



Competition-Coaching Introduction Advanced (T2T)

Step 3:

Teaching classic and downhill technique



**Reference Material
for On Snow Workshop**



PARTNERS IN COACH EDUCATION

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3.1 Teaching Classic and Downhill Technique

General Considerations for Teaching Technique (Both Skating and Classic)

Important objectives for athletes in the T2T stage of development are:

- ✓ master balance and weight shift for all techniques;
- ✓ further refine all ski techniques;
- ✓ learn to adapt technique to various snow, track and terrain conditions;
- ✓ improve downhill skills;
- ✓ improve performance related technique adaptations; and
- ✓ improve technique efficiency when dealing with a high level of fatigue.

Following are some key considerations for coaches to keep in mind to help athletes achieve this.

- ❑ It is essential to have a good understanding of the elements of proper technique in order to teach and evaluate technique effectively.
- ❑ It is essential to have frequent, regular and properly structured opportunities to teach technique to your athletes.
- ❑ Skiing fast must not be the initial objective. Focus first on teaching proper body positioning, body movements and timing – which, when executed correctly and together, produce rhythm. Ensure that your athletes have acquired the characteristic rhythm of a technique before emphasizing the generation of power and speed.
- ❑ In order to truly perfect technique, athletes must develop an accurate kinesthetic sense – an instinctive feeling for what is efficient – so that they are able to continuously and reflexively adapt their movements to be optimal, even when fatigued or in the pressure of competition. Developing this acute kinesthetic sense is best achieved by exposing athletes to a variety of stimuli. The following approaches to learning and training are applicable to this process:
 - ✓ Techniques should be practiced on a variety of snow and track conditions. Once the mechanics of technique have been learned in a teaching situation, athletes should be required to practice in wet and mild conditions, on hard tracks and in soft powder snow so that they can learn how to adjust their technique to the different situations. Moreover, skiing in less than ideal conditions (e.g. on tracks that weren't set following a light snowfall) will help them develop balance and agility.
 - ✓ As well as practicing technique in a variety of snow and track conditions, athletes should practice technique on different types of ski trails. For example, modern ski trails and competition courses are often built like “super highways”, but skiing on less manicured trails that twist and turn is important in order for athletes to improve their agility on skis and learn to change techniques reflexively as the trail requires.
 - ✓ Participating in year-round activities that require relevant technical abilities (balance, coordination, rhythm, etc.) will also help to develop the desired kinesthetic sense.

- ❑ Athletes should do some of their technique practice without poles. This will help them refine their balance skills and the timing of their leg actions and weight shift. This is especially important early in the season, when athletes first get on snow. However, skiing without poles also serves to remind athletes of some of the underlying fundamentals of sound technique and should therefore be included in practices periodically throughout the season.
- ❑ The balance and agility drills provided in the Community Coaching Reference Material (section 4) should be a part of every practice session.
- ❑ Most athletes require frequent and consistent feedback on their performance in order to ensure technique improvement occurs. To assist with this, coaches are strongly encouraged to use video cameras to provide on-snow analysis and feedback (section 3.3 of the Learning to Train (On-Snow) Reference Material) and to develop good observation, intervention and feedback skills to maximize teaching effectiveness (section 5.4 of the Learning to Train (On-Snow) Reference Material). In the latter context, it is extremely advantageous for coaches to periodically ski behind each of their athletes for several kilometers of mixed trail conditions, as this will permit them to provide immediate feedback on technique beyond the relatively constrained view that is available on a training grid, from a fixed camera point or from a split station during a competition.
- ❑ It is important for athletes to see examples of good technique, so they can create a mental picture of what they are aiming to achieve. To this end coaches should work on upgrading their own technique, as they are key role models for their athletes.
- ❑ When competing, athletes need to use the techniques that will give them optimal speed in the given terrain and snow conditions. Fitness obviously affects when and where a specific technique is used, but adapting the technique to the terrain is very important as well. Competitive skiers must therefore learn to analyze both the course profile and the prevailing snow and track conditions in order to determine how to best ski the trail. In addition they need to learn how to maintain momentum when switching from one technique to another. Choosing the best technique for a given situation means using the one that is optimal for a certain speed.

Characteristics of the “Best” Skiers

- ❑ The “big three” characteristics are the following:
 - ✓ Good balance.
 - ✓ Good weight shift.
 - ✓ Good rhythm (i.e. correct body positioning, body movements and timing).

- ❑ Other important characteristics are as follows:
 - ✓ Good forward movement – “gains lots of ground”.
 - ✓ Generates and maintains momentum – “keeps the wheels turning”.
 - ✓ Good at creating force in the direction of travel – not up, down or sideways.
 - ✓ Good at changing technique to match terrain, snow and track conditions.
 - ✓ Good physical condition.
 - ✓ Good kinesthetic feel.

Key Considerations Specific to Teaching Classic Technique

- ❑ The Teaching Points provided later in this section outline the key elements that make up each classic technique. It is recommended that coaches analyze the classic technique skills of the athletes in their group at the beginning of the season and, based on this evaluation, develop an individualized “classic technique plan” for each. These plans will be useful in determining the focus of the technique sessions for the whole group as well as in guiding your advice to individual athletes throughout the season.
- ❑ The learning curve for classic techniques is different than for skating techniques. At a basic level, classic techniques are easier to execute than skating techniques. However, they are also more difficult to execute well, in that there are many nuances to the essential body positions and movements that are required, particularly for Diagonal Stride. Somewhat simplistically, executing classic techniques correctly invariably requires finesse, while in skating a skier who is physically strong may be able to compensate for technique deficiencies. Overall, the process of refining – let alone perfecting – classic techniques is typically longer than for skating techniques, so coaches and skiers must be prepared to be patient.
- ❑ Classic techniques are further complicated by the additional variables of wax effectiveness and weather dependency. It is difficult and frustrating for a skier to learn good classic technique if his/her wax is not working well. Therefore, it is important for both coaches and athletes to become competent in waxing for the full spectrum of conditions. At the same time, regardless of the effort put into wax selection, there will inevitably be days when wax performance will be less than perfect – and occasionally downright bad. Athletes must accept that such days are part of skiing and learn to persevere, recognizing that good technique will enable them to get the best results possible in difficult conditions.
- ❑ There is a particular premium on good weight shift and balance in classic skiing, in that classic technique is executed in a narrow track and thus within the constraints of a relatively narrow base of support. Good weight shift is essential for sustaining forward momentum, establishing the body position needed for good balance and facilitating good wax performance at critical points in several classic techniques. Good balance is essential for enabling a skier to glide on a single ski in a variety of different snow and track conditions. Frequent practice without poles is an effective way for skiers to improve their capabilities in these key components of technique.

3.2 Classic Techniques

The material provided in the following sections will provide you with comprehensive information on the various classic techniques, together with recommendations on how to teach them. Classic Technique Checklists are summarized in section 3.2.5.

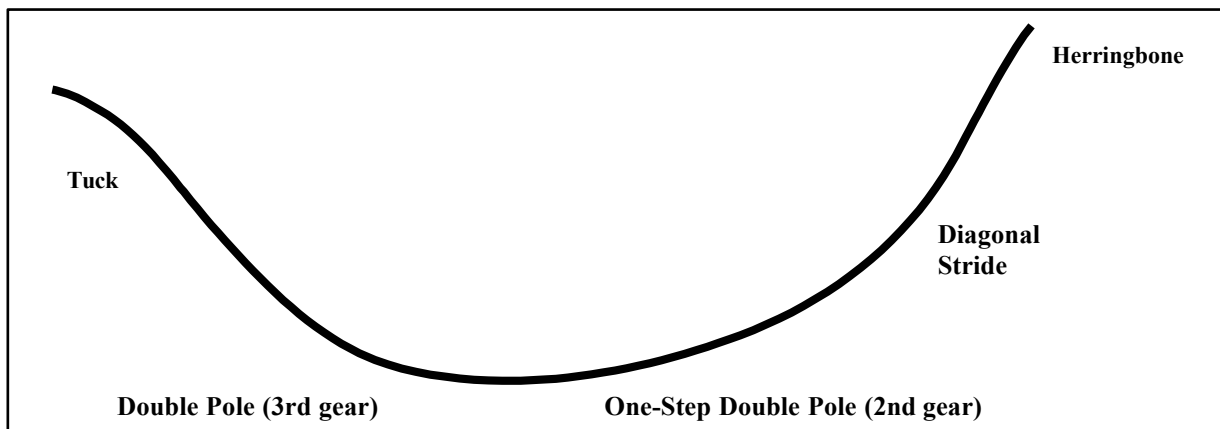
The technique descriptions in this manual are appropriate for distance races and for recreational skiing. Note that experienced ski racers may make minor modifications to classic techniques for sprint competitions in order to be more dynamic and explosive. These modifications can be executed for relatively short distances and/or races of short duration only.

Ski technique and our understanding of it are constantly evolving – sometimes quickly. This material articulates the most current doctrine and will be updated periodically as changes occur.

This section presents detailed information on the classic techniques as follows: Diagonal Stride, One-Step Double Pole and Double Pole. Some general information is also provided on Herringbone, but this technique is not treated in the same depth as other techniques since it has much in common with Diagonal Stride as regards body movements and positioning.

In this section, classic techniques are equated to “gears” (analogous to gears in a vehicle) which give an indication of the relative speed of a skier when using each of the techniques. This is illustrated in Figure 3.1.

Figure 3.1



The gear analogy gives an indication of the relative speed of a skier when using them. Thus, classic techniques are described as follows:

3.2.1 Herringbone – a sub-gear (as with the Diagonal Skate technique in the skating context).

When the slope of a hill becomes very steep, there may be a point where the skier cannot ascend further using Diagonal Stride as the wax will no longer grip. At this point the skier will resort to the Herringbone technique to maintain forward movement up the hill. In the Herringbone, the skier angles the skis out to the side in a “V” in order to maintain grip, but the upper body movements and weight shift are the same as for Diagonal Stride.

Herringbone is an essential technique for recreational skiers, as an energy-efficient means to

climb steeper hills.

In a racing context in which ski trails are properly designed, a competent and fit skier with properly waxed skis may not need to resort to using Herringbone to climb hills. While this approach is correct in principle, practicality dictates that there are situations where Herringbone will still be used. This will certainly be the case when grip waxes fail to work due to difficult conditions or a poor wax selection decision. In addition, Herringbone may be used more frequently by younger skiers whose fitness or technique ability may not permit a relatively steep hill to be climbed using Diagonal Stride. As well, more proficient skiers may need to use Herringbone when faced by a particularly steep grade on a race course. Ultimately, when the situation dictates (i.e. continuing to climb while executing Diagonal Stride technique correctly is impossible), Herringbone must be used.

Apart from the racing scenarios described above, many or most skiers will continue to find the Herringbone to be of value when training. When training in the lower zones/ intensities, skiers should attempt to use Diagonal Stride technique for hill-climbing to the extent possible. However, they will sometimes find it expedient to climb steeper sections of the course using Herringbone in order to keep their heart rate within the specified parameters for the zone in which the training is taking place.

As noted previously, this manual will not cover Herringbone in depth. Nevertheless, coaches should ensure that when Herringbone is being used by their athletes, the technique is being executed correctly. On steeper slopes, well-executed Herringbone technique is only marginally slower than Diagonal Stride; poorly executed Herringbone is simply walking up a steep hill without back-slipping. Points to emphasize for good Herringbone technique include the following:

- a) The weight is transferred dynamically from ski to ski, maintaining a high tempo and good rhythm. See Figure 3.2.
- b) The hips must remain high and forward. See Figure 3.3. A forward hip position serves to facilitate forward momentum and helps make the wax work by keeping the skier's weight over the wax pocket. However, excessive forward body lean takes the weight off the skis and leads to back-slip.

Figure 3.2



Figure 3.3



- c) The "V" placement of the skis should be as narrow as possible. As the hill gets steeper, the "V" becomes wider.
- d) The skier should land on a flat ski to the extent possible, in order to permit the wax to work,

but may need to edge the ski to apply pressure on the inner edge of the skis on particularly steep slopes and difficult snow conditions. In principle, it is preferable to improve traction by widening the “V” than by edging the skis.

- e) The poling action is rapid and close to the body. The pole is used both for push and to prevent back-slip.

3.2.2 Diagonal Stride (1st Gear)

Purpose

The Diagonal Stride, or 1st gear, is the classic technique that is used as follows:

- ❑ in a racing context, on most uphill; and
- ❑ in a recreational context, on flat terrain and gradual uphill.

The technical ability, fitness and strength of the skier will dictate the actual terrain in which Diagonal Stride will be used. The firmness and speed of the track and the evenness of the terrain will determine where a transition to another technique becomes necessary.

For both racers and recreational skiers, the Diagonal Stride is used on uphill sections of a ski trail with the exception of very steep uphill. As the slope gets steeper and glide shortens or ceases, the execution of the Diagonal Stride must be modified to improve its effectiveness in these circumstances. When the hill becomes too steep to be climbed using Diagonal Stride, the skier must switch to Herringbone to obtain better traction and maintain forward momentum (Herringbone technique was discussed briefly in section 3.2.1).

Mechanics

The Diagonal Stride technique comprises the same rhythmic arm and leg movements used in walking and running. This basic striding action is such that diagonally opposite arms and legs move forward and backward at the same time.

The Diagonal Stride is composed of a number of interconnected body movements, the synergistic effect of which far exceeds the effect of the individual components. To achieve this effect, the skier must not only move through certain body positions but also move continuously, smoothly and powerfully through the stride cycle.

A complete cycle of Diagonal Stride is depicted at Figure 3.4.

Figure 3.4: Complete Cycle of Diagonal Stride Technique



To successfully teach this technique, the coach must understand the stride cycle and the phases within it. A complete Diagonal Stride cycle consists of two identical but opposite stride sequences:

- ❑ the right leg stride sequence – comprised of:
 - ✓ a left leg push and consequent glide action of the right leg; and
 - ✓ a supporting pull/push with the left pole.
- ❑ the left leg stride sequence – comprised of:
 - ✓ a right leg push and consequent glide action of the left leg; and
 - ✓ a supporting pull/push with the right pole.

The major component of the power generated in the Diagonal Stride comes from the leg movements in each stride sequence. The supporting poling action integral to each stride sequence adds additional power and provides linkage/continuity between stride sequences.

The essence of Diagonal Stride is to fluidly and rhythmically integrate the propulsion derived from the cyclical leg-arm-leg-arm action – the entire cycle being supported and enhanced by a dynamic weight shift and precise body positioning, movements and timing.

A complete and properly timed weight shift from one ski to another is even more important in classic technique than in skating. In addition to contributing to forward momentum, it is necessary for effective wax performance at critical points in the technique.

As the skier is at all times supported by only a single leg, good balance – derived in large part from correct body positioning – is a critical element of the technique. Proper weight shift and good balance go hand-in-hand; one cannot occur without the other.

For the purposes of analyzing and describing the technique, a stride sequence of Diagonal Stride (i.e. half of a cycle) can be viewed as consisting of three phases: the leg push phase; the unassisted glide phase; and the pole-assisted glide phase. The following description is of a right leg stride sequence:

❑ **The Leg Push Phase.** The first phase, featuring the left leg push, begins when the skier's right leg (i.e. the recovery leg) is moving forward and about to pass beside the gliding/supporting leg (this may be viewed as the Ready Position for Diagonal Stride). The phase finishes just as the pushing foot leaves the snow. The majority of propulsive force in the Diagonal Stride technique – as much as 80% – is generated in this phase. Figures 3.5.1 and 3.5.2 depict the start and finish of the leg push phase.

Figure 3.5.1



Figure 3.5.2



- a) At the start of the phase, the skier has most of his/her weight forward on the pushing foot (i.e. the old gliding/supporting ski). There is a good bend at the ankle, with the hip lined up over the front of the foot, and the upper body is inclined forward. The hip, knee and ankle joints are angled similarly (see Figure 3.5.1). The weight-forward, flexed position is a powerful starting position that helps to ensure efficient movement down the track.
- b) As the recovery (right) leg is swung forcefully forward and the new gliding ski is placed on the snow, the left leg push begins and continues until the pushing foot leaves the snow. The leg push must follow biomechanical principles laid out in section 2.1. To be effective, the hip, knee and ankle joints should contribute to the leg push in that order, constituting a sequential but very rapid and explosive movement. The hip muscles work first, then the thigh muscles start straightening the knee midway through the hip action and the calf muscles begin extending the ankle shortly thereafter.
- c) The angles at the hip, knee and ankle joints should open up (i.e. the leg should straighten) as much as possible before the pushing leg leaves the snow. The leg push should be thought of as a pushing action on the snow and backwards with the ball of the foot. The leg push should be executed quickly and effectively so that power is transferred quickly to the snow, the wax pocket of the pushing ski is compressed (allowing the grip wax to work) and a resulting glide is created.
- d) Weight transfer occurs progressively throughout this phase. Initially the majority of weight is on the pushing (left) leg. The skier's upper body begins to shift diagonally across the track toward the right side as the recovery leg swings forward. The weight shift becomes more dominant as the new gliding/supporting ski touches the snow forward of the pushing foot and is completed as the pushing foot and majority of the ski leave the snow.
- e) During this phase, the skier's hips rotate slightly. The left hip opens to the rear at the end of the leg push to facilitate the follow-through of the pushing leg. The right hip wraps forward slightly as the weight shift is completed, to permit the skier to be positioned with weight balanced over the gliding/supporting ski.
- f) At the beginning of this phase, the poling arm is in mid-thrust, with the poling hand yet to pass the leg. During the phase, the hand continues the pull/push to the rear, passing close to the leg. The pole thrust ends shortly after the hand passes the leg. The hand relaxes, with force on the pole towards the end of the phase being maintained largely through hand pressure on the pole strap.

- g) Concurrently, the pole on the push leg side is in mid-recovery, with the poling hand already well forward past the leg as the phase begins. The pole is inclined well to the rear and the arm is slightly flexed at the elbow. The recovery is not fully completed during this phase.
- h) At the end of the leg-push phase, the forward lean of the upper body and the full extension of the push leg are such that a straight line is formed from the skier's shoulder to the toe just as the pushing foot leaves the snow.

□ **The Unassisted Glide Phase.** The second phase of the Diagonal Stride is called the unassisted glide phase. It begins when the pushing (left) leg leaves the snow (Figure 3.6.1) and ends with the pole plant of the same side pole (Figure 3.6.2). No propulsive force is generated in this phase. The objectives of the phase are to maintain a good balanced gliding position and position the body for the pole thrust which occurs in the next phase.

Figure 3.6.1



Figure 3.6.2



- a) To maintain the gliding action, the skier keeps his/her weight entirely on the gliding/supporting foot (i.e. the right foot), with the weight distributed comfortably across the whole foot. The gliding leg continues to straighten as the skier's body moves up and over the gliding foot, though it does not reach a fully straight and locked position. The right hip remains wrapped slightly forward to facilitate proper body positioning over the gliding/supporting ski.
- b) During this phase the pushing leg completes its follow-through to the rear. The skier's hip on the pushing side remains somewhat open to facilitate the follow-through.
- c) During this phase, the pole on the push side completes its recovery motion and is planted in preparation for the pole thrust. As the pole is positioned for pole plant, the pole tip is swung forward until the pole angle is slightly less than vertical. The moderate elbow flex of the recovery motion increases noticeably, with the elbow flared very slightly to the side, putting the arm in a position to generate force effectively when the pole thrust begins. The pole tip is planted beside the track and opposite the toe of the gliding foot. Figure 3.7 depicts the skier's body position at the moment of pole plant.

Figure 3.7



d) Concurrently, the pole on the opposite side leaves the snow and completes its follow-through to the rear. The follow through of the arm is relatively short (depending on skier velocity and glide length). The hand is relaxed with fingers extended, maintaining control over the pole through pressure on the pole strap.

- ❑ **The Pole-Assisted Glide Phase.** The final phase is the pole-assisted glide phase. It begins at the planting of the pole at the end of the unassisted glide phase (Figure 3.8.1) and ends with the return to the Ready Position where the legs pass one another (Figure 3.8.3). This phase serves to position the body correctly for the next leg push. In addition, the poling action within the phase provides propulsion that helps to maintain the velocity and forward momentum created by the leg push, thus lengthening the glide on each ski.

Figure 3.8.1



Figure 3.8.2



Figure 3.8.3



- a) At pole plant, the hand is directly forward of the shoulder, at or slightly below shoulder height. To permit the reach needed for proper arm positioning, the shoulder wraps forward slightly, rather than remaining blocked in a position perpendicular to the direction of travel. The shaft of the pole is inclined slightly to the rear – i.e. the pole grip is slightly ahead of the tip. As the pole is planted, the flex at the elbow increases, with the angle created by the upper arm and forearm decreasing to as little as 90 degrees. The actual degree of flex varies dependent on the skier's velocity and the pitch of the slope being climbed; a greater flex generates more force and is suited to steeper slopes.
- b) In the poling action, the arm joints are used in sequence – shoulder, elbow and wrist. The poling action is initiated with the engagement – in very rapid sequence – of the shoulder, back and core muscles, pulling down and back on the pole. Once engaged, these muscle groups work together in a fluid and forceful motion. The movement continues with the increase in angular speed of the elbow extension as the hand passes below the elbow and continues to move to the rear. The poling action that starts as a pull ends in a push to the rear as the hand passes the hip, the latter action occurring in the leg push phase of the next stride sequence.
- c) Concurrently, the right arm begins the recovery motion. The arm recovery action is similar in nature to the pendulum action of leg recovery. The hand grip on the pole tightens, with control now being asserted largely through the thumb and forefinger. The hand and elbow pass close to skier's body. The hand is well forward of the body by the time the legs pass beside one another. Arm movement should be forward down the track rather than arcing up or swinging across the body. An arcing action can tend to cause the skier to "bob" with the upper body up into the air. Swinging the hand across the body can lead to an improper arm position on pole plant and potentially a misdirected pole thrust that undermines balance.
- d) The trailing left leg (i.e. the one used for the leg push phase) is swung forward naturally, as a pendulum from the hip. This is a forceful movement using the hip, then knee and finally the foot. Note that there is a strong relationship between the leg follow-through from the push and the pendulum action of the recovery leg swinging forward. If the follow-through has not been sufficient there will be limited scope to generate force in the pendulum.
- e) The weight shift that started in the push-off phase culminates dynamically in the hip and leg action that drive the recovery leg forward to become the new gliding/supporting leg. The core muscles are actively engaged throughout this movement.
- f) As the recovery leg passes the original pushing foot, the hips return to a position perpendicular to the direction of travel.
- g) At the same time as the trailing leg moves forward there is a rapid straightening (though not to a locked position) and subsequent compressing action of the glide leg. This action, called preload, can be seen in Figures 3.8.2 and 3.8.3. It is this preloading that allows a powerful leg push to take place. Straightening followed by rapid compressing (preloading) stretches the muscles (their tendons and connective tissue) used in the leg push action of the next cycle. This action is akin to loading a spring - the leg muscles can produce a more powerful push if they are slightly flexed immediately before the leg push.
- h) This phase completes the stride sequence and half of an overall cycle.

The opposite stride sequence (in this case, a left stride) is then executed, with no discernible break between the two sequences. Key points in the left stride sequence are shown in Figure 3.9.

Figure 3.9.1



Figure 3.9.2



Figure 3.9.3



As the steepness of the hill increases, the skier's glide decreases to the point where there is very little to no glide at all and forward momentum is lost, necessitating modifications to the Diagonal Stride technique. To maintain forward momentum, the skier must increase stride rate. Essentially the skier starts "ski striding" on his/her skis (see section 9 of your NCCP L2T (Dryland) Reference Material). The detailed modifications are described below:

❑ **Modifications of Leg Actions for Steep Uphills**

- a) In the pole-assisted glide phase, the glide leg straightens less, but it is essential that the skier keeps the hips as high and forward as possible.
- b) The follow through of the leg is short and the leg moves forward energetically.
- c) The foot of the returning leg is pushed in front of the knee when it contacts the snow. This moves the ski farther up the hill. The ski lands on the snow forcefully and the grip of the wax in the next leg push improves as a result. The skier must remember to keep the hips high and forward.

- d) There is more bend in the knee and ankle in the legs together position.
- e) The proportion of the skier's overall propulsive force being generated by the legs increases.

❑ **Modifications of Upper Body Actions for Steep Uphills**

- a) As the hill gets steeper, the skier stands more upright, to keep the weight over the pushing foot.
- b) The arm doesn't come very far forward when the poles are planted, and there is more elbow bend than in the normal Diagonal Stride.
- c) The follow through of the poling action is shortened.

Body Positioning

- ❑ **Core.** The core muscles must be engaged to allow the back and upper body to be slightly rounded throughout the Diagonal Stride motion, but not to the point where the upper body is stiff. The skier's trunk will be more upright as the hill gets steeper. Note that too much bend at the waist at any point in the cycle (jackknifing at the waist) pushes the hips back, making it difficult to produce a strong push from the legs and frequently resulting in back-slipping and loss of kick.

❑ **Ankles and Knees**

- a) A pronounced bend at the ankles and knees as the legs pass together is critical to optimize the skier's power (this is one of the most important technical aspects of the Diagonal Stride). See Figure 3.10. More bend in these joints is required with increasing ski resistance associated with steep uphill or slow snow.

Figure 3.10



Figure 3.11



- b) The gliding/supporting leg is relatively straight (though not locked) during the glide phases, which reduces the leg muscle effort to hold the gliding position.

❑ **Hips**

- a) It is crucial that the hips be high and forward right over the ball of the foot when the leg push

is initiated. The hip position moves to the rear somewhat as the push takes place, returning to a high position during preload and the most forward position for leg push.

- b) A good indicator of proper body positioning is for the skier to feel the weight distribution – centered in the upper body – across the forefoot during the pole-assisted glide phase.
- c) The hip orientation changes through the three phases of each movement sequence. As the leg push phase begins, the hips are squared to the direction of travel. As the push leg extends, the hip on that side opens slightly to permit a full extension and follow through. See Figure 3.11 above. At the same time, on the opposite side of the body, as the recovery leg swings through and lands, the same side hip wraps forward to permit the skier's weight to align fully over the glide foot.

❑ **Arms and Shoulder**

- a) The movement of the arms and shoulders should be smooth and have good rhythm.
- b) The arm travels straight forward and back.
- c) The arm bend at the elbow on pole plant will increase as the hill gets steeper.
- d) Because of the relatively low speed during the Diagonal Stride, the follow-through of the arms and hands is short and stops just past the hips. This allows the quick return of the arms to their initial position.
- e) The shoulders remain generally perpendicular to the direction of travel, though there is a slight wrapping forward on the poling side as the arm reaches to adopt the pole plant position.

- ❑ **Feet.** For the Diagonal Stride to be most effective, the skier's centre of gravity must be over the forefoot during most of the cycle of the technique. This will happen naturally if the skier's overall body position – particularly the alignment of the hips – is well forward. This position allows for a quick and powerful leg push.

Progression

Once the basic sequence of actions in Diagonal Stride can be accomplished, the skier must develop the ability to glide on one ski at a time and perform proper weight shift. This involves pushing off the snow with one foot and moving the upper body over the other ski in a forward gliding position. Mastery of this aspect of technique takes an abundance of time, patience and good coaching. Once the skier has achieved good weight shift and a good alternating extension action in the arms and legs, he/she should work on improving force production and glide by improving the individual components of the Diagonal Stride.

The following progression describes in more detail how the fundamental components should be reviewed and strengthened. Initial instruction for the first two stages of progression listed below should take place on a flat or gently rising track-set trail or teaching grid:

- ❑ Teach and practice the various components of Diagonal Stride without poles. The aim is for skiers to learn the correct body movements, weight shift and timing (i.e. developing the essential rhythm of Diagonal Stride) and improving balance on one ski.

- a) Without poles, skiers should walk on their skis, swinging the arms naturally – emphasize weight shift with each step, with a slight side-to-side motion being evident. The focus at this stage is entirely on weight shift.
 - b) Next skiers should increase the speed at which the recovery leg is brought forward, which will generate a small glide. Emphasize that weight shift must continue to be present. Again, arms are swung naturally forward and back in the poling motion.
 - c) With weight shift satisfactory, move on to a refinement of body position. In particular, emphasize keeping the hips forward and swinging the recovery foot past the gliding foot before it touches the snow.
- ❑ Teach and practice the same components with the skier using poles. The aim is to introduce poles into the technique while maintaining and ultimately improving upon the correct body movements, weight shift and timing already learned. Emphasize that the poling action is intended to generate force, not to compensate for poor balance.
 - ❑ Once skiers are comfortable with the basic movements and rhythm of the technique, and they can execute proper weight shift and achieve a balanced position on the gliding ski, move on to refining the technique components that are critical for optimal force generation.
 - a) Work on the pronounced bend at the ankles and knees in the legs-together position.
 - b) Work on fast arm recovery, which contributes to down-the-trail momentum (a slow recovery does not contribute).
 - c) Work on a quick preloading action of the gliding leg in the legs-together position and an immediate, powerful leg push.
 - d) Ensure a proper pole plant, and powerful pole motion.
 - e) Work on proper glide leg position during the pole-assisted glide. A 90 degree angle between the shins and the snow is desired.
 - f) Work on recovering the push leg forward powerfully, leading with the hip, knee and foot (in that order).
 - ❑ Polish the whole technique as each component is incorporated, thereby producing a smooth technique that is more effective overall.

Note that the fluidity and effective power transfer between body positions is as important as the actual body positions!

Teaching Points

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. The following are the most important teaching points applicable to Diagonal Stride.

- ✓ There is a clear and equal push off with each leg, combined with a distinct weight transfer from ski to ski.
- ✓ There is a consistent and confident glide on each ski.
- ✓ The forward movement of the arm and backwards movement of the same side leg are synchronized.
- ✓ When viewed from the side, the recovery foot lands beside or in front of (not behind) the gliding foot 100% of the time.
- ✓ When the legs pass together there is good ankle and knee bend so the hips are aligned over the balls of the feet.
- ✓ The rear leg is extended at the end of the leg push.
- ✓ There is a forward upper body lean, which aligns with the extended leg at the end of the leg push.
- ✓ Hips rise at the end of the glide phase.
- ✓ At pole plant the elbows are flexed to permit a strong arm pull to be generated. They should bend further as the slope increases.
- ✓ Each pole tip is planted beside the toe of the opposite side ski boot.
- ✓ The poling action is powerful. The hands extend just past the hips.
- ✓ The pole grip is released briefly in the latter stage of each poling action; the pole thrust is completed through pressure on the pole strap.

Figure 3.12 below isolates four of the critical instants in the Diagonal Stride cycle, emphasizing the fluid and explosive nature of the technique.

Figure 3.12

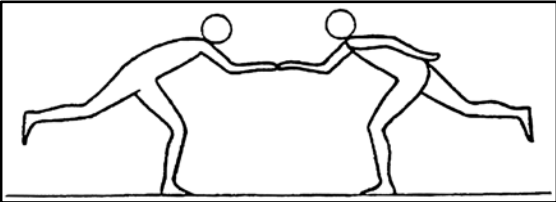


Common Errors and Solutions – Diagonal Stride

The Diagonal Stride is a series of interconnected actions. As a result, technique problems in one part of the stride can be caused by another part of the stride. Before trying to correct problems in a skier's Diagonal Stride technique, ensure that he/she is moving through the correct body positions (preliminary movements) as described in the mechanics section. The following is a description of some common errors and how to correct them.

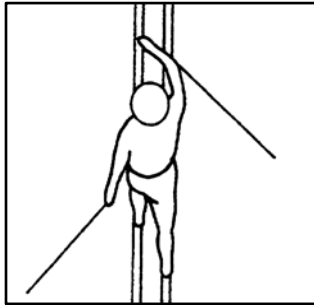
Errors	Solutions
<p>Poor weight shift. The skier is unable to fully commit the weight to the gliding ski.</p>	<ul style="list-style-type: none"> ✓ Return to the basic drill of shifting from one ski to the other while standing still. Then introduce forward movement, first without poles and then with poles. ✓ The key to an effective weight transfer is in the positioning of the hips. As the weight is shifted to the right leg, the right hip wraps forward of the left hip, so that the weight is aligned through the hip and down the leg directly over the right foot. ✓ Next execute the basic shifting movement on a gradual uphill; then the same action on a gradual downhill.
<p>Poor balance. Often Diagonal Stride problems are the result of poor balance. Balance is of two types: side-to-side; and forward-backward.</p>	<ul style="list-style-type: none"> ✓ Diagonal Stride without poles can be a very useful method of improving balance and the athlete's overall technique. Athletes should be encouraged to do some of this type of skiing in gradually rising terrain to improve their balance and leg push. ✓ Striding downhill while maintaining long glides is a very good way to increase stride length and confidence while gliding on one ski. ✓ Skiing at night, with low visibility, can be helpful as it requires a skier to focus more fully because they can't anticipate terrain or track variations.
<p>Uncoordinated stride. If the skier's balance is quite good, the problem is likely a failure to replicate the correct timing and rhythm of the technique.</p>	<ul style="list-style-type: none"> ✓ Return to the basic general athletic stance without poles. Have the skier walk naturally on skis and then gradually accelerate and decelerate in turn. Stress the maintenance of a relaxed body. Then re-introduce poles. ✓ Depending on progress with the above exercises, you can have the athlete: <ul style="list-style-type: none"> • ski using the arms only in a Diagonal Stride on a slight downhill; and • ski quickly and powerfully uphill.

<p>Short strides (bobbing). The leg push propels the skier more upwards, rather than forward over the glide ski and down the track.</p>	<ul style="list-style-type: none"> ✓ Verify that the skier’s ankles are bent enough as the legs pass together. Straight legs will push the skier up, not forward. ✓ Practice the scooter exercises (from Community Coaching manual) and work on getting up and over the glide ski. It can also be useful to encourage more of a forward upper body lean if the skier is quite upright. ✓ Encourage the athlete to swing the arms more “forward” rather than up, which should draw the athlete more on to the toes and bring the hips forward causing the body to drive forward rather than up.
<p>Sitting Back. The key to an effective Diagonal Stride is to quickly push the body weight forward on to the glide ski so the skier is only on one weighted ski at a time. Skiers that are sitting back do not get good weight transfer. Often this can be seen from the side when the recovering ski contacts the snow behind the glide foot and a slapping noise is heard. The underlying problem is poor weight transfer.</p>	<ul style="list-style-type: none"> ✓ Start the skier in the general athletic stance. Tilt the body forward until the skier needs to step forward to stay upright. A good drill to complement this is to have the skier lean forward with hands supported by a coach standing in front of him/her. While retaining the leaning supported position, have the skier extend one leg behind in a follow-through position. The coach can then remove the supporting hands and the skier will automatically bring the extended leg forward to a stable position forward of the opposite foot. This accurately replicates the correct body positioning for the push-off phase of the Diagonal Stride. ✓ Emphasizing a good bend at the ankles and knees and the weight on the ball of the feet as the legs pass together will help the skier feel his/her weight forward. The skier should also feel the weight across the whole foot (not on the heels) during the gliding phase. The scooter exercises can help with this. ✓ The hip on the gliding side must wrap forward and the hip and knee should line up over the front of the foot in the glide phase. ✓ The skier’s hips should not rise and fall dramatically; however, there is some up and down action as preloading occurs. ✓ Instruct skiers to look at a point three meters down the track. ✓ Try to review the problem with video. ✓ Exaggerate the movements by skiing “big”. Bigger kicks and increased drive of the returning leg will force the athlete on to the front of their stride.

<p>Back-slipping going up a hill (not attributable to poor wax). Often skiers will start losing some of their grip while going up a hill. There are two major causes for this: 1) the skier might be sitting back (see solution above); and/ or 2) the skier “leans into the hill” with too much flexion in the trunk.</p>	<ul style="list-style-type: none"> ✓ A good coaching cue for helping a skier that is leaning too far forward (#2 above) is to ask the skier to look up to the top of the hill and straighten up the upper body a bit every time a back-slip occurs. In this way the skier can determine how much lean is appropriate for different grades of hills.
<p>Incomplete push-off. Many skiers do not quickly extend their hip, knee and ankle joints prior to the ski leaving the snow.</p>	<ul style="list-style-type: none"> ✓ Verify that the weight shift is complete and properly timed. ✓ Verify that the skier’s ankles and knees are bent enough and the skier’s weight is on the ball of the feet as the legs pass one another. ✓ Have the skier practice full extension on dryland. Have the athlete practice hopping as far as possible on one foot to get full extension. Practice next at full speed and then on snow.
<p>Ineffective shoulder use in poling. A common poling error is ineffective use of the powerful shoulder muscles, leading to loss of glide during the pole-assisted glide phase of Diagonal Stride.</p>	<ul style="list-style-type: none"> ✓ The ski team handshake is a fun exercise that promotes good balance in a position similar to the pole plant and also trains the forward movement of the shoulder complex that is important for good, powerful poling. Two skiers stand facing each other, about two arm-lengths apart. Each skier should be on the left leg with the right leg relaxed backwards in a counter-balancing position. Both skiers can then lean forward about 45 degrees. The skiers grasp hands and alternate gently pulling each other slightly forward. The person being pulled relaxes his/her shoulder so that it moves forward. ✓ Figure 3.13: Ski Team Handshake 

Poor pole plant positioning. The skier plants the pole across the front of the body. For example, on pole plant the right pole grip is near the skier's left shoulder and the tip is under the right shoulder. Such pole plant often occurs when skiers compensate for poor forward movement of the shoulder at the beginning of the pole plant. It can twist the body noticeably from side to side.

Figure 3.14: Poor Pole Plant Positioning



- ✓ Check the athlete's pole length to ensure a proper length pole is being used.
- ✓ Practice the correct pendulum-like arm movement without poles. Progress to executing the movement with poles held halfway down the shaft and kept parallel to the ground. Any tendency of the arms to cross-over will be very evident.
- ✓ Progress from stationary to slow-motion to full-speed poling.

3.1.2 Double Pole (3rd Gear)

Note: Although Double Pole equates to 3rd gear, it is discussed before the One-Step Double Pole (i.e. 2nd Gear) because the technique is integral to One-Step Double Pole. In terms of teaching progression, coaches should work on Double Pole before One-Step Double Pole.

Purpose

As is implied by its designation as 3rd gear, Double Pole is used in conditions where the skier's velocity is high. Generally it is used on flat, gradual downhill and gradual uphill terrain. When executed by a fit and competent skier, Double Pole is the fastest and most powerful technique. The skier's technical ability, fitness and strength will dictate the actual terrain where this technique will be used. The firmness and speed of the track, as well as the evenness of the terrain, will determine when a transition to another technique becomes necessary.

Of the several classic techniques, Double Pole has evolved most significantly in recent years. Indeed, in sprint races at the elite level, strong skiers may use it throughout the race (other than on downhills) – on skis with no kick wax – in order to achieve the highest skier velocities possible. Coaches need to be able to distinguish between the basic Double Pole and the more aggressive Double Pole which has evolved for competitive purposes. Both are technically correct. The particular circumstances and application by a particular skier will determine which is appropriate.

Mechanics

A complete cycle of an aggressive Double Pole technique is illustrated at figure 3.15.

Figure 3.15: Complete Cycle of Double Pole Technique



For the purposes of analyzing and describing the technique, a cycle of the Double Pole can be viewed as comprising two phases: the propulsion phase; and the free glide phase. Note that this is in some respects an artificial delineation. Successive cycles are uninterrupted, with the movements of one flowing seamlessly into the other.

- ❑ **Propulsion Phase.** The propulsion phase begins with the movement of pole plant and finishes at the end of the pole push. The aim of the propulsion phase is to transfer the force produced by the back, upper body, abdominal and arm muscles into an increase in the forward velocity of the gliding skis. This phase is depicted in Figure 3.16.

Figure 3.16.1



Figure 3.16.2



Figure 3.16.3



Figure 3.16.4



- a) Upper body position at the time of pole plant is high and relaxed, and is forward to the point where the body would fall forward if the poles are not planted. The shoulders, hips and knees are all forward of the ankle. To obtain the desired upper body position, the ankle must be well flexed. In aggressive Double Poling, the skier's heels will leave the ski in the lead-up to pole plant (i.e. in the preceding free glide/recovery phase) to support the high and forward body position.
 - b) The arms reach in front of the body. The elbows are pointing down and slightly outwards and the forearms are angled upward sharply. This arm position brings the latissimus dorsi and upper back muscles into play.
 - c) The poles are planted in front of the bindings (or at the binding when glide speeds are lower or the position of the upper body is not as far forward).
 - d) At pole plant, the shafts are nearly vertical, with grips slightly ahead of pole tips. Skier velocity will quickly put the pole at a rearward angle by the time the pull begins.
 - e) The hips, knees and ankles are slightly flexed at the time of pole plant.
 - f) From the relaxed position before pole plant, the pole is driven downward rapidly and forcefully. This is done with a quick, powerful contraction of the abdominal muscles, in conjunction with the use of the upper body's weight compressing from its high, forward pole plant position. The pulling down action is similar to "hanging on the poles".
 - g) The torso compression ends before the torso is horizontal to the ground.
 - h) The arm joints are used in sequence – shoulder, elbow and wrist. Early in the pull down and push back arm movement the elbow is more noticeably flexed, with the angle between upper arm and forearm decreasing to as little as 90 degrees. The arms straighten through the elbow and wrist at the end of the Double Pole motion. The thrust ends with hands pushing on the pole strap.
 - i) Power generation peaks early in the propulsion phase and ends as the hands pass the thighs. The rest of the arm motion in this phase is largely follow-through.
- ❑ **The Free Glide (or Recovery) Phase.** The free glide phase starts when the poles leave the snow and ends with the pole plant. See Figure 3.17. The skier's aim in this phase is to recover the body dynamically and smoothly into a high pole plant position.

Figure 3.17.1



Figure 3.17.2



Figure 3.17.3



- a) The recovery phase is not passive. Rather, with the shoulders leading the arms the skier brings the arms forward directly for the initiation of the next pole plant.
- b) The shoulders remain relaxed (i.e. not raised) during this movement; the back remains slightly rounded (i.e. no arching or hyperextension of the back).
- c) As the recovery begins, the weight is evenly distributed across the full foot of both feet. As the trunk rises and the arms swing forward, the hips shift forward and the weight shifts to the balls of the feet. When the arms reach their highest position, ready for pole plant, the skier's trunk, hips and knees are all forward of the ankle, with the ankles flexed to accommodate this position. For aggressive Double Poling, the heels will lift off the ski.
- d) The return of the arms and the lifting of the trunk must be synchronized.

Body Positioning

❑ Core

- a) The core muscles must be engaged. This allows the back and upper body to be slightly rounded throughout the Double Pole motion, though not to the point where the upper body is stiff. It also permits the core muscles to contribute to force production as the skier pulls down on the poles in the propulsion phase.
- b) The bend at the waist at the end of the poling motion must be slightly less than horizontal. This will keep the hips from falling too far back and will permit a rapid return to the high position for the propulsion phase. Rapid recovery is necessary to maintain the correct timing and rhythm of the technique. Stopping the downward movement of the upper body before the horizontal position also conserves energy, in that the trunk must travel a shorter distance to return to the high position.

❑ Ankles and Knees

- a) A good bend at the ankles is necessary at pole plant to allow the skier's trunk to be high and forward. Also, the more bend in the ankles, the more forward the skier's body position can be, thus enhancing force generation. More bend in these joints is required with increasing ski resistance associated with steep uphill or slow snow.

b) In aggressive Double Pole sequences, as the upper body rises in preparation for pole plant the ankle flexion will be so great and the body positioned so far forward that the heel of the boot lifts off the ski. See Figures 3.18.1 and 3.18.2.

Figure 3.18.1



Figure 3.18.2



c) Note that heel lift is not essential to a properly executed Double Pole technique; rather it is particular to a powerful version of the technique used in competitive scenarios. However, without the heel lift a skier will not be able to get the body mass as high and forward of the ankles, and poling power will be limited accordingly.

d) There is only a shallow flex in the knees at pole plant. Knee flexion increases slightly as the poling action takes place.

❑ **Hips.** It is crucial that the hips be high and forward right over the balls of the feet at pole plant. See Figure 3.18.2 above. The hip position moves slightly rearward as the poling action progresses, but this must not be over-accentuated.

❑ **Arms and Shoulder**

a) The movement of the arms and shoulders must be smooth and rhythmic.

b) At pole plant, the arms are high and forward and the elbows are moderately flexed, pointing slightly outwards (see Figure 3.19.1). The arm flex at the elbow will be greater when the resistance from terrain and/or snow conditions is higher.

c) As the poling action begins, the elbow flexion increases to facilitate a strong pull and push (see Figure 3.19.2).

Figure 3.19.1



Figure 3.19.2



- d) The follow-through of the arms and hands is somewhat dependent on terrain (i.e. the amount of glide being generated), but in general is limited, to allow for the hips to remain high during the whole cycle. This also allows the quick return of the arms to their initial position.

❑ Feet

- a) A skier's weight is spread across the whole foot during the Double Pole, except for at pole plant when the skier's weight is on the balls of the feet.
- b) As noted above under "Ankles and Knees", in some cases the heels will be lifted off the skis to facilitate an optimal poling action.
- c) Some skiers attempt to facilitate a forward position of the upper body and a good arm reach by unweighting one foot and allow it to slide slightly to the rear, to be recovered beside the gliding foot just before pole plant. This should be discouraged, as it actually serves to bring the hip back with the trailing foot – which is counterproductive to the aim of keeping the centre of gravity forward.

Progression

There are two areas that need to be focused on while teaching the Double Pole: 1) refining the technique to maximize the amount of power produced in the propulsion phase; and 2) minimizing the slowing of the skis in the free glide phase so that the athlete is thinking about maintaining speed.

The following progression is for use over several weeks of technical practice and is the optimal sequence for working on the individual components of the Double Pole:

- ✓ Perfect the upper body, arm and knee/ankle positions at pole plant.
- ✓ Achieve peak force production early in the propulsion phase, through simultaneous engagement of core, shoulder and arm muscles.
- ✓ Work on a quick, smooth and direct return of the hands/poles from the end of push to the next pole plant.

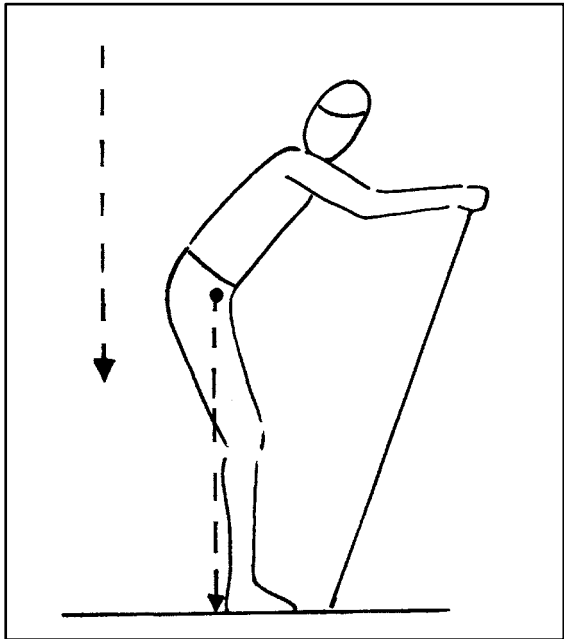
Teaching Points

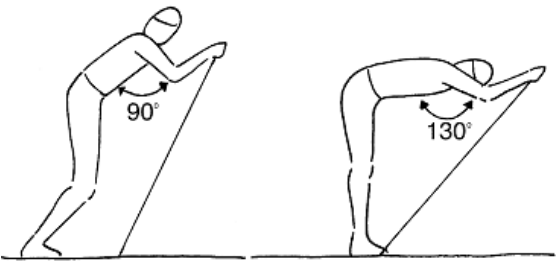
For recreational skiing, Double Pole is used on flat terrain for variety and maintaining speed, and on gradual downhills for speed and efficiency. In competitive skiing, Double Pole is used in similar situations when it is able to generate more speed and power than One-Step Double Pole. This technique should be practiced and assessed on a gentle uphill or flat terrain. The skier begins in a static position.

- ✓ The skier is in the general athletic stance.
- ✓ Hands reach forward to initiate pole plant; hips are forward.
- ✓ When the poles are planted, the hips are over the balls of the feet; the hands are forward and high (at shoulder level); the elbows are pointed downwards and slightly out. The arm bend at the elbow will be greater when the resistance is higher.
- ✓ The upper body flexes at the waist just after poles are planted to provide initial propulsion. Immediately following the pole plant, the skier is clearly pulling on the poles with the upper body weight. This coincides with the engagement of back, shoulder, core and arm muscles.
- ✓ The flex at the elbow increases in the initial phase of the pole motion, but the elbow joint

does not collapse.

- ✓ The upper body movement is completed by extending the arms to the rear. The progression is sequential from larger joint/limb and muscle groups to smaller, ending with extension of the wrist. At the end of the pole thrust the hand is pushing on the ski pole strap.
- ✓ Knees should be slightly bent and flexible through all phases of the movement.
- ✓ The follow-through of the arms and hands is not excessive, to allow for the hips to remain high during the whole cycle. This also allows the quick return of the arms to their initial position.
- ✓ Similarly, the trunk position does not reach the horizontal level.
- ✓ After completing the push, the arms and upper body are recovered directly forward at the same time to initiate another poling action. The shoulders lead the arms in recovery.

Common Errors and Solutions – Double Pole	
Errors	Solutions
<p>Jackknife position. In this position, the skier cannot use the body weight to enhance the power of the poling action. The body weight is over the heels instead of the toes</p> <p>Figure 3.20: The Jackknife Position</p> 	<ul style="list-style-type: none"> ✓ Have the skier assume the correct pole plant position, using the poles to prevent falling forward. Ask the skier to think about and feel the correct position. Have him/her rock gently slightly backward and forward to feel the differences in weighting on the poles at other positions. ✓ Stress that the poles should support the skier. ✓ Have the skier make sure to have the hips over the toes before beginning each pole plant. ✓ Have the skier go up on tip-toes when first learning the technique, to get the feel of the action ✓ Make sure the skier does not sit down too much at the end of the pole plant. This will cause a lag in the timing of the action and the hips will not be able to go forward enough. ✓ Ensure the poles are not too short
<p>Excess flexion of the trunk. Some skiers will flex the upper body to the horizontal position and beyond. This error forces the skier to waste time and energy to return to a high pole plant position.</p>	<ul style="list-style-type: none"> ✓ Ask the skier to finish the arm/hand thrust sooner in the propulsion phase. ✓ Emphasize a high and forward position at pole plant. ✓ Have the skier look at least five meters down the track throughout the stride.

<p>Head ducking. The skier is unable to gain power from the action of the abdominal muscles. Figure 3.21: Head Ducking</p> 	<ul style="list-style-type: none"> ✓ Emphasize that the shoulder must be the first arm joint to be used in the upper body in the propulsion phase.
<p>Sitting Double Pole. This error is similar to jackknifing, except that skier sits down through excessive flexing of the knees. In this case the flexion in the knees counteracts the contraction from the abdominal muscles and trunk. This results in a weak pole thrust.</p>	<ul style="list-style-type: none"> ✓ Ensure high and forward body position at pole plant. ✓ Ask the skier to Double Pole with locked knees to get the feel of not bending at the knees.

3.1.2 One-Step Double Pole (2nd Gear)

Purpose

One-Step Double Pole, or 2nd gear, is the technique used when the skier's velocity is too great for an effective Diagonal Stride and too slow for ordinary Double Pole.

It is a powerful technique that incorporates both a strong leg push and a strong poling action. It is particularly useful for creating velocity and momentum. However, on fast sections of the course, transition to Double Pole will normally be desirable. Once sufficient velocity is attained, Double Pole is more efficient, and will potentially generate more velocity. There are two reasons for this:

- ✓ The poling motion in Double Pole produces more force than in One-Step Double Pole.
- ✓ A higher tempo of poling can be achieved in Double Pole. This is because the force is being applied by relatively short body segments – the arms and trunk – that can be recovered quickly. In contrast, the One-Step Double Pole technique also engages the leg segments. While containing large and strong muscle groups that allow a forceful leg push, these limbs are also long and heavy and cannot be recovered as quickly as the arms.

The One-Step Double Pole technique is usually used on the flat or gentle uphill, depending on the resistance of the snow. However, the skier's technical ability, fitness and strength are all factors that will influence the actual terrain in which this technique will be used. The firmness and speed of the track, as well as the evenness of the terrain, will determine when a transition to another technique becomes necessary.

Mechanics

The primary sources of power in One-Step Double Pole are the leg push and the poling motion. Both are critical to the technique, with the relative force generated by each varying with the

circumstance and the strength/proficiency of the skier:

- ❑ In many situations (e.g. snow and terrain conditions) and for many skiers, the leg push will be dominant. The leg push occurs at a moment in the technique cycle where the skier's glide is diminishing. As such, it serves to break inertia, accelerate the skier and re-establish forward momentum. In this scenario, the poling motion helps maintain the velocity and glide created by the leg push. Most recreational skiers are likely to perform One-Step Double Pole in this manner. In addition, executing the technique in this manner is common in competitive skiing in certain types of terrain or at particular stages of a race. For instance, it might be appropriate on long gradual uphill where the efficiency of Double Pole begins to decline. Equally, it might be appropriate after a prolonged stretch of Double Poling, as it re-engages the large leg muscles and provides some relief to the muscle groups involved in the Double Pole motion.
- ❑ In other situations, particularly in elite racing and/or sprint competitions, the greater part of power is generated by an aggressive poling motion. In this scenario, the leg push provides supplementary power to prolong glide, but also serves the critical function of situating the skier's body in the optimal position to execute an explosive Double-Pole-type motion. If a forceful and dominant Double Pole is intended, efforts to generate power from the leg push should not be allowed to compromise the poling action; accordingly, the leg push and arm return phases may be of shorter duration than might otherwise be the case.

Coaches must be careful not to over-simplify what is actually a fairly complex technique. Although the One-Step Double Pole is often described as a technique that combines the leg push and stride of Diagonal Stride with the poling motion of Double Pole, there are, in fact, important differences that make the two power-generating components of One-Step Double Pole unique unto themselves. Notably, the application of bio-mechanical principles is such that, in combining a strong leg push with a strong poling motion, the poling motion cannot be as powerful as it is in Double Pole, a technique designed to optimize the motion. Nevertheless, combining a leg push with a sub-optimal Double Pole-type motion results in a technique that is very powerful in its own right and which has particular utility in some situations.

A complete cycle of aggressively executed One-Step Double Pole is depicted in Figure 3.22.

Figure 3.22: Complete Cycle of One-Step Double Pole Technique



For the purposes of analyzing and describing the technique, a cycle of One-Step Double Pole can be viewed as comprising four phases: the leg push phase; the free glide phase; the pole-assisted glide phase; and the arm return phase. Key body positions mark the start and finish of

each phase.

In principle, successive cycles of One-Step Double Pole should alternate pushing legs. However, it is possible for successive cycles to use the same leg. Factors that govern this include the manner in which the trail bends or banks, as well as the skier's comfort level (strength and/or balance) on a particular leg.

The mechanics of the four phases of a One-Step Double Pole cycle are described below:

❑ **The Leg Push Phase.** The first phase is the leg push phase, which starts with a leg push and stride similar to that of the Diagonal Stride (refer to section 3.2.1 for detail on the leg push mechanics of Diagonal Stride). The leg push phase ends when the pushing foot leaves the snow. The aim in this phase is to achieve a powerful leg push that propels the body down the track, while at the same time initiating upper body movements to prepare for the poling motion. The leg push phase is depicted in Figure 3.23.

- a) At the beginning of this phase, the skier is in the Ready Position - i.e. the general athletic stance for this technique. The weight is balanced evenly on two gliding skis, and the hands are just swinging past the thighs in recovery from the previous cycle.
- b) Note that, in practice, there is no distinction between the leg push phase and the preceding arm return phase. It is important to understand that the arm return and accompanying body re-positioning lead directly into the pre-load that initiates the leg push.

Figure 3.23.1



Figure 3.23.2



Figure 3.23.2



- c) As the leg push phase begins, the pushing foot is weighted and there is a quick pre-load of the push leg. The ensuing leg push is forceful and snappy. As the push occurs, the hips lower and move to the rear slightly, as in the Diagonal Stride.

- d) The leg push may be enhanced by sliding the pushing foot forward slightly before the pre-load (as is the case with the right foot in Figure 3.23.1). However, this is a technical enhancement that tends to be used by competent skiers in a competitive context. It is not essential to the basic technique.
 - e) As the leg push occurs, the opposite ski strides forward in the track and the arms swing up and forward to prepare for pole plant. Timing is critical. The stride leg and both arms must be advanced simultaneously and explosively; and at the same time the push leg must be driven forcefully down onto the track and slightly back.
 - f) A dynamic weight shift is a key component of this phase. At the end of the preceding arm return phase the skier's weight is distributed on two skis. In the leg push phase, the weight is shifted first to the pushing foot for the leg push, and then quickly to the striding foot as the push ends. The weight shift to the pushing foot contributes to both the force of the push and the performance of the grip wax that gives the ski purchase on the snow. The weight shift to the striding foot is completed as the pushing foot leaves the snow, with the striding leg becoming the gliding/supporting leg for the next phase. The latter weight shift contributes to forward momentum and allows the skier to adopt a balanced body position over the gliding/supporting ski.
 - g) The push occurs primarily below the hips, not behind them. Its duration varies with the slope of the trail and the glide being generated (i.e. longer on flats and gradual downhill; shorter on gradual uphill). A particularly strong and protracted leg push can be accommodated within the essential timing of the technique, but this will likely necessitate a somewhat slower skiing tempo (i.e. fewer cycles in a given period of time) due to the time needed to recover the push leg and re-position the hips forward. If poorly executed, this may lead to poor weight shift and/or the hips may be in a sub-optimal position for the next poling motion.
 - h) The concurrent and vigorous swing forward of the arms to the Double Pole position contributes to the down-the-track momentum created by the leg push and weight shift.
- **The Free Glide Phase.** The next phase is the fleeting free glide phase. It begins at the end of the leg push and ends with pole plant. See Figure 3.24. In this phase, the skier tries to maintain the ski's glide while getting the arms, hips and upper body into a good position for a strong poling action.

Figure 3.24



- a) Between the end of leg push and pole plant, the push leg continues to travel backwards in follow-through, the body moves forward over the supporting/gliding foot and the hips and trunk rise slowly.
 - b) A high and forward upper body position and good arm reach are consistent with the strong leg push and stride executed in the leg push phase. The forward body and arm position serves to counter-balance the push leg in its follow-through and recovery, while the foot of the striding leg provides a relatively forward base on which to balance. Both of these are distinct differences from the Double Pole technique.
 - c) In general, it is easier to have a forward lean in the torso in One-Step Double Pole than in Double Pole. This lean must not be permitted to be too pronounced.
 - d) At the same time, getting the hips forward is more of a challenge in One-Step Double Pole, as they move to the rear as the leg push occurs. During the free glide phase, the skier must recover the hips forward as far as possible to prepare for the poling motion. However, a hip position that is forward over the ball of the foot – as in Double Pole – will not typically be possible. On balance, the position of hips and torso in Double Pole will be better than in One-Step Double Pole for generating force from the poling motion.
 - e) As noted in the previous phase, the time required to recover the push leg and re-position the hips must not be allowed to impair the timing of the technique, but may of necessity affect the tempo at which the technique can be correctly executed.
 - f) As the hips are being re-positioned following the leg push, the gliding/supporting leg straightens somewhat, until the knee is only slightly flexed, in order to provide a stable gliding platform that does not unduly stress the leg muscles. Proper body positioning over the gliding ski is critical for balance. The upper body will be over the forefoot, while the hips will generally be behind the ankle (unlike the Double Pole position).
 - g) The arm position adopted during this phase is as for the Double Pole. Forward arm extension must not be excessive, as this can lead to too much forward lean and inhibit the repositioning of the hips for a good Double Pole position.
 - h) From a position about 5-10 cm off the ground, the poles are lowered forcefully (through arm and trunk movements) in preparation for pole plant.
 - i) The follow-through of the push leg ends and the push leg starts to return forward as the poles descend to the snow for the pole-assisted glide phase.
- **The Pole-Assisted Glide Phase.** The third phase is the pole-assisted glide phase. It begins at pole plant, continues through a Double Pole-type motion and ends when the poles leave the snow. See Figure 3.25. The skier's goal in this phase is a powerful arm push.

Figure 3.25.1



Figure 3.25.2



Figure 3.25.3



- a) To obtain an effective poling thrust, the body weight must be high and forward. While the hips won't be as far forward as in Double Pole, it is important that they be as far forward as possible, and that the upper body be over the poles when the pole thrust begins.
- b) Relative to Double Pole, the poles are more vertical on pole plant and the tips are planted well in front of the ski binding of the gliding ski (rather than beside the ski bindings as in Double Pole). This is because in One-Step Double Pole there is typically more forward lean in the torso. The latter facts imply an overall lower body position at the time of poling when compared to Double Pole alone. The poles are planted straighter and further ahead of the bindings to ensure a long enough arm push to generate the required power. At the same time, the hips move forward slightly as the push leg is recovered and the poling motion is initiated, allowing the skier to adopt a more efficient Double Poling position for the remainder of the poling motion.
- c) The trunk initiates the poling motion from its high and forward position, with the mechanics of the poling motion conforming in many respects to those of the Double Pole technique. The poling motion from pole plant until the pole tips leave the snow is completed in this phase.
- d) There are several other divergences from the Double Pole technique, the net result of which must of necessity be a less powerful pole thrust:
 - I. The salient difference between One-Step Double Pole and Double Pole at this point is that the skier initiates the poling action while gliding on one leg, with the other leg still in recovery. Good balance, underpinned by proper body positioning, is key enabling a strong poling motion to be executed.
 - II. Although the skier's weight (centre of gravity) is centered on the forefoot of the gliding/striding leg, the hips are actually behind this point.
 - III. The skier is unable to rise on the balls of the feet as in aggressive Double Poling.
 - IV. The finishing trunk position is not as low as in Double Pole, due to the need to return promptly to a good position for initiating the next leg push.
- e) The push/recovery leg completes its return forward to land beside the glide foot shortly after the poling action begins.
- f) The skier's weight is fully over the gliding ski as the poling motion begins, and is redistributed to both skis mid-way through the poling motion as both feet are together

again.

- **The Arm Return Phase.** Arm return is the final phase of One-Step Double Pole. See Figure 3.26. It begins at the end of pole push and finishes with a seamless flow into the beginning of the next leg push phase. In this phase, the skier tries to minimize the decrease in ski glide and to get into the correct body position for an effective leg push.

Figure 3.26.1



Figure 3.26.2



Figure 3.26.3



- a) The shoulders lead the arms in recovery and, relative to the Double Pole, the upper body rises more quickly from its compression (to facilitate body positioning for the pre-load, leg push and stride that occur at the beginning of the next cycle).
- b) As in Double Pole, arm recovery is uninterrupted and direct from the follow-through position to the high position needed for the next Double Pole action, though the hands only reach the hips (i.e. the Ready Position) in this phase (the remaining swing forward being part of the next leg push phase).
- c) The duration of this phase depends on the skier's velocity and length of glide. When performed on flat or downhill terrain, the arm follow-through after the pole thrust will likely be longer, and the speed of arm recovery must be adjusted accordingly so as not to compromise the timing of the next cycle.

Body Positioning

❑ Core

- a) The core muscles must be engaged to allow the back and upper body to be slightly rounded throughout the One-Step Double Pole motion, but not to the point where the upper body is stiff. Note that any tendency to arch or hyperextend the back as poles are swung forward is incorrect and should be discouraged.
- b) With a strong leg push and follow-through, a more pronounced forward lean should naturally occur to maintain balance.
- c) The bend at the waist during the Double Pole motion will be less than in normal Double Pole, to permit the upper body to rise quickly to the Ready Position for the next leg push phase. See Figure 3.27.

Figure 3.27.1



Figure 3.27.2



Figure 3.27.3



❑ Ankles and Knees

- a) The knee and ankle are slightly flexed during the free glide phase, with the leg providing a stable base on which to balance. See Figure 3.24. Excessive flexion will cause undue fatigue in the leg muscles.

- b) More flexion will be required during the leg push phase if a strong and protracted push occurs.
 - c) The knees and ankles stay slightly flexed during the poling motion.
- **Hips.** In principle, the hips should be as far forward as possible at critical force-producing instants, but the movements of the technique impose some constraints.
- a) The hips assume a more rearward position relative to the gliding ski, and are slightly lowered as the leg push occurs and the striding/gliding ski is pushed forward. See Figures 3.23 and 3.24.
 - b) The hips rotate slightly at leg push, opening on the push leg side to facilitate the push and follow-through, and positioning the opposite hip over the striding/gliding ski for effective balance.
 - c) The hips are recovered up and as far forward as possible during the free glide phase.
 - d) At the time of pole plant, the hips are typically over the rear of the foot, noticeably different from the hip position in Double Pole. See Figure 3.25.1.
- **Arms and Shoulders.** The movement of the arms and shoulders should be smooth and rhythmic. The arm bend at the elbow will increase as the hill gets steeper (about 90 degrees). Because of the speed achieved during the One-Step Double Pole, the follow-through of the arms and hands is fairly short to allow for the hips to remain as high as possible during the whole cycle. This allows the quick return of the arms to their initial position.
- **Feet.** A skier's weight is mostly on the forefoot during the One-Step Double Pole. The only exception to this is at the end of the poling motion, where the skier's weight is centred across the whole foot. If the weight is too far back it will force the skier's hips to the rear and make it difficult to have a quick and powerful leg push.

Progression

The skier should first be able to execute the Diagonal Stride and Double Pole techniques correctly, as the main components of these techniques are combined in One-Step Double Pole. The following is the optimal progression for learning One-Step Double Pole technique:

- ✓ Work on a strong simultaneous leg push and stride.
- ✓ Ensure that there is a correct and complete weight shift in the leg push movement – with the weight shifting from the push foot to the striding foot as the leg push ends.
- ✓ Ensure that the force created in the push phase propels the skier down the track, not upward.
- ✓ Work on acquiring good pole plant position, with trunk and hips high and forward as much as possible.
- ✓ Emphasize good poling mechanics (as in Double Pole).
- ✓ Emphasize smooth movements in the arm return phase to maximize glide.

Teaching Points

This technique should be practiced and assessed on a gentle uphill or flat terrain. The skier begins in a static position or is gliding slowly on two skis.

- ✓ As the cycle begins, the skier is in the Ready Position (the general athletic stance), with body weight on the both skis. Arms and poles are behind the body, as in the follow-through to the poling motion.
- ✓ The skier weights one ski (the push ski), pre-loads that leg and starts to swing the arms forward from their trailing position.
- ✓ The skier then pushes with the push foot, strides with the other foot and reaches forward with the arms to the Double Pole initiation position. These movements occur simultaneously. Weight is shifted from the push foot to the striding foot by the end of the push.
- ✓ The leg push mechanics are as for the leg push phase of Diagonal Stride.
- ✓ The skier's hips and trunk rise during leg push follow-through, with the hips recovering forward as much as possible to assume a high and forward position for the pole plant.
- ✓ A good bend at the ankles will facilitate this.
- ✓ The skier then initiates a powerful Double Pole-type motion, while the recovering pushing foot completes its return to a position beside the gliding foot shortly after the poling motion begins.
- ✓ The body and arm mechanics of the poling motion are as for Double Pole.
- ✓ The amount of bend at the waist at the end of the pole push is less than a normal Double Pole.
- ✓ The skier glides on both skis without sitting back excessively, and then begins the cycle again, with (normally) the opposite leg doing the pushing.
- ✓ Arm recovery from the follow-through position to the high hands forward position is direct and uninterrupted.

Figure 3.28 below provides another illustration of correctly executed One-Step Double Pole, with less aggressive body movements and body positioning than in the example at Figure 3.22

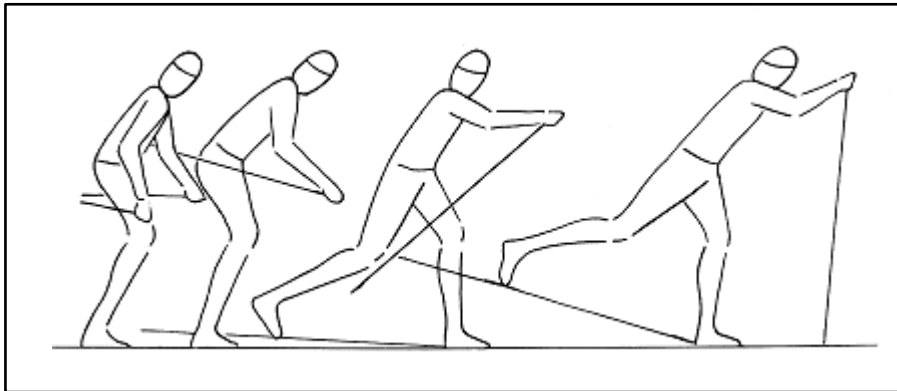
Figure 3.28



Common Errors and Solutions – One-Step Double Pole	
<p>Many of the errors that occur in One-Step Double Pole also occur in Double Pole and Diagonal Stride. Therefore, this section discusses only problems unique to One-Step Double Pole.</p>	
Errors	Solutions
<p>Timing. As this is most frequent error for those learning the technique, it should have been overcome by the L2T stage. Still, many skiers may be losing power by poorly timed arm and leg movements.</p>	<ul style="list-style-type: none"> ✓ Emphasize the simultaneous projection of both arms and the stride leg forward of the body. Practice this on dry land; from the Ready Position take a sharp step forward while swinging the arms up and forward at the same time. ✓ Practice adopting the post-push position with arms extended forward and one leg behind.
<p>Balance. The glide is too short, and the recovery foot returns to the track too quickly, often with a slap.</p>	<ul style="list-style-type: none"> ✓ The skier may not have fully shifted weight to the gliding ski and assumed the correct body position to establish balance. ✓ Practice standing in the extended leg position – with hip over the gliding/ supporting foot, with knee very slightly flexed. Then practice gliding in this position.
<p>Too much forward lean. The skier has excessive forward lean at the waist and/ or keeps the hips back. Therefore, the skier gets little forward thrust from the trunk.</p>	<ul style="list-style-type: none"> ✓ The skier may be misdirecting the force of the leg push to the rear, and may be over-emphasizing leg follow-through. Both serve to create more pronounced upper body lean, particularly if combined with the arms stretching too far in front. Have the skier focus on a leg push that is snappier and with reduced follow-through. ✓ Have the skier practice correct forward lean, with well flexed ankle and hips and trunk high. Try this as a static drill and then at slow and normal skiing speeds. ✓ Have the skier look at a point farther down the track at the beginning of leg push.
<p>Too upright. The skier is too upright in the upper body, which constrains leg push and results in too much force being directed upward.</p>	<ul style="list-style-type: none"> ✓ Have the skier practice correct forward lean, as a static drill first and then at slow and normal skiing speeds. ✓ Have the skier look at a point on the track closer to him/her at the beginning of leg push.

<p>Ineffective leg push. As a result of this common error, the skier does not get maximum benefit from technique; propulsion is poor and the preparation for poling is ineffective.</p>	<ul style="list-style-type: none">✓ To emphasize the correct beginning-of- leg-push position and a powerful pushing action, have the skier stand in the correct Ready Position and then push quickly and powerfully off one foot, as in the Diagonal Stride technique. Ensure that the push leg is weighted for push-off, with the body weight then transferring dynamically to the striding foot.✓ Ensure that the leg push is snappy, with good preload.✓ Ensure that the arms and push leg finish the drill in the position shown in Figure 3.29.
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Figure 3.29: Push Leg Drill



<p>Repeatedly using the same push leg. This error may make the pushing and glide support muscles excessively tired.</p>	<ul style="list-style-type: none">✓ Learn early to produce a powerful leg push action in both legs.✓ Practice gliding on each leg.
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3.1.2 Classic Technique Checklists

To simplify the detection and correction of technique errors when you are out on the snow, a series of checklists has been developed. You may also use CCC's technique benchmarks videos on CCC's online Athlete Development Matrix: <http://www.cccski.com/Programs/Coaching-Development/Athlete-Development-Matrix.aspx>

Common Checkpoints

The following checkpoints are common to all classic techniques (with notable exceptions for Double Pole technique, in which there is no leg push):

❑ Overall

- ✓ All techniques originate with the general athletic stance, modified for the specific technique being learned.
- ✓ Weight shifts fully from ski to ski (not applicable in Double Pole).
- ✓ The skier is balanced on the gliding ski, in Diagonal Stride and One-Step Double Pole.
- ✓ Motion of arms and legs is snappy and forceful.

❑ Lower Body

- ✓ Good angle is maintained at the ankle to permit forward upper body position and correct alignment of hips over the foot at the critical instant of leg and arm push.
- ✓ Leg push is preceded by a pre-load of the gliding leg before it initiates the push.
- ✓ Leg pushes down, into the snow, and slightly back.
- ✓ Leg push is executed quickly and effectively so that power is transferred quickly to the snow and a resulting glide is created.
- ✓ Hip, knee and ankle joints contribute to the leg push in that order, constituting a sequential but very rapid and explosive movement.
- ✓ Hips should rotate slightly to allow body weight to be balanced over the gliding ski.
- ✓ Hips are high and forward over the glide foot (or feet).

❑ Upper Body

- ✓ Poles are planted close to skis.
- ✓ Skier reaches high and forward with bent arms; the amount of elbow bend and the elbow orientation (i.e. tight to the body or pointing slightly outward) vary with the particular classic technique being executed, the phase of the technique and the pitch of the slope being climbed.
- ✓ The shoulders are parallel to the ground.
- ✓ The shoulder, back, core and arm muscles are engaged in poling action.
- ✓ The back is slightly rounded (no hyper-extension).
- ✓ There is a distinct, but not excessive, forward body lean (achieved through flex in ankles).

Diagonal Stride

❑ Most Important

- ✓ The skier commits weight fully to the gliding/supporting ski in the glide phases.
- ✓ The recovery foot is unweighted until placed on the snow ahead of the other foot (with

- ankle pushed ahead of knee as upward slope increases).
- ✓ The middle of hips is over toes at initiation of leg push, and further ahead as slope of hill increases.
- ✓ Forward body lean comes from a flexed ankle.
- ✓ Hips rotate slightly during leg push, without twisting the upper body.
- ✓ There is a pre-load and explosive leg push (knee and ankle are momentarily straightened and flexed to load the leg, followed by the forceful extension of the leg push).

❑ **Very Important**

- ✓ There is complete extension of the leg and arm at the end of their respective pushes.
- ✓ There is a straight line through the upper body and leg as the push leg leaves the snow.
- ✓ The gliding/supporting leg straightens (without the knee locking) during the glide phases.
- ✓ The recovery leg is swung forcefully forward in a pendulum motion.
- ✓ The arm action is generally straight forward and back, hinging as a pendulum from the shoulder.
- ✓ Arm push ends shortly after hands pass legs, with natural follow-through continuing.
- ✓ The shoulder reaches forward on pole plant, hands at or below shoulder height.

❑ **Important**

- ✓ The pole is generally planted opposite the glide foot; as the slope increases, the pole plants a bit farther back.
- ✓ The flex in the elbow joint increases as the poling action commences.
- ✓ At pole release, the skier extends the wrist/hand, with pressure exclusively on the pole strap.

Double Pole

❑ **Most Important**

- ✓ The hips, upper body and arms are well forward and high to load the poles on pole plant.
- ✓ The forward body position originates in well flexed ankles.
- ✓ The skier “falls forward” and “hangs on poles”.
- ✓ The skier pulls down on the poles, engaging the back, shoulder, core and arm muscles.

❑ **Very Important**

- ✓ Elbows are moderately flexed on pole plant, with the degree of flex increasing with the amount of force being applied.
- ✓ The elbow flexion increases as the poling action begins.
- ✓ Legs are slightly flexed on pole plant, with flex increasing noticeably – but not excessively during the poling action.
- ✓ If the skier rises on the balls of feet, motion should be forward, not up.
- ✓ Arm recovery forward (not up) is aggressive, with shoulders leading.

❑ **Important**

- ✓ Upper body compression ends before the horizontal position.
- ✓ The upper body stays down until the arms are finished.
- ✓ The poles are planted in front of the bindings (or at the binding when glide speeds are lower or body position not as far forward).

- ✓ At pole plant, the shafts are nearly vertical, with grips slightly ahead of pole tips.

One-Step Double Pole

☐ Most Important

- ✓ The leg push, stride and arm reach forward occur simultaneously, and are all snappy/forceful.
- ✓ As the leg push is initiated, the push leg is fully weighted, with weight shifting dynamically to the striding leg as the push ends.
- ✓ The skier is balanced on one fully weighted gliding ski – weight centered over the forefoot during the free glide phase and as the poling motion is initiated.
- ✓ The poling action is as for Double Pole in several respects:
 - I. The upper body and arms are well forward and high to load the poles for pole plant.
 - II. The hips are high and forward, to the extent possible (though they will not be as far forward as in Double Pole).
 - III. The skier “falls forward” and “hangs on poles”.
 - IV. The skier pulls down on the poles, engaging the back, shoulder, core and arm muscles.

☐ Very Important

- ✓ There is a pre-load of the push leg before the push.
- ✓ Elbows are moderately flexed on pole plant, with the degree of flex increasing with the amount of force being applied.
- ✓ The elbow flexion increases as the poling action begins.
- ✓ Legs are slightly flexed on pole plant, with flex increasing noticeably – but not excessively – during the poling action.
- ✓ Arm recovery forward (not up) is uninterrupted, with shoulders leading.

☐ Important

- ✓ Upper body compression ends well before the horizontal position (i.e. there is less compression than in Double Pole).
- ✓ Relative to the Double Pole, the upper body rises more quickly from its compression (to enable the body to be positioned for the pre-load, leg push and stride that occur at the beginning of the next cycle).
- ✓ The poles are planted well in front of the binding of the gliding ski.
- ✓ At pole plant, the shafts are nearly vertical, with grips slightly ahead of pole tips.

3.3 Downhill Techniques

Downhill techniques are used to control downhill speed and make necessary changes in direction, while at the same time enabling the skier to maintain as much velocity as possible. The particular downhill technique used by a skier is mainly determined by the snow/trail conditions and the skier's level of ability.

General Considerations for Teaching Downhill Technique

Work on downhill technique can be a fun addition to a practice. Dual slalom practice or race courses, and other variations of bumps and dips, can provide hours of fun while teaching athletes the balance, skills and confidence necessary for good downhill technique. A useful axiom to remember is "terrain teaches". Often an hour of fun downhill practice on a slope, without comments from the coach, can teach as much as an hour of instruction.

While practice is important, there are also some techniques the athlete must become comfortable with prior to being able to perform the advanced skills effectively. A guest appearance by a local alpine instructor, or a day of alpine skiing and instruction at a local area, may also be a wise investment.

For teaching downhill technique, the practice hill should be obstruction free and have a long, gradual runout. There should be steep and gradual slopes and the surface should be smooth and well packed. As the skier's skill increases, he/she may practice on more challenging terrain, but the snow should still be well packed. Skis should be waxed for good glide, and the binding- ski and boot-binding fittings should be snug.

When teaching all downhill techniques, it is important to remember the information provided in section 2 (Tools for teaching technique) regarding the stabilizing effect of lowering the centre of gravity. While athletes may initially feel more in control in a relatively upright position, with coaching and practice they will learn that a lower body position is actually more stable (as well as being more aerodynamic and therefore faster).

Types of Downhill Techniques

In general, downhill techniques can be divided into two categories:

- Techniques for Descending and/or Accelerating Through Downhills and Downhill Turns.** These techniques are used when the trail and snow conditions and/or skier's level of ability are such that a downhill can be skied aggressively without the need to reduce or control speed. Techniques in this category are the following:
 - a) **Straight Running.** Where a downhill is track-set (whether in classic or skating competitions) and the conditions and skier competence are permissive, the skier will stay in the track (or move into it, in skate skiing) and "ride the track" by a combination of changes to body and ski positioning. In dealing with the centrifugal forces exerted on the skier while attempting to "ride the rails" through a turn, the skier retains a tuck position and moves the hips and knees to the inside of the turn. The skis are somewhat edged inwards in the track as the skier travels through the arc of the turn.
 - b) **Ready Position.** See section 3.3.1 below.
 - c) **Tuck Position.** See section 3.3.2 below.

d) **Step Turn.** This is a technique used to permit a skier to negotiate a downhill corner without braking. It involves a succession of rapid steps in the direction of the turn. When executed aggressively, each step involves a push from the outside ski, with the skier thus using the turn for acceleration. Skiers will normally enter the Step Turn situation in the Ready Position or Tuck Position. See section 3.3.3 below for detail.

□ **Techniques for Braking/Controlling Speed in Downhills and Downhill Turns.** These techniques are used when the steepness of the descent, the condition of the track, the degree of corner in the downhill and/or the skier's level of ability are such that the skier must reduce or control speed in order to negotiate the descent safely or without losing control. The techniques in this category represent a spectrum in which optimal control is at one end and conservation of speed is at the other. These techniques are as follows:

a) **Side Slipping.** This technique is used for descending particularly steep or icy stretches of trail when the skier is unable to control speed using other techniques. Side Slipping is primarily used in a recreational skiing context, where the conservation of skier velocity is not an objective. Its only relevance in a competitive skiing context is in the application of the Side Slipping movements as an integral component of the Parallel Turn. Side Slipping is described in detail in Section 4 of the Community Coaching Reference Material.

b) **Snowplow and Snowplow Turn.** These techniques are used for braking and controlling speed and direction on downhills where the steepness of the hill and/or the skier's level of competence and confidence do not permit the use of one of the techniques in the "descending and accelerating" category described earlier. These techniques are widely used in recreational skiing. They have some application in competitive skiing, depending on the trail profile and the level of a skier's ability. In addition, the Snowplow and Snowplow Turn can form part of the evolution of the Parallel Turn. These techniques are described in detail in Section 4 of the Community Coaching Reference Material.

c) **Parallel Turn.** This is the fastest technique for negotiating bends on steep downhills, and is commonly used by competent skiers in a competitive context when the trail profile and/or snow conditions do not permit the use of one of the techniques in the "descending and accelerating" category described earlier. See section 3.3.4 below.

d) Note that a skier may need to use more than one technique to descend a particular hill or section of trail, and that the types of technique needed for a particular descent may vary widely over time in accordance with the prevailing snow and track conditions. Therefore, a skier must attempt to become proficient in all techniques and be prepared to use the range of techniques flexibly as conditions warrant.

3.3.1 Ready Position

Purpose

The Ready Position is a transitional downhill technique that is used when the trail is uneven or when quick changes of direction are necessary. It is a position which can be adopted quickly and from which a skier can move easily to another downhill technique as the track requires.

Mechanics

The skier's feet are slightly farther apart (shoulder width) than in the other tucks. The skier assumes a relaxed crouch. The hands are down in front and slightly out to the sides to help maintain balance. The torso is inclined forward, but not so far as to be parallel to the snow. The weight is distributed evenly across the skier's feet. See Figure 3.30 below.

Figure 3.30



3.3.2 Tuck Position

Purpose

The Tuck Position is used in order to descend a hill as quickly as possible. It is used in both skating and classic skiing (in the latter, trails are normally groomed so as to permit a skier to descend steeper hills outside of the track).

Elite skiers use the Tucking technique often. Two factors influence how low the Tuck is maintained: the skier's fatigue and the desired speed. In general, the lower the skier's crouch, the less air resistance there is and the faster he/she can go. However, when a skier is in a deep crouch, the leg muscles are usually contracted and there is little blood flow to and from them. As a result, muscles may cramp, causing performance to deteriorate.

Gaining time on a downhill section calls for no extra physical effort or energy consumption if the skier's technique is good. Furthermore, good and poor tucks take about the same effort.

Mechanics

Tucking is commonly used for maximum speed in elite competition, as it produces less drag than standing upright when descending a hill.

- ❑ The back should be parallel to the snow, the elbows held close together and in front of the knees, and the hands in front of the chin. For a low Tuck, there must be considerable flex in the hips, knees and ankles. A low Tuck is illustrated in Figure 3.31.

Figure 3.31



- ❑ Adopting a higher Tuck by not bending as much at knees and hips permits better blood flow to the legs and easier breathing. The high Tuck position is also used when preparing for a turn. Skiers often adopt positions between the low and high Tuck that vary with their fatigue. Two views of a high Tuck are illustrated in Figure 3.32.

Figure 3.32.1

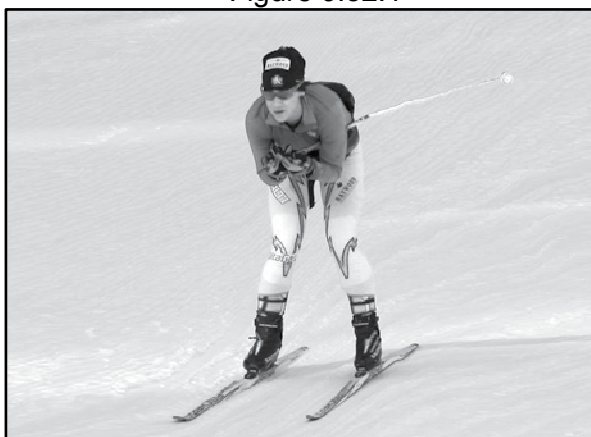


Figure 3.32.2



- ❑ The skier should concentrate on the trail ahead and plan how to ski it as quickly as possible. His/her feet are normally about track width apart, the weight should be evenly balanced over both feet with the weight centered across the whole foot.
- ❑ To improve aerodynamics (minimizing wind resistance) and improve balance, the hands should always be forward of the hips and are usually held in front of the skier's face. Elbows can at times rest on the knees.

3.3.3 Step Turn

Purpose

The skier uses the Step Turn when he/she is skiing fast and wishes to maintain that speed while making changes in direction. It is also the best turn to be used in classic races as there is minimal loss of wax compared to a Parallel Turn.

Mechanics

This technique involves taking a series of incremental steps in the direction of travel around a corner while gliding forward. Figure 3.33 below illustrates a Step Turn in a Tuck position. The size of each step will depend on many factors, including the skier's velocity and the prevailing track/snow conditions.

- ❑ As the skier approaches a turn, his/her weight is evenly distributed on both skis. The skier adopts the Ready Position or a Tuck position (depending on the skier's speed and competence, the gradient of the hill, the trail surface, etc.). The skier lifts the inside ski, putting all the body weight on the outside ski which is edged. The skier then explosively extends the outside leg and transfers the weight to the inside ski in the new direction.
- ❑ As the skier lifts the inside ski and points it in the new direction, the skier's upper body and hips change orientation to face the new direction of travel. Thus, when the push takes place, the shift of weight to the inside ski is facilitated by correct body positioning over the inside ski.
- ❑ The skier's weight returns to the outside ski in preparation for the next step.
- ❑ The skier continues to take steps to the inside of the turn until the change of direction is completed and the track straightens out. At high speed, the steps must be rapid. It is important to emphasize quick and complete weight shift from ski to ski.
- ❑ In this technique the poles are held as in the Ready Position or Tuck, and are used only for balance.

Progression

- ❑ For beginners, start on relatively flat terrain. Skiers should step through a series of figure 8s to get the feel of changing direction to both sides.
- ❑ Then ski down a slight grade, lifting each ski in turn.
- ❑ Ski down a slight grade, making one Step Turn until performance is good, then add several steps in the same direction.

Figure 3.33 – Step Turn in Tuck Position

Figure 3.33.1



Figure 3.33.2



Figure 3.33.3



Figure 3.33.4



Figure 3.33.5



Figure 3.33.6



- ✓ Repeat the above three progressions in the other direction.
- ✓ On a steeper hill, practice the third and fourth progression.
- ✓ Take several steps in one direction, followed by several steps in the opposite direction.
- ✓ Practice maintaining a Tuck while performing the step turn.
- ✓ Practice Step Turns on a modified slalom course at ever greater speeds.

Common Errors and Solutions – Step Turn	
Errors	Solutions
<p>Incomplete weight transfer. This may cause the skier to catch an inside edge when skiing on soft snow. It also causes the skier to become unbalanced and to lose momentum.</p>	<ul style="list-style-type: none"> ✓ Have the skier practice balancing on one ski. ✓ Work on Star Turn or Step Turn techniques in loose, deep snow.
<p>Too big a step. The skier’s step takes him/her beyond the base of support resulting in an unstable position. The effects are the same as if the weight transfer had been incomplete.</p>	<ul style="list-style-type: none"> ✓ Emphasize taking small steps. ✓ Set up two lines between which a skier must do a given number of Step Turns as he/she goes down a hill.

3.3.4 Parallel Turn

Purpose

The Parallel Turn is the most effective high-speed turn when turning space is limited and the turn must be done very quickly. The technique is also used when snow conditions are such that the skier cannot do a Step Turn around a corner, for example on an icy course. A Parallel Turn will slow the skier down relative to a Step Turn, as the sliding action causes the skier to lose speed. There also can be a significant loss of grip wax with this technique, particularly in icy conditions.

Mechanics

The Parallel Turn should not be confused with the technique of the same name used in Alpine skiing. Rather it is a cross-country skiing technique that has evolved from the relatively traditional descending techniques known as the basic Christie, the stem Christie and the parallel Christie. In practice, it is a technique that can be entered from any one of Straight Running, the Ready Position and the Tuck, and which may contain elements of the Snowplow, Snowplow Turn and Side Slipping, depending on the demands of the trail and snow conditions and the skier’s level of ability:

- ❑ Prior to attempting the Parallel Turn, the skier should be comfortable at Side Slipping and the Snowplow Turn, covered in the FUNdamentals stage (see section 4 of the Community Coaching Reference Material).
- ❑ **Parallel Turn from Snowplow Entry.** This turn is essentially a combination of a narrow Snowplow Turn and Side Slipping. See Figure 4.34. To teach the technique, have the

skier ski down the slope in a narrow Snowplow position and begin a Snowplow Turn. The mechanics of the technique are as follows:

- a) The skier enters the turn in a narrow Snowplow position. See Figure 3.34.1.
- b) The skier initiates the turn by turning the hips and upper body into the turn.
- c) The skier keeps the knees flexed, weights the downhill ski briefly (if traversing the slope), then transfers the weight sharply onto the outside ski to carve through the turn (with the outside ski becoming the new downhill ski as the skier exits the turn). See Figure 3.34.2.
- d) The inside ski tracks parallel to the outside ski from the mid-point of the turn. See Figure 3.34.3.
- e) The weight shift, an accompanying angling of the knees and ankles into the hill during the turn and the edging of the inside of both skis through the latter part of the turn permit slipping and turning as in Figure 3.34.4.
- f) The poles are carried as for the Ready Position throughout.

Figure 3.34 – Parallel Turn from Snowplow Entry

Figure 3.34.1



Figure 3.34.2



Figure 3.34.3



Figure 3.34.4



❑ **High Speed Parallel Turn.** Once a skier is comfortable initiating the Parallel Turn from the Snowplow position, he/she is ready to carry out the turn from a Tuck position. In appearance and practice, this is a turn that is similar to the turns executed by an Alpine skier in a Downhill type of race. An Alpine skier attempts to carve through turns to the degree possible, thus conserving speed, but some tighter or icier turns require more edging of the skis and a degree of skidding/slipping in order to complete the turn (though the aim remains to minimize this and the resulting loss of speed). A Parallel Turn from a Tuck entry is illustrated in Figure 3.35. Mechanics of the technique are as follows:

- a) Approaching the Parallel Turn, the skier is likely in the Ready Position or the downhill Tuck Position, with the weight well centered across the feet.
- b) Upon the initiation of the turn, the skier shifts weight predominantly to the outside ski, with the weight returning to be more evenly balanced on both skis in the later portion of the turn. The skis remain parallel to each other entering the turn and they remain parallel throughout the turn. The skier edges the skis strongly by angling the knees into the hill.
- c) The skier should keep the hands well forward during the turn and the body facing down the hill. The skier should practice the turns at a fairly high speed on a gentle slope that is smooth and well packed. In soft conditions, the skier should be able to edge into the snow when making the turn. However, in harder conditions this will not be possible and some skidding or slipping will occur.

Figure 3.35 – Parallel Turn from Tuck Entry

Figure 3.35.1



Figure 3.35.2



Figure 3.35.3



Figure 3.35.4



Progression

- ✓ Use flat, easy, open slopes that are well packed and slightly convex. Turn in one direction only.
- ✓ Do as above, but turn in the other direction.
- ✓ Turn in one direction and immediately turn the other way.
- ✓ Practice on a section of hill where the Parallel Turn would be used during competition.
- ✓ Practice on steeper hills.

Common Errors and Solutions – Parallel Turn	
Errors	Solutions
Weight too far back. This reduces the turning ability of the skis and can send the skier off balance more easily.	✓ Have the skier keep the weight predominantly on the outside ski through the turn, with the body positioned forward over the feet.

3.4 Classic and Downhill Technique Drills

3.4.1 Diagonal Stride Drills

- ❑ **Scooters - A.** For this progression, a set track is preferred, on flat or even slightly downhill terrain. The skier should have good grip from the wax, but not too sticky! The skier does not use poles. The skier removes the right ski and stands on the left ski, in the right hand track. The skier then pushes down the track using the right foot, and is encouraged to push up over the left ski and to glide for a period between push offs. During the glide the skier should be encouraged to get the upper body up and over the glide ski with the gliding knee and hips lining up over the front part of the foot. This is the same position as used in the Forward Lean exercise in the FUNdamental skills. Once the skier has become proficient at this, he/she should try the same activity with the ski on the right foot (in the left hand track) and pushing off the left foot.

The skier begins the leg push with a short quick flex at the knee and ankle followed by extension of these joints. The skier should be encouraged to push off using the full foot, starting with pressure from the whole foot and finishing off with a powerful push from the front of the foot and the toes.

The next step would be to encourage a longer glide between each push. Mark off a section of track and see if the skier can reduce the number of strides needed to complete the section. You can also see who in your group can take the longest glide.

- ❑ **Pairs Scooters - B.** This can be a fun partner exercise. A pair of skiers with one ski each stands beside each other in a set track. The left hand skier only has a ski on the right foot, which is in the left track, and the right hand skier has a ski on the left foot, which is in the right hand track. They both hold onto one half of a ski pole which is held in front of them in a horizontal position. The skiers then work together, scootering down the track. By skiing together, the skiers minimize unnecessary side to side motion, and a more capable skier can help the less skilled skier develop more appropriate timing and weight transfer.
- ❑ **Diagonal No Poles.** The skier practices the complete Diagonal Stride without poles. The skier should work on a good weight transfer with a long glide and should be swinging the arms, so the forward arm movement and the backward leg extension end at the same time. As with the above exercises, this generally can be more easily accomplished on a flat or very slightly ascending section of track. This activity can also be done with a partner and sharing one pole. This can be quite helpful for a beginning skier when paired up with a more advanced skier.

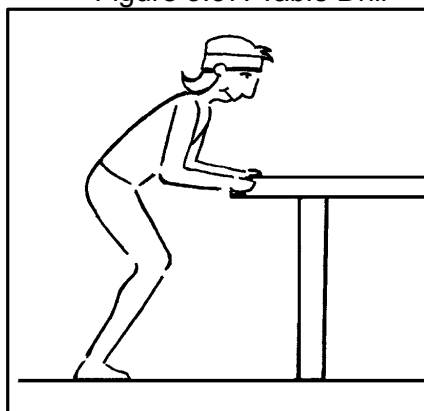
As the skier becomes more comfortable on the glide ski, the hips and knee should line up over the toes of the glide ski, and the next leg push should be initiated by a quick bending and then a powerfully extension of the hip and then knee. Practicing quite extensively without poles is a very good way of developing the proper balance and timing required in the Diagonal Stride. A useful exercise for more skilled skiers is to practice (in a good track) with their eyes closed. This causes the skier to focus more intently on how to push off with the foot and leg and how to balance on the other ski.

- ❑ **Diagonal Stride, Hands behind Back.** The skier practices legs only Diagonal Stride with the hands behind the back, thus permitting focus on the leg action in the stride. This can also be done with a pole held behind the back at the elbows, or resting on the shoulder. The

pole should generally remain in a fairly horizontal position.

- ❑ **Diagonal Stride Holding Poles in the Middle.** To get the skier used to holding poles, he/she can start by holding the poles mid-way down the shaft in a very loose grip, between the thumb and index finger. The skier should be encouraged to have a very relaxed grip on the poles and swing the arms naturally, similar to when skiing with no poles.
- ❑ **Connected Diagonal Stride.** This is another activity for partners. It that can be done with a more skilled skier leading a less skilled skier. Partners ski slowly, one behind the other, with the front skier holding the handle of a ski pole in the right hand and the other skier holding the tip. They also share a ski pole in their left hands. This is another activity that can help a less skilled skier develop a good rhythm for the technique.
- ❑ **Table Drill.** The following drill (see Figure 3.37 below) can be practiced during dryland training to help skiers get used to the correct legs together position. With legs together, the skier stands relaxed about a half-meter in front of a table or wall. The skier bends at the ankle, knee and hip so that the weight starts to go onto the toes and the heels begin to rise off the ground. The skier touches the table or wall with the hands for light support. The skier transfers all the weight onto the right foot; the left foot touches the ground only lightly.

Figure 3.37: Table Drill



3.4.2 Overall Downhill Drills

The following drills can be useful for improving the skier's overall downhill skills:

- ✓ Have races on slalom courses.
- ✓ Play follow-the-leader games on downhill terrain.
- ✓ Have a competition on a bumpy track.
- ✓ Have a race up and back down a hill.

3.4.3 Tucking Drills

- ✓ Practice Tucks on dryland and on flat terrain.
- ✓ Hold some speed trials, having skiers use the same pair of skis and try different Tuck positions.
- ✓ Practice on alpine slopes.
- ✓ Practice on hills that the skier will race on. Find the quickest way down and the best and

quickest way to make it through the rough spots.

3.4.4 Step Turn Drills

❑ Balance Drills on One Leg

- ✓ **The Stork Stance.** Skiers practice standing on one leg while remaining balanced. They are allowed to extend their hands sideways to steady themselves. Alternate legs.
- ✓ **Rubber Leg.** Skiers first stand tall on one leg/ski, and then relax it, letting it slump into a flexed position at the ankle and knee. Alternate legs.
- ✓ **One-Legged Pops.** Skiers pop/spring off one leg, which is bent, and then land on it. Alternate legs.
- ✓ **Back Leg Lifts.** Skiers extend one leg/ski rearward and off the snow while bending forward at the waist. They then move the same leg/ski forward, without weighting it, and return their upper body to an upright position. Repeat with the opposite leg.
- ✓ **Poison Peanut Butter.** Skiers lift one ski and then the other off the snow so that the “poison peanut butter” (i.e. the snow) doesn’t stick to their skis. The coach encourages the skiers to keep moving by saying “quick, don’t let the peanut butter stick!”
- ✓ **Stepping Movements.** These movements are the basis of the Side Step and Star Turn. They follow on from the “Poison Peanut Butter” exercise above. This exercise should be introduced on packed snow, but it can also be practiced in deeper snow when the skiers are ready for the challenge. Another option is to set several ski tracks parallel to each other. To begin, have the ski poles lying on each side of the skiers, parallel to their skis. The skiers step over the poles going first in one direction, and then the other. As the skiers gain competence, several poles can be lined up for them to step over, or they can be placed farther apart to require a longer step. The skiers can also try to jump over the poles with both feet.
- ✓ **Practice in Soft, Deep, Loose Snow.** This emphasizes weight shift and lifting the skis.
- ✓ **Practice on Slalom Course.** High speeds are not necessary and course poles should be fairly far apart. Start off easily so that everyone can accomplish the technique; then move the gates closer together. Several formats are possible: dual starts; races against the clock; and skiing with and without poles.

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