of the ski leave the snow at the same time.		
Follow-through of the arms and hands is short, and generally stops at or just past the hips.		

The full track attack program description and information on the additional achievement stickers that can be accumulated can be found on [CCC’s website](#).

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