

# Skiing: Cross-Country

Completion of this chapter should enable the reader to:

- Appreciate the development of cross-country skiing
- Select and care for cross-country skiing equipment
- Practice proper skiing techniques on various terrains
- Suggest appropriate off-season conditioning activities
- Identify correct cross-country skiing clothing
- Be aware of safety concerns

## HISTORY

The history of skiing is deeply meshed with the history of all lands that are seasonally covered with snow. The earliest pictorial representation of skiing shows man hunting elk on skis. This picture dates back to approximately 2500 B.C. and was found on the island of Rödöy, off the coast of Norway. The earliest known skis date back to the same era and were found in a bog near Hoting, Sweden. It appears that the early skis were made of bone and were used in Scandinavia for hunting and later for warfare.

Two events in the Middle Ages demonstrate the importance of skiing to the military in the northern countries. In 1206 in Norway, two members of the king's guard carried the king's son, Haken, on skis over the Dovre mountains away from enemy forces. The child later became one of Norway's greatest kings, and the event is now celebrated in the famous Norwegian Birkebeiner race. In the 1500s, a similar event occurred in Sweden when Gustav Vasa was leading the battle against Danish rulers. Sensing defeat, Vasa left the town of Darlarna and headed for the Norwegian border. He was later persuaded by skiers to return to fight the Danish army, and the route of his triumphant return on skis is followed in today's most famous cross-country ski race, the Vasaloppet. Gustav Vasa went on to become the founder of modern Sweden.

Interest in skiing spread internationally in the late 1800s as the British discovered skiing in the European Alps and started formal ski competitions. The exploits of Norwegian explorer Fridthjof Nansen, written in *The*

*First Crossing of Greenland*, fueled British interest in skiing. Gradually, skiing in the Alps acquired its own techniques and style and evolved into the current discipline of alpine skiing. At the same time, cross-country skiing continued to grow in popularity and technical development. The use of metal bindings appeared at the end of the nineteenth century near Telemark, Norway, and the use of two ski poles of equal length was substituted for the traditional long single pole at about the same time.

Skiing was brought to the United States by Scandinavian immigrants and flourished in the 1800s. Pictures of the California mining camps of the 1840s and 1850s show well-organized ski racing. The most well-remembered American skier of this era was John "Snowshoe" Thompson, who, beginning in 1856, carried mail from Nevada to California over the mountains on skis. Thompson's legendary trips covered 90 miles (144 km) in about 3 days while he carried 60 to 90 pounds (27 to 40 kg) of mail.

Interest in skiing in the United States focused in those geographic areas with large concentrations of Scandinavian settlers. By 1872, the first ski club in the United States was formed in Berlin, New Hampshire, and named the Nansen Ski Club. Other clubs soon followed in the Midwest. The 1932 Winter Olympics in Lake Placid, New York, further heightened interest in skiing because it was the first Olympiad with Nordic and alpine skiing competitions (cross-country and jumping). The previous Olympics had featured only nordic events.

Interest in cross-country skiing was sustained in the early twentieth century by a small group of clubs, Eastern colleges and universities, and preparatory schools. Competitions accompanied winter carnivals at many colleges and universities in the Northeast, with ski jumping attracting more spectators than cross-country skiing. At the same time, alpine, or downhill, skiing was growing rapidly in popularity in the United States, led by Hannes Schneider and his distinctive Austrian Alborg technique with its Christina turns.

Skiing in the United States was greatly advanced by the onset of World War II and the formation of the country's first ski troops, the Tenth Mountain Division. The ski troops proved to be one of the most effective and decorated units of the war, combating German forces in the Battle of Italy. A lasting side effect of this wartime activity was that a cross-section of American men—and not just those graduating from certain Eastern colleges—was exposed to the latest skiing and survival techniques. After the war, many of the soldiers of the Tenth Mountain Division continued to follow their interest in skiing by working in the ski industry.

Despite the expanded base for cross-country skiing, participation in the sport remained relatively small through the 1960s, obscured by its downhill relative. This status was dramatically changed by the "discovery" of cross-country skiing in the early 1970s, resulting in the recent boom in the sport. Cross-country ski sales in the United States amounted to about 14,000 pairs in 1966 and exploded to about 277,000 pairs by the winter of 1971–72. This twentyfold increase can be partially attributed to the American public's growing interest in fitness and the environment. Cross-country skiing appealed to people who participated in other cardiovascular fitness pursuits, such as jogging and cycling, and seemed consistent with their sense of concern for the environment. In short, the sport took on the image of being health- and fitness-enhancing as well as environmentally sound.

### Recent historical developments

Cross-country skiing has continued to grow in popularity since 1972, but at a reduced rate. Sales of cross-country skis currently exceed 300,000 pairs annually. Helping this growth has been increased media attention and books such as John Caldwell's *The Cross-Country Ski Book*. First published in 1964, the volume provided much-needed technical information for first-time skiers. Bill Koch's silver medal in the 1976 Olympics in Seefeld, Austria, and his subsequent overall World Cup Title in 1982 brought cross-country skiing further attention.

With the increased popularity of cross-country skiing, the public now has a wider range of skiing opportunities. Back-country skiing in wilderness parks and on undevel-

oped lands is still available. In addition, well-developed commercial ski touring centers now exist in most parts of the country with adequate winter snow cover. Cross-country skiing facilities can provide prepared and groomed trail systems, trail maps, and systematic markings, and usually some kind of ski patrol for safety support. This kind of skiing simply was not available in the United States before 1972 and widens the base of appeal to those who would not explore wilderness areas on their own. Now the skier can choose his or her level of involvement in skiing.

In addition, more ski organizations now sponsor and support cross-country ski events. The U.S. Ski Association traditionally sponsors ski races and ski touring opportunities. Ski touring clubs now appear in or near most urban areas of the Snow Belt to provide instruction, tours, and racing experiences for the public.

With the dramatic improvements in snow grooming of cross-country ski trails, the skating technique has become increasingly feasible and practical. Bill Koch popularized the technique in North America with his World Cup victory in the winter of 1981–82. The skating technique on cross-country skis closely resembles a speed skater using long ski poles. Skating is considerably faster than the traditional skiing technique that has been used for centuries, but it requires different waxing, equipment, and conditioning.

### EQUIPMENT

Recent interest in cross-country skiing has led to more changes in ski equipment in the past 20 years than in the previous century. Touring skis have become lighter and more responsive; fiberglass and other synthetic fibers have all but replaced traditional hickory and other hardwood skis; ski bottoms either are waxable in the old skiing tradition or have special "no-wax" synthetic bases; ski boot and binding combinations have become more diverse and provide more support. Today's cross-country skiers must become good consumers to purchase the appropriate equipment for their needs, locale, and budget. In sum, the recent advances in cross-country ski technology provide for safer and more enjoyable skiing.

### Skis

Cross-country skis are longer, lighter, and thinner than their alpine counterparts. They are designed primarily to allow the skier to slide forward over the snow with a minimum of resistance and effort. Cross-country skis have traditionally been made of thin laminated strips of wood, but in the past two decades the trend has been toward fiberglass skis with wood and fiberglass cores and various types of plastic running surfaces. Cross-country skis can be categorized into five distinctive types:

Ski	Width (mm)	Purpose
Mountaineering	60 and up	Skiing with heavy pack; ski mountaineering
Touring	53 to 60	Skiing with light pack; wilderness, ungroomed trail skiing
Light touring	48 to 52	Skiing on prepared track or ungroomed trails
Classical racing	44 to 47	Ski racing
Skating racing	39 to 42	Ski racing

Beginners are advised to use touring or light touring skis, depending on their use. The other two types of skis and their usage go beyond the scope of this chapter. Skis for adults (Fig. 26-1) will vary between 73 and 85 inches (185 and 215 cm) in length based on the skier's height. The general rule of thumb for a good fit is that skis should be as tall as the skier's outstretched wrist held overhead. Cross-country skis are built with a degree of camber, or bow, in the bottom running surface. The camber of both skis in a pair should match, and the user should be able to flatten out the entire length of the skis when he or she stands on them on a smooth, hard floor. Bottom camber helps propel the skier forward when flattened on the snow.

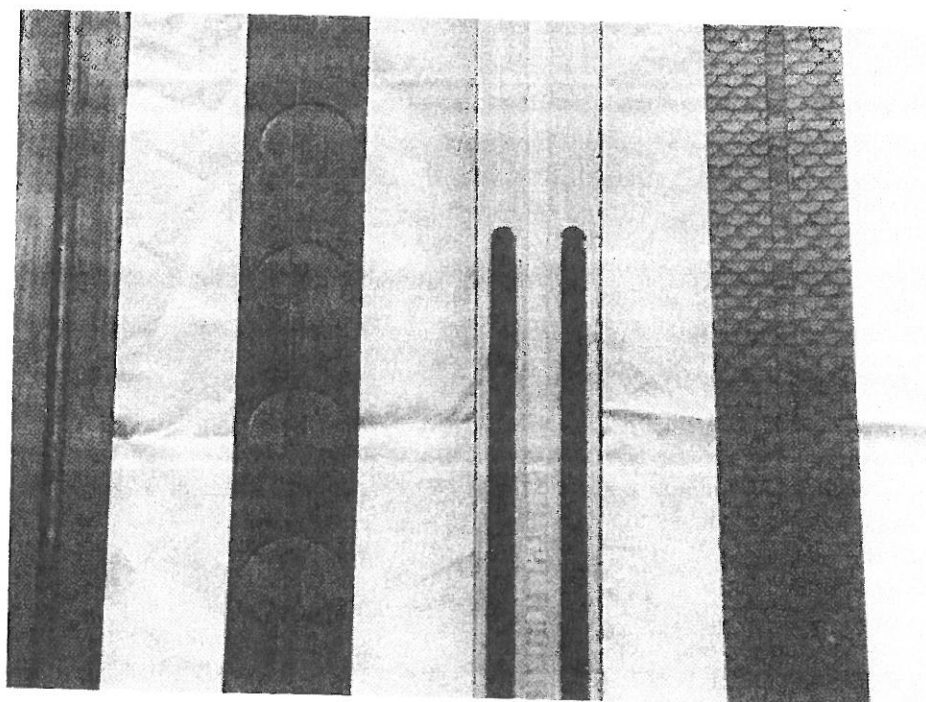
Perhaps the most difficult decision when purchasing the first pair of skis is whether to choose waxable or

waxless skis. Recently, cross-country skis with machined or mohair bottoms have eliminated the necessity of applying wax to the bottom, or running, surface of the skis. Such waxless skis have gained popularity with beginning and recreational skiers because of their convenience. The disadvantage of waxless skis lies in their performance. They cannot adjust to the variety of snows and temperatures that the skis will face and as a result will not slide as easily as well-waxed cross-country skis. However, improved technology has narrowed the gap between the performance of waxable and waxless skis.

With the evolution of the skating technique, "skating" skis are now available. They are about 2 to 4 inches (5 to 10 cm) shorter than classical skis; have a stiffer bottom camber, particularly in the tail of the ski; and feature reinforced sidewalls to withstand stress.

### Poles

Ski poles are important for a cross-country skier because they are used for both balance and pushing the skier forward. Beginners will quickly learn that downhill ski poles are not adequate for skiing cross-country. Cross-country poles are made of tonkin, aluminum, or carbon fiber and have three distinctive features. They are quite long and should fit comfortably under the skier's armpit while she or he is standing on a floor. Second, the tip of a cross-country ski pole is bent forward to allow for easy



**Fig. 26-1.** Fiberglass ski bottoms. (From *Cross-country skiing today*, by John Caldwell. © 1977 by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)



removal from the snow when the pole is well behind the sliding skier. Third, cross-country poles have a comfortable grip with an adjustable strap that allows the pole to stay attached to the skier's wrist even when not tightly gripped.

Poles come with a variety of baskets that are appropriate for different skiing conditions. Wide baskets can support the pole in deep, soft snow, while smaller, sometimes triangular baskets work well in packed, prepared-track ski conditions.

Skiers who intend to do much of their skiing using the skate technique should purchase ski poles that come up to their upper lip with the tip of the pole on the floor. Longer poles are mandated by the increased stride length of the skate. The added length of the poles requires them to be much stiffer than traditional poles. Common skating-pole materials are aluminum or a graphite fiberglass blend. Most skis, boots, and bindings can be used for both classical and skating techniques, but longer ski poles are essential for proper skating.

### Boots

Cross-country ski boots (Fig. 26-2) vary to be compatible with the five types of skis previously cited, with touring and light touring boots the preference for most recreational skiers. Although cross-country boots have long been made of leather uppers with leather or rubber soles, they are now also commonly made with synthetic soles and nylon, plastic, and even Gore-tex uppers. Despite these changes, several rules remain:

1. The ski boot should fit like a comfortable hiking boot or running shoe with the socks of the skier's choice.
2. Higher ski boots should be used because they provide more support and warmth than low-cut models.
3. The ski boot should be compatible with the type of ski and should tightly match the ski binding.
4. Cross-country ski boot soles should allow for maximum heel-to-toe flexibility while minimizing side-to-side movement.

Light touring boots suffice for most recreational usage because they provide a compromise among support, warmth, and flexibility. Skiers with unique podiatric or circulatory conditions should seek ski boots to accommodate their requirements. Fortunately, a wide variety of quality ski boots is available today.

Boots designed for the skating technique are useful but not necessary. They feature more lateral support in the heel counter, have less flexibility in the heel-to-toe plane, and have a higher cut than the classical boots.

### Bindings

The modern advances of ski technology are also evident in cross-country ski bindings. Traditional cable and three-

pinned "Nordic norm" bindings have been challenged. As in many sports, the changes originated in racing skis and later were used in recreational skis. The changes have complicated a once simple decision. Modern bindings appear to work well when matched with the correct boot sole. The skier should carefully examine the compatibility of boots and bindings and check for lateral play between the two. The best boot-binding combinations feature a tight, positive attachment.

Many new bindings extend the entire length of the ski boot sole. They provide a heel plate or locator that keeps the boot stable when flattened to the ski.

## CLASSICAL SKI TECHNIQUES

### Getting started

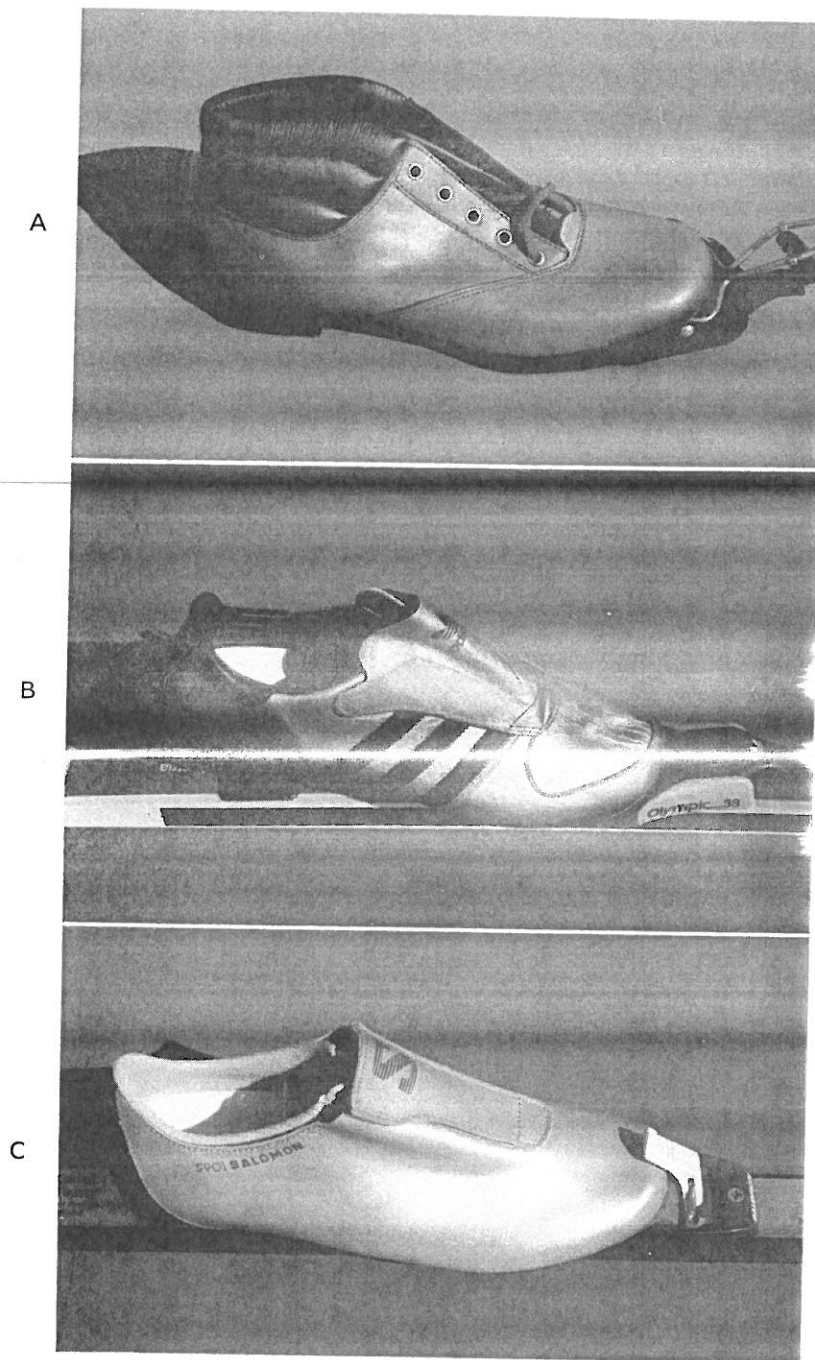
Correct cross-country skiing technique allows the skier to cover a wide variety of terrain in an effective and efficient manner. Technique is discussed here to help the skier make the sport more enjoyable and safe. First, the skier should practice putting on the skis and then simply walking about for a short distance with or without poles. Second, while on flat ground the skier should fall, if the snow is soft enough, and practice getting up. This exercise demonstrates the relative safety of cross-country skis. With the skis attached to the ski boots only at the toe, the skier should have little fear of slow-motion falls. Relaxation plays a major part in all ski techniques. The skier should take some time to become comfortable both walking and getting up from a fall.

### Flat-terrain techniques

#### Diagonal stride

The basic stride of cross-country skiing is called the "diagonal stride" (Fig. 26-3), and it is the hallmark of sound cross-country ski technique. Besides being used on flat terrain, it can be adapted, depending on the skier's strength and ability, to uphill sections. The diagonal stride can be broken down into three distinct but overlapping phases: the kick, glide, and pole.

The kick phase begins with one leg kicking, or pushing, back against the snow and the opposite leg sliding or shuffling forward. The body leans forward from the hips as the skier's weight transfers to the bent front leg. The glide phase extends from this weight transfer until the time the pole in the skier's opposite hand is planted out in front. Remember that the left arm and right leg will be forward at the same time, just as in walking or running. The poling phase continues until the opposite leg begins to kick, beginning the next cycle. This rhythmic stride allows the skier to shuffle, using arms and legs for propulsion forward. The kick should be down, as well as backward, into the snow. The poling motion should markedly contribute to extending the skier's already initiated glide ahead and will require considerable effort with the



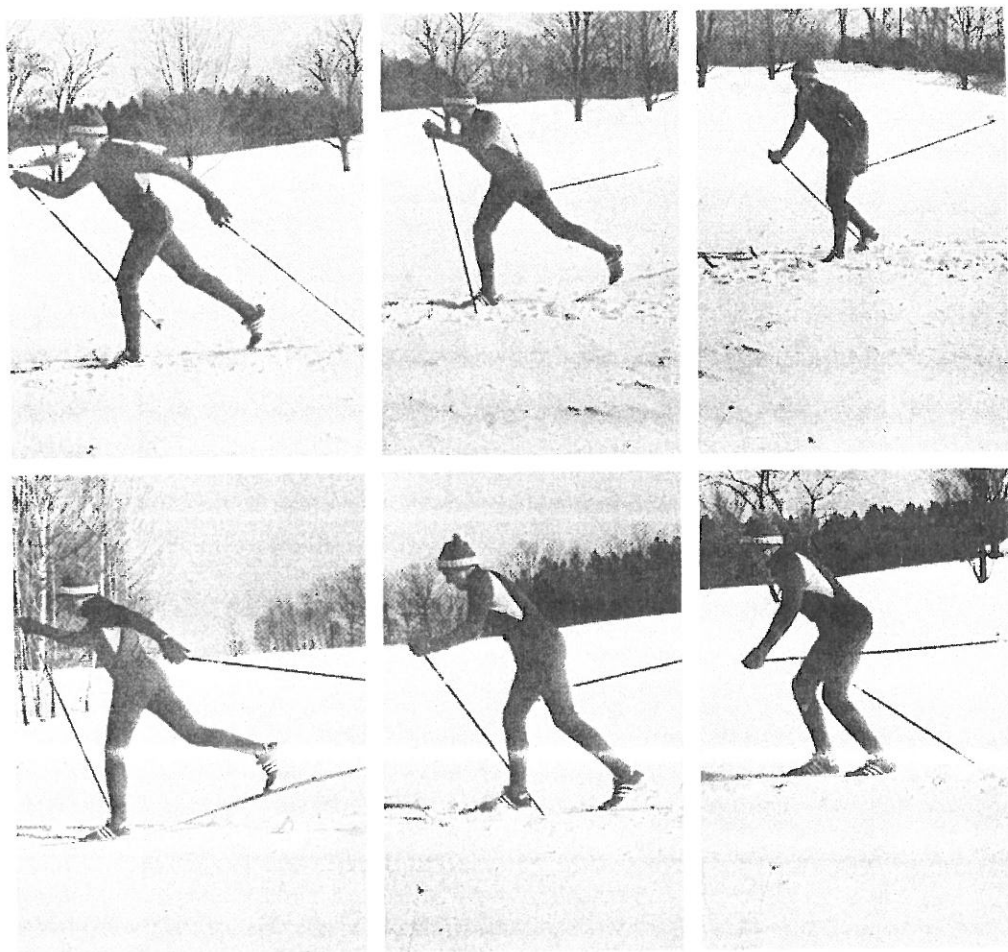
**Fig. 26-2.** A, Light touring/boot binding combination. B and C, Racing boot/binding combinations. (From *The cross-country ski book*, by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)

arms for the beginner. The diagonal stride, seen as a whole, requires strength, balance, and coordination.

#### **Double pole**

Double poling (Fig. 26-4) can be used to maintain forward motion on slight downhill or on flat terrain as an

alternative to the diagonal stride. The double pole can be defined as having two phases: the poling phase and the recovery-free glide phase. In the initial poling phase, the poles are planted as far forward as pole length and strength will allow and with the arms in a rigid but flexed position. Then the upper body sinks over the poles,



**Fig. 26-3.** Diagonal stride. (From *The cross-country ski book*, by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)



**Fig. 26-4.** Double poling. (From *The cross-country ski book*, by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)

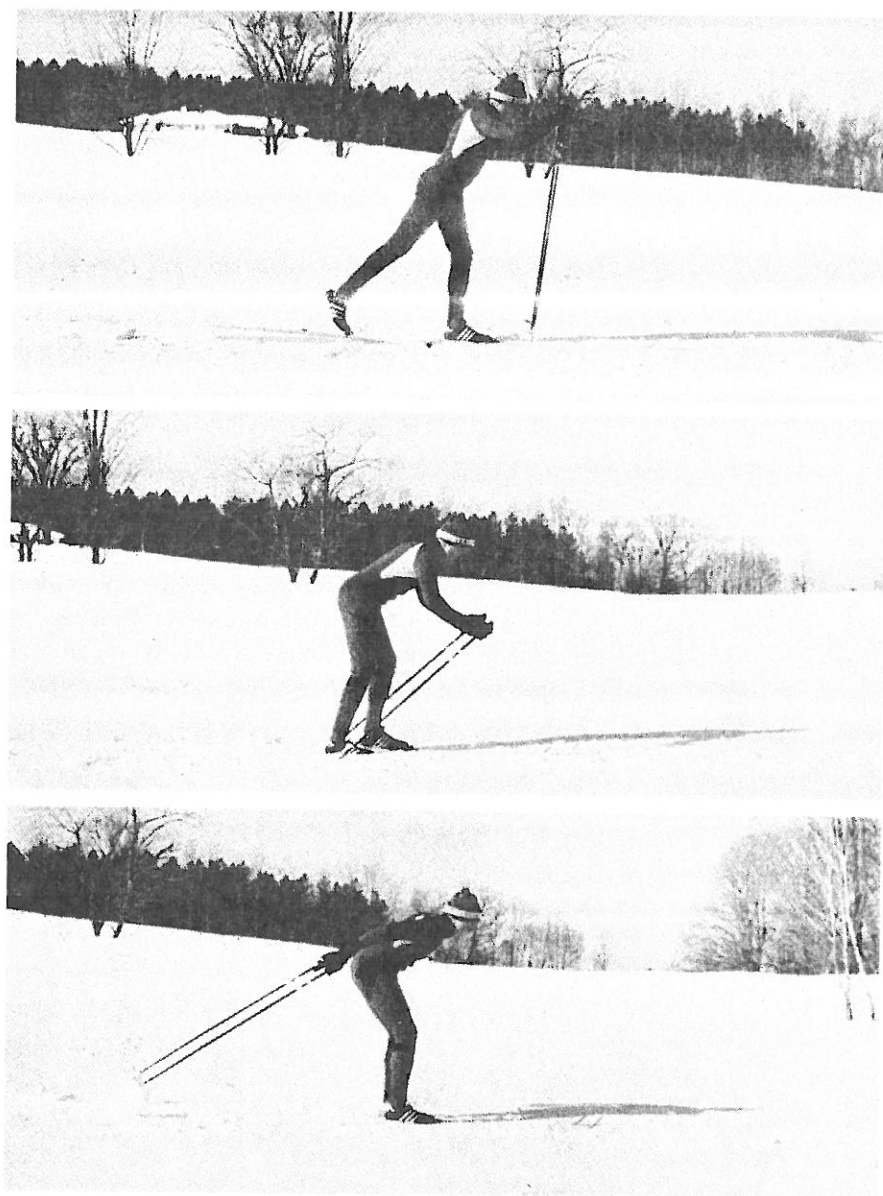
moving the skier forward. The arms push the poles back behind the skier, leaving the skier bent over almost horizontal to the ground with both arms extended behind. In the recovery phase, the poles are retracted from the snow and the body should come back up to the vertical as the arms prepare to reach ahead to begin the next pole. Much of the poling force should be provided by the upper torso—by the abdominal muscles in particular—rather than only by the arms.

#### **Double pole with kick**

This maneuver (Fig. 26-5) combines the upper-body motion of the double pole with a single kick, or “scooter

push,” of one leg, as in the diagonal stride, and serves as an efficient way to change pace while skiing. Practiced skiers mix these three techniques, depending on their level of fatigue and the demands of the terrain.

The double pole with kick is initiated by simultaneously reaching forward with both arms and pushing backward or kicking with one leg as described in the diagonal stride. The skier's body weight is now all on the forward ski, and the rear, or kicking, leg is extended. While the skier glides on one ski, both poles are planted as far forward as possible. The glide is now maintained by a double pole. The kicking leg returns to the snow as the body collapses over the poles.



**Fig. 26-5.** Double poling with kick. (From *Cross-country skiing today*, by John Caldwell. © 1977 by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)



The recovery phase is the same as in double poling. The double pole with kick requires some coordination and practice before mastery, but it is a relaxing technique to use on flat or rolling terrain. The difference between the double pole with kick and the pure double pole is that in the pure double pole the kicking phase is excluded and only the poling motion provides the power to propel the skier down the track.

### Uphill techniques

With practice and strength, all of the previously described techniques used on flat terrain can be applied to gradual uphill. Some adaptations must be made, particularly in the diagonal stride, in which the free-glide phase becomes shorter and the pole is planted back further than on the flats. Stride length decreases, and the gliding foot is pushed further ahead of the knee. Again, skiers should measure their capabilities and match them to the terrain. Other techniques exist for steep or otherwise difficult uphill stretches.

#### Herringbone

Here the skier uses the basic diagonal stride but angles both skis out (Fig. 26-6) to reduce the angle of the hill. The arms are kept low, with the poles forcefully pushed into the snow behind the skier. To help grip the snow, the inside edges of each ski are angled into the snow. A common error that occurs when executing the herringbone is to bend forward at the waist, so the skier should be aware of keeping the head looking up the hill and the heel down on the forward ski.

#### Side step

On even steeper hills, the side step (Fig. 26-7) is a slower but certain way for beginners to get up. The skier stands

with the skis going across (at a right angle to) the fall-line of the hill (the imaginary line down the hill's steepest slope). The skier angles the skis into the hill and lifts the uphill ski, stepping up the hill about 1 foot (30 cm). The downhill ski follows, and the action is repeated. The skier should be certain that the skis remain perpendicular to the fall line and that the uphill edges of the skis are rolled into the hill.

### Downhill techniques

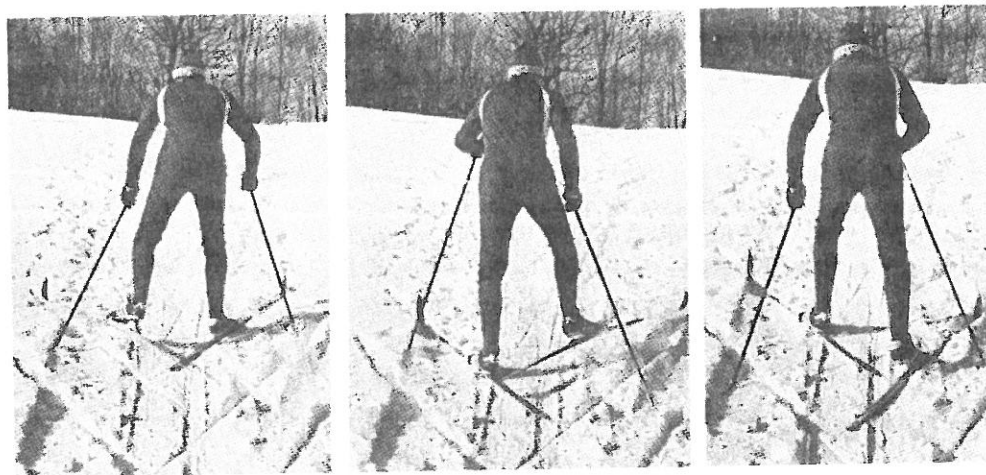
#### Straight downhill

Cross-country skis are designed to cut through the snow in a straight path with a minimum of resistance and therefore cannot be turned and maneuvered as readily as alpine skis on downhill situations. Velocity and direction can be controlled on cross-country skis using several simple techniques.

The basic downhill position of the skis should be a relaxed position with the weight evenly distributed on both skis. The skier must be conscious that the ski-boot heel is not attached to the ski and must keep his or her body weight pushing down on the heels. The term *soft knees* has been developed to explain the skier's relaxed, flexible stance that is needed to absorb the bumps in the terrain. The wedge (Fig. 26-8) serves as the basic technique used to control the skier's downhill descent. As the skier descends the hill, the tips of the skis are moved together as the tails are spread apart, forming a V-shaped ski position. To brake from this position, the skier wedges out the ski tails and pushes on the inside edges of both skis.

#### Wedge turn

From the controlled position just described, the skier can initiate a turn by shifting weight onto one ski, which turns



**Fig. 26-6.** Herringbone on uphill. (From *Cross-country skiing today*, by John Caldwell. © 1977 by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)





**Fig. 26-7.** Sidestep on gradual uphill. (From *Cross-country skiing today*, by John Caldwell. © 1977 by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)

the skier in the opposite direction. A good sign of a strong weight shift to one ski will be the shoulder of that same side rotating forward as the skis turn. Wedge turns can be linked together to form a controlled method of traversing and descending a hill.

#### **Step turn**

The step turn is the basic maneuver for changing direction on cross-country skis. The technique appears to be a simple movement, but requires the skier to commit almost all body weight to one ski and then to regain balance. While in the basic downhill position, the skier picks up the ski in the direction of the turn. The skier then plants that ski in the new direction and shifts the body weight to that ski. The trailing ski is then brought alongside the first ski to regain the basic downhill position. Emphasis should be placed on a smooth, complete weight transfer from one ski to the other. Several quick, small step turns are preferable to one wide-angle step adjustment, particularly at higher speeds.

#### **Advanced downhill turns**

Once the skier masters these basic downhill maneuvers, she or he can acquire other, more advanced downhill turns. (Refer to Chapter 25 for an elaboration of other downhill turns that can also be done on cross-country skis.) In addition, the time-honored telemark turn still remains as a classic advanced cross-country ski maneuver.

### **SKATING TECHNIQUES**

Skating requires different rhythms, skills, and strengths from the classical technique previously explained. Many beginners, particularly children, find skating to be more natural and easier to learn than the older kick-and-glide

approach. Keep in mind that the movements explained here require adequate equipment (particularly longer poles) and skis without cross-country kick wax.

#### **Marathon skate**

Skating (Fig. 26-9), a recent addition to cross-country ski technique, was popularized in ski racing by Bill Koch in his 1981–82 World Cup victory. The skate has revolutionized cross-country ski racing and has been adopted by most successful ski racers. The effects of this revolution are filtering down to citizen ski racers and ski tourers. Skating can be used as a replacement for the double pole with kick and the diagonal stride in situations where the skier wishes to maintain a relatively high velocity. This is most effective on crusty snow or on well-prepared ski tracks.

The skate is initiated with a double pole followed by a single kicking action of one leg. The kicking foot is lifted off the snow, angled out at about 40 degrees and vigorously pushed back as in an ice-skating motion. The tails of the skis will slightly cross before the kick, and at the end of the kick the leg will be extended. In the recovery phase, the kicking leg is brought back completely over the ski track and followed by a glide phase. As a new technique, the skate has many variations, but the skier should practice skating with either leg and mixing it into the other, more traditional techniques. While learning the technique, use existing ski tracks on a level or slightly downhill trail. Practice the marathon skate using both feet as the skating foot.

#### **V-1 skate**

Now the skier does not need set ski tracks, but just packed snow. The V-1, or asymmetric, skate gains its name from



**Fig. 26-8.** Wedge on gradual downhill. (From *Cross-country skiing today*, by John Caldwell. © 1977 by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)

the V pattern that the skis etch on the snow. Here the skier steps out onto one ski and adds a double-pole motion. But instead of returning the ski into the track as in the marathon skate, the skier skates off onto the other foot as the arms recover. In total, this looks like a speed skater's motion with the lower body combined with a strong double pole. This creates a strong stride on one ski (with the poling) and a recovery step with the opposite leg. Try this on level terrain before moving to slight uphills. Common problems with beginners include not committing their full weight to the skating ski and allowing the skis to drift farther and farther apart when initiating the skate step. The two boots almost touch one another as they pass in their strides.

Strength and coordination are required to use the V-1 on steeper and longer uphills.

Notice in the illustration (Fig. 26-10) how the skier stays fairly erect and straightens the skating leg as he rides over the flat skating ski.

### V-2 skate

As the skating technique evolves, the V-2, or symmetric, skate appears to be the technique of the future. Now mostly used on flat or slightly downhill terrain by ski racers, future skiers will be strong enough and have enough balance to V-2 on the uphills.

The V-2 is performed in the same fashion as the V-1 except that the skier double poles on every skating step. Instead of having a strong and weak side, as in the V-1, the V-2 has a bilateral motion with a poling action on the left and right strides. The leg tempo must slow down to allow the arms to recover, and the poling motion is shorter and quicker.

### Summary

Skating is a relatively new technique in cross-country skiing. In cross-country ski-racing events, classical and skating events exist side by side, in much the same way that different swimming strokes have their own events. They are just variations of self-propulsion on snow. Skating requires more strength, particularly in the upper body, yet it provides more freedom of motion. Although skating equipment differs from classical skiing equipment, longer ski poles are the only essential difference. Beginners are encouraged to try both versions for the full enjoyment of all skiing techniques.

### GUIDELINES FOR THE CROSS-COUNTRY COURSE

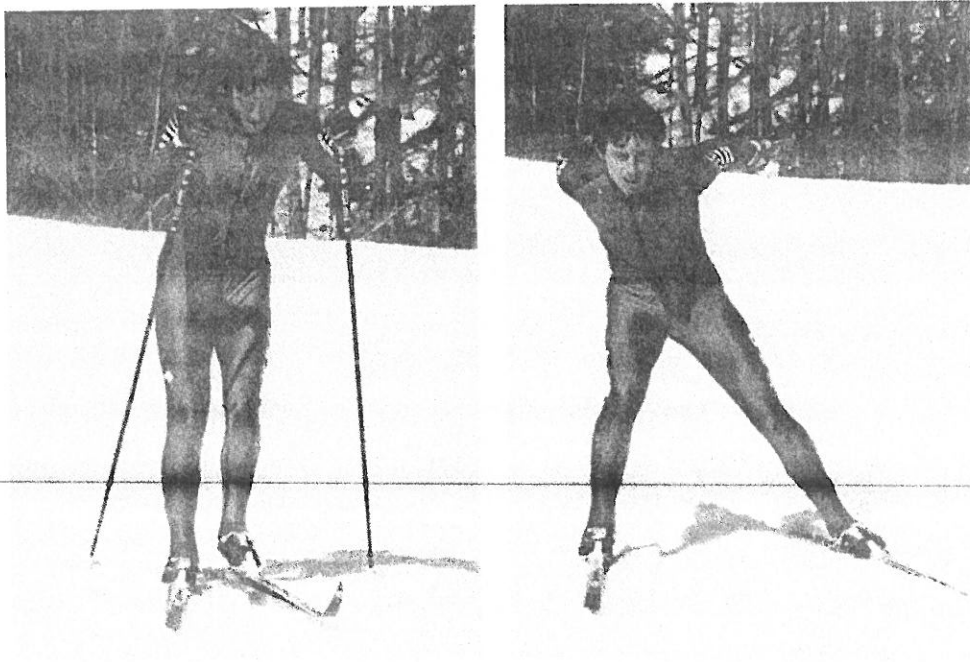
A cross-country course must be laid out to be a technical, tactical, and physical test of the skier. The degree of difficulty should be in accordance with the ability of the competitors.

The cross-country course should consist of:

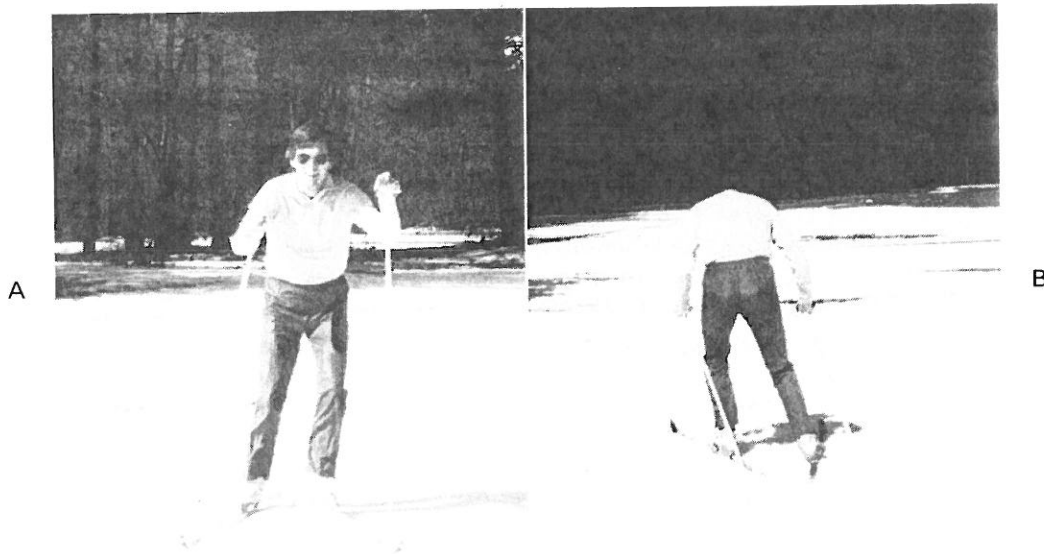
1. One-third uphill section with a climb between 9% and 15% plus some short climbs that are steeper (10% slope = 45 degrees).
2. One-third undulating terrain using all terrain features, with short climbs and downhill sections, and height differences of 5½ to 11 yards (5 to 10 m).
3. One-third varied downhill section demanding competence in all downhill skills.

### Number of competitors

Five men and five women from a team may compete in the individual event for the team score, with the highest finishing three in each to count in the team scoring. A relay team consists of three competitors.



**Fig. 26-9.** Marathon skate at the end of the kick. (From *The cross-country ski book*, by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, inc.)



**Fig. 26-10.** V-1 Skate. **A.** Front view. **B.** Rear view.

## WAXING

Cross-country ski wax is a unique chemical compound that allows cross-country skiers to get a grip, or purchase, on uphill. When properly selected and applied, cross-country, or kicker, wax alternately grips the snow crystals when weight is put on the ski and slides when the weight is released from the ski as in the glide phase of the

cross-country ski technique. There is both an art and a science to cross-country ski waxing. It requires matching the ski and the skier's weight and technique to the snow conditions and temperature.

Before the revolutionary changes in skis from wood to synthetic-base surfaces and from straight bottoms to patterned or mohair no-wax surfaces, ski waxing was a

reasonably straightforward procedure. Charts matching snow conditions to ski wax color were simple. Now, with the wide variety of skis and ski bottoms and wax and no-wax surfaces, waxing has become specific to each type of cross-country ski. (Written procedures go beyond the scope of this chapter.) Some suggestions will prove helpful for the beginner:

1. Follow the manufacturer's ski base preparation and waxing recommendations. These should come with the skis or be available from the retailer.
2. Adjust these basic waxing rules to your personal technique, needs, and local snow conditions.
3. Consistently use one or two brands of cross-country and alpine wax until you have mastered their entire range of waxes before moving on to other brands.
4. Even "no-wax" skis can perform better with the application of gliding, or alpine, wax on the nongripping portion of the ski bottoms. This will protect the ski against wear and damage as well as improve its gliding capabilities.

The skating technique simplifies cross-country ski waxing. Because the skier gets more power on the snow using the edge of the ski, no cross-country, or kick, wax is necessary. A coat of alpine wax is put on the ski bottoms to enhance the ski glide and protect its running surface.

### OFF-SEASON CONDITIONING

Because cross-country skiing is a winter sport, most cross-country skiers turn to other sports and recreational activities for the remainder of the year. Most cross-country participants engage in other outdoor pursuits that are in the same endurance-based, aerobic family of sports. The purpose of off-season conditioning should be to adapt the skier to the physical demands of skiing, allowing the skier to enjoy skiing when snow arrives. Cross-country skiing can be a demanding experience for those who have been dormant in the off-season. Keep in mind that ski tours, cross-country pursuits, and citizen ski races can extend for a matter of hours or an entire day, depending on the fitness and skills of the skier, so the skier's off-season conditioning should focus on gradually adapting the skier's conditioning for such adventures. Specifically, the skier should prepare for the demands (cardiovascular, muscular, and technical) required for his or her level of involvement. Some conditioning guidelines to remember are as follows:

1. Make cross-country training as enjoyable as possible. Find off-season pursuits that are fun. If possible, find other people to train with. This will provide companionship and a support system to maintain a training program.
2. Train in the off-season at the same level of intensity that you will use when skiing. Higher levels of conditioning for skiers require more formal training

programs and time. Be realistic in the goals for a cross-country ski season.

3. Conditioning that approximates cross-country skiing is more effective than general conditioning. Gear off-season training specifically to cross-country skiing if you are serious about ski fitness. An example of this is to train on terrain similar to that which will be skied in the winter.
4. Cross-country skiing is a total-body sport in terms of the demands placed on the skier. No individual can excel in all dimensions of skiing. Conditioning programs should place emphasis on the skier's weaknesses to produce more balance.

### Cardiovascular endurance training

Cross-country skiing is a member of the cardiovascular endurance family of activities. For that reason, participating in any other endurance-producing activity in the off-season can be beneficial for skiing performance. Bicycling, jogging, orienteering, hiking, skulling, and rowing are common off-season alternatives. Canoeing, kayaking, and swimming, although not as commonly used, are also beneficial to off-season recreational skiers. The use of roller skis (Fig. 26-11) or roller blades is the most sport-specific form of off-season cardiovascular training.

### Muscular strength and endurance training

Cross-country skiing places demands on the strength and endurance of all the major muscle groups of the body. Besides the weight-lifting, weight-training, and circuit-training methods cited in Chapter 40, the use of Universal and Nautilus exercise devices is helpful. The skier should not overlook hard physical labor, such as wood splitting, gardening, and chain sawing, as a means for developing muscular endurance. Cross-country trail clearing in the late autumn can be a foundation to snow-skiing fitness.

The skating technique places a premium on muscle endurance and strength. Therefore, skaters should place emphasis on strength and muscle endurance training relative to their cardiovascular fitness.

### Skill training

As previously mentioned, off-season conditioning should closely approximate snow skiing. Skill training is a component that helps the skier master the technical aspects of skiing while in the off-season. Skill training minimizes the difficulty of the transition from off-season or dry-land training to snow skiing. Many ingenious forms of skill training have been developed by ski racers. Some are appropriate for the recreational athlete (such as roller skiing or roller blading). The simple addition of ski poles in hiking or jogging can improve both endurance and technique. Ski bounding and ski striding on gradual uphill slopes are other examples of excellent skill-training activities.





**Fig. 26-11.** Off-season conditioning on roller skis. (From *The cross-country ski book*, by John Caldwell. Reprinted by permission of The Stephen Greene Press, a wholly owned subsidiary of Viking Penguin, Inc.)

The recent development of roller blades, or hockey skates on in-line wheels, has been a great asset to cross-country skiers. Roller blades, when used with skating-length ski poles, provide excellent skill, cardiovascular, and muscle endurance training.

### CLOTHING

The correct clothing for cross-country skiing can vary as widely as skiing and weather conditions. Few formal rules can be stated, but several guidelines are offered:

1. Dress in the same clothes you would wear if hiking in similar weather.
2. Wear loose-fitting, nonbinding clothing, which will allow a wide range of motion.
3. Wear several light and warm layers, which provide more ventilation than a few heavy bulky layers (e.g., a ski parka).
4. Always remember that hats, ear band, and gloves or mittens are essential.
5. Bring a change of dry shirts, socks, and footwear for after a ski tour.

Many ski tourers have found some of the new synthetic fibers that can provide warmth and windproofing to be ideally suited for the sport. A small backpack or fannypack can hold additional clothing and a trail snack.

### SAFETY CONCERNS

Although cross-country skiing is a relatively safe sport, the participant should exercise caution, ski within his or her limits, and use common sense. When on a day-long tour, the following equipment should be included:

Small backpack	Screwdriver
Extra ski wax	Matches
Spare ski tip	Map and compass
Adhesive tape	Ample fluids
Knife	Extra food

Injuries are rare in cross-country skiing, but two emergency situations should be recognizable to all skiers: frostbite and hypothermia. Frostbite is the freezing of the surface layers of skin cells on exposed extremities of the body—usually ears, nose, chin, fingers, or toes. Frostbite

can be prevented by keeping hands and feet—and face, in extreme cold—properly covered. Partners can check each other's faces to reveal any area lacking in circulation and appearing white or gray. Frostbite victims should be removed from the wind and cold as quickly as possible. Treatment for serious frostbite requires medical personnel.

Hypothermia is the gradual lowering of the core temperature of the body and can occur when a person is exposed to much wind, cold, and wetness. Hypothermia is most likely to occur when a skier is hungry, tired, and inexperienced about how to behave outdoors in the winter. Symptoms of hypothermia include lethargy, slurred speech, poor coordination, and shivering. Efforts must be made immediately to warm the person both by removing her or him from the cold and feeding hot fluids, if the person is conscious. Medical care is advised in serious cases. Hypothermia can be avoided by proper clothing, adequate feeding, and traveling within one's limits.

Cross-country skiers venturing away from prepared trails in the wilderness of Western states should be aware of and prepared for avalanches. These circumstances mark where cross-country skiing borders on ski mountaineering and demands particular respect and training for unstable snow conditions. Skiers who anticipate going into such environments—usually found in the Rocky Mountains and the Sierra Nevada—need information beyond the scope of this chapter. Skiers traveling in these conditions must carry special equipment, such as beepers and avalanche chords, for avalanche protection. Most cross-country skiers will avoid such steep terrain and deep-snow conditions.

### TEACHING CONSIDERATIONS

1. Initial practice should include walking with skis on flat terrain. Practice lowering the body to the ground in a slow fall and getting up again until the skier is comfortable maneuvering the length of the skis.
2. Instruction should be consistent with the perceived purposes of the learner. Beginning recreational skiers will need only basic skills to make their initial experiences safe and satisfying. Do not attempt to teach all techniques in one period. Come back to more advanced techniques after participants have had an opportunity to use what they have learned. If possible, teach techniques on a need-to-know basis as students encounter conditions needing more advanced techniques. Consider the endurance level of participants when planning lessons. Beginners use more energy than skilled participants. Make beginning trails short.
3. Begin with flat-terrain techniques. The diagonal-stride and double-pole techniques should be sufficient for the beginner to enjoy a flat-terrain experience. Later lessons can incorporate the double pole with a kick or

marathon-skate technique for students who are interested in speed.

4. Most cross-country experiences require only minor adjustments to the basic cross-country skiing techniques, which can be taught and practiced quickly on the appropriate terrain. Skiers who will experience steeper slopes will need basic instruction in how to get up and down a hill safely on their skis. The side step and herringbone should be taught as methods of getting up a steep hill. The straight-downhill ski technique will be sufficient for moderate inclines, but the wedge technique will need to be mastered to control speed on steeper inclines. These skills are not easily performed without practice or instruction on sloped terrain, and beginners should be encouraged not to attempt downhill skills on large slopes. The side step can be taught as a safety skill to get down a slope that is beyond the skier's skill level.
5. Keep instruction sessions short. Minimize listening time; maximize practice and opportunity to participate in a cross-country experience right away.

### GLOSSARY

- cardiovascular fitness** The ability of the body to process oxygen to do work using the heart, lungs, blood vessels, and muscles.
- citizen ski races** Ski races designed for mass participation by recreational skiers. Citizen ski racers are considered skiers between elite ski racers and recreational ski tourers.
- glide wax** Sometimes referred to as "alpine, or speed, wax"; it can be applied to the tips and tails of skis to enhance ski speed. Used exclusively in skating.
- kicker wax** Sometimes referred to as "cross-country wax"; it is applied to a waxing zone of varying length in the middle of the ski. Kicker wax produces the grip allowing the skier to move uphill.
- ski bounding** An uphill running exercise designed to simulate the movement of skiing uphill. This is done in the off-season for skill and cardiovascular training.

### SUGGESTED READINGS

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