

Adaptive Nordic Instructor's Manual



Photo: www.flyingpointroad.com

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Organizational Contributors:

CXC www.cxcskiing.org

Central Cross Country Ski Association, P.O. Box 930442, Verona, WI 53593
608.277.0220

NENSA www.nensa.net

New England Nordic Ski Association, 49 Pineland Dr., Suite 301 A., New Gloucester, Maine 04260
207.688.6503

Northeast Passage <http://www.nepassage.org/>

4 Library Way
Durham, NH 03290
603.862.0070

PSIA www.psia.org

Professional Ski Instructors of America, 133 South Van Gordon Street, Ste. 200, Lakewood, CO 80228
303.987.9390

U.S. Paralympics usparalympics.org

U.S. Olympic Committee, 1 Olympic Plaza, Colorado Springs, CO 80909
719.866.2030

John Farra, High Performance Director, U.S. Paralympic Nordic Skiing
Jessica Smith, Manager, Paralympic National Ski Teams

john.farra@usoc.org

jessica.smith@usoc.org

U.S. Ski and Snowboard Association ussa.org

1 Victory Lane, Box 100, Park City, UT 84060
435.649.9090

National Adaptive Organizations with Local Chapters:

U.S. Paralympic Regional Organizations & Local Paralympic Sport Clubs

<http://findaclub.usparalympics.org/>

Disabled Sports USA – Chapter Information

<http://dsusa.org/chapter.html>

Special Olympics – Find a Location Near You

http://specialolympics.org/Common/Special_Olympics_Program_Locator.aspx



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Chapter 1. Adaptive Nordic Overview

Adaptive sports are sports that are adapted in some way to better support individuals with intellectual or physical impairments. These adaptations can include differences in equipment, technique, or teaching techniques.

Cross-country or Nordic skiing is a wonderful option for people with disabilities who enjoy exploring trails or engaging in physical activity in a winter environment. Some people like Nordic skiing for the peace and solitude, some like the fitness that comes with practice of the sport, and others enjoy pushing their bodies to the physical limit.

As with other snow sports, the teaching progression for skiers with disabilities has evolved as instructors and students explore different and innovative approaches. Being an adaptive instructor gives you the opportunity to share what you know and love about skiing while introducing the sport to more people in your community.

We hope this manual will provide you with information that can be a base of Nordic instruction for adaptive skiers. As with any kind of instruction, the most critical piece of the process is recognizing everyone as an individual and adapting your instruction accordingly. The most effective instructors and coaches, whether for adaptive athletes or not, recognize that each person arrives to the trails with different goals, needs, capabilities and a history that informs us as instructors. In this way, adaptive instruction is most simply an extension of best teaching practices.

Adaptive Sports Organizations

Under the adaptive sports umbrella are organizations that specialize in sports programming that support people with different types of impairments.

The Special Olympics is an international organization with local chapters that specialize in providing athletic opportunities for individuals with intellectual impairments.

The International Paralympic Committee (or IPC) is the international governing body for Paralympic sports. The Paralympics are the highest level of sports competition for people with physical disabilities. Some types of impairments necessitate completely different categories within competition (i.e. sit skiing), while other adaptive athletes could compete in both mainstream and adaptive classes. The national governing body for adaptive Nordic skiing is USA Paralympics, under which the US Paralympic Nordic National Team is housed. The Nordic National Team competes in both cross-country and biathlon competitions, with the majority of the current athletes competing in both.

Disabled Sports USA (DS/USA) is another national organization, which has community-based sports rehabilitation chapters for individuals with permanent disabilities.

There are many regional and local adaptive organizations throughout the country that fall under one or more of the abovementioned organizations. All three of their websites have local program finders, which are listed on page 2 of this manual.

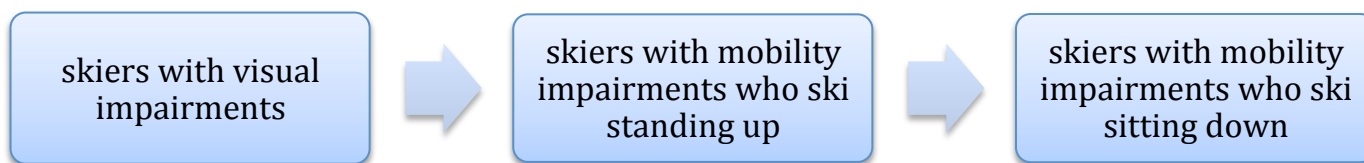
Classification in Paralympic Skiing

Why do we race? Spend countless hours training? Waxing skis? Take our place on the start line? Push through pain of exertion and exhaustion? The answer is varied for each athlete, but most athletes agree that there is a draw that feeds who they are as individuals. At the heart of athletic competition is the concept of a fair contest of athletic ability and will, self-discipline and strength.

Most of us are well versed with the idea of having different classifications or categories within race events. Historically, in races amongst athletes without disabilities, we see categories based on gender and age to allow for physiological and developmental functional differences. No one expects a 10-year-old boy to compete against a 25-year-old man.

The question for athletes with disabilities is the same. How do we create a fair contest of athletic ability and will, self-discipline and strength? The short answer is the same as well: to group people into categories based on how their bodies function/how their disability impacts how they ski.

That being said, there are a lot of different disabilities that people can experience or even different experiences of similar disabilities. Rather than have an exhaustive list of different categories, Nordic skiers with disabilities compete within 3 different categories:



Now for the longer answer: within each of these categories there are also different sport classes into which the athlete is further grouped. For each of these classifications there is a percentage assigned, that when factored into the raw time for the race, has the effect of “leveling the playing field”. It goes in this fashion: athletes are classified based on their functional ability. Once the athlete is classified they enter the race. Everyone in the same general category completes the course. Their raw time then is “factored” or multiplied by the assigned percentage to come up with an adjusted time that will be used to determine overall results of the race.

Sounds confusing? It will make sense as you keep going. Lets take, for example, the second category of skiers who ski standing up. Within this category you may have skier 1 who has an amputation just above the ankle and skier 2 who has an amputation of their leg just above the knee. Each skier skis in roughly the same manner with two skis and two poles, but the first skier has a greater percentage of his/her overall function present. Say the percentage assigned to his/her category is 96%. The skier who has an amputation higher up has less of a percentage of his/her overall function present... say 89% is what is assigned to them. The difference in percentage is designed to account for the difference based on type of disability/functional level so that athletes are able to compete with each other based on fitness, technique, strategy, determination etc. Theoretically, if these two skiers were identical in all these aspects, and the only difference was disability, it would factor out completely and they would tie.

Example:

Skier 1 - raw time: 00:20:01 X 96% = 00:19:13 factored time

Skier 2 - raw time: 00:21:35 X 89% = 00:19:13 factored time

Who decides what sport class people race in?

The International Paralympic Committee Nordic Skiing certifies classifiers to evaluate athletes based on physical assessment as well as observation while skiing. Classifiers are doctors, physical therapists, and professionals such as coaches with extensive experience in adaptive Nordic skiing. Athletes must be classified by an international IPC classification panel prior to competing in an international event such as a World Cup race. Ideally athletes would be classified prior to the start of any race, however at a local level within the United States this opportunity is currently limited. At a minimum, athletes can be educated about the classification system, questions answered through contacting the US Paralympic Nordic Team or regional affiliates. Athletes can compete locally with each other, understanding that classification efforts are estimates and unofficial.

A thorough explanation of each sport class, associated percentages, and who determines in which class an athlete will compete and how they decide can be found in the March 2011 version of the IPC Nordic Skiing Classification Regulations and percentages. This can be found on line at:

<http://www.ipc-nordicskiing.org/Classification/>. The following is an abridged version taken from this source IPC percentages are listed with description of sport class.

skiers with visual impairments - all skiers ski with a guide

B1 -
(most impairment)
87% classic
85% freestyle

Unable to recognize the orientation of a 100M Single Tumbling E target (height: 145mm) at a distance of 250mm.

Visual ability may range from no light perception to a Single Tumbling E visual acuity poorer than LogMAR = 2.60.

Skier wears opaque goggles or covering over eyes

B2
98% classic
98% freestyle

Unable to recognize the orientation of a 40M Single Tumbling E target (height: 58mm) at a distance of 1m (STE LogMAR = 1.60); and/or

Visual field is constricted to a diameter of less than 10 degrees.

Visual acuity may range from Single Tumbling E visual acuity poorer than LogMAR = 1.60 to Single Tumbling E visual acuity of LogMAR = 2.60.

B3
100% classic
100% freestyle

Visual acuity that is poorer than LogMAR = 1.00 (6/60) measured with an ETDRS letter chart or an equivalent chart (Tumbling E) in the LogMAR format presented at a distance of at least 1meter.; and/or visual field that is constricted to a diameter of less than 40 degrees.

Visual acuity may range from a letter chart acuity poorer than LogMAR = 1.60 to a Single Tumbling E visual acuity of LogMAR = 1.60.

skiers with mobility impairments who ski standing up

Skiers who ski with two skis and two poles
lower limb impairment

LW2 - impairment in one lower limb above knee

91-93% classic
86-91% free

LW3 -impairment in both lower limbs

87-94% classic
80-96% free

LW4-impairment in one lower limb below knee

96% classic
96% free

Skiers who ski with two skis and one pole
upper limb impairment

LW 6-impairment in one one upper limb through or above elbow

91% classic
96% free

LW 8 -impairment in one upper limb below elbow

92% classic
97% free

skiers who ski with two skis and no poles
upper limb impairment

LW5/7-impairment in both upper limbs - unable to use poles

79% classic
87% free

skiers with a combination of upper and lower limb impairments

LW9-combination of impairments affecting at least one upper and one lower limb

85-95% classic
82-96%free

Please note that there is a percentage range for the LW 3-4 and LW 9 categories due to the range of how disability may present and effect application of power. In addition, there is a difference in how that power may or may not be applied from classic to skate technique. The percentage range listed for each technique is designed to account for this variance.

Skiers with mobility impairments who ski sitting down

LW 10 86%	LW 10.5 91%	LW11 94%	LW 11.5 98%	LW 12 100%
<p>Has impairment in lower limbs and trunk no sensation in the buttocks</p> <p>Minimal trunk stability in flexion or extension</p> <p>Unable to maintain seating position against gravity without arm support.</p>	<p>Has impairment in lower limbs and trunk no sensation in the buttocks</p> <p>Has some upper abdominal/ trunk extensor activity</p> <p>May have some lower motor function with scoliosis and spinal fusion</p> <p>Able to maintain seating position when strapped to table but can not move out of base of support</p>	<p>Has impairments in lower limbs and trunk</p> <p>Retains use of abdominal muscles especially those attached to pelvis</p> <p>Can sit unsupported on test table, move trunk out of base of support, and return unaided</p> <p>Unable to flex hip against gravity from seated position</p> <p>Unable to stand or walk even with orthosis</p>	<p>Has impairment in lower limbs and trunk</p> <p>Near to normal trunk activation</p> <p>Able to flex hip in a seated position through near normal range.</p> <p>May have some hip extension</p> <p>May be able to stand or walk with or without aids or orthosis</p>	<p>Has impairment in lower limbs with normal trunk function</p> <p>May be able to walk with or without aids or orthosis</p>

Chapter 2. Student Assessment

The first and most critical part of every ski lesson is the student assessment or evaluation. To teach a successful lesson, the instructor must first have a complete picture of the student's particular abilities and goals to help create a realistic lesson plan. This is doubly important for adaptive skiers because of their special physical capabilities, the need for any adaptive equipment suited to their situation, and the need for more highly customized lesson plans. Each student must be treated like an individual, as no two students are alike, even if they have the same disability or level of injury. The assessment must consider:

- Cognitive, affective, and physical aspects of the disability including: physical condition, fitness, and the mental, emotional and learning preferences *See Appendix A for Disabilities We Teach
- The student's body function, including: stance and gait; balance fore, aft and laterally; strength of upper and lower body; and mobility of arms, legs, trunk and hips
- Medical Information including specific personal information of the disability, medications that the student is taking and associated side effects. *See appendix C for Medications

Components of the student assessment include a:

1. Student information form
2. Visual assessment
3. Physical assessment
4. Cognitive assessment
5. Equipment needs and set-up

1. The Student Information Form is a questionnaire completed by the student or a family member or caregiver before the first lesson. It provides general information on the student's disability, ability and special behavioral, learning, physical, and medical considerations. A liability release should be signed for all participants. The student information form is available for the instructor's review prior to the lesson.

After each lesson, the instructor records the type of equipment and setup used and notes any information to help the next instructor pick up the lesson where it left off. All of this information should be kept in a file or a database for the student and accessible for subsequent instructors. An example of student information form is provided at the end of this chapter.

2. The Visual Assessment begins as the student arrives for the lesson. It starts with general observations, watching how the person enters the room or facility, watching their interactions with others in the room and with the people who brought them and shaking hands to greet the student when introduced. This becomes more specific with inquiries about the skier's disability, past experiences, medications (if any), motivations, goals, and other questions pertinent to that person. Sometimes questions need to be directed towards a parent or caregiver, depending upon the age of the student or ability of the student to converse easily. *See Appendix D for Common Gaits Found in Adaptive Students

The following questions may help you, but use these only as a starting point. You will need to expand upon the questions as you see fit.

- Is the student in a wheelchair, wheeling independently or in a power chair, using a walker or crutches, wearing leg braces or a prosthetic, or walking with a cane? Sometimes you cannot see a brace or prosthetic, so a thorough reading of the Assessment Form before the student arrives is helpful to know the primary and any secondary disabilities. There are a lot of disabilities that you may not be able to see and you should always ask about hidden disabilities.
- Did the student need help opening the door? Turning a doorknob and pushing or pulling a door. This may denote a certain amount of grip strength and arm strength as well as an independence level.

- Is the student outgoing or withdrawn, excited or fearful, unreserved or having second thoughts? Knowing a student's attitude about the lesson can be a valuable aid in selecting the appropriate teaching style and terrain.
- Does the student look strong and athletic? A student who participates in sports and works out will probably be ready for the experience of cross-country skiing. Be prepared to keep the lesson moving at a pace and to skip steps in the teaching progression if needed to maintain interest.
- Is the student dressed appropriately for the conditions? Lack of appropriate attire may require loan of some clothing for the first lesson. This student may need some instruction about dressing for the winter environment before going out.

3. The Physical Assessment allows the instructor to gather specific information about the student's disability and physical condition beyond that provided in the Student Information Form. Before conducting a physical assessment ask questions that will help you understand your student's disability. The student or their caregivers are experts in their disability and can provide ample information. It is far better to ask questions up front than to put yourself in an uncomfortable situation later or to endanger your student.

- Does the student have any related, unrelated or hidden secondary disabilities? You must consider secondary disabilities when setting up equipment and teaching. For example, visual, hearing, or cognitive impairments may accompany multiple sclerosis, traumatic brain injury or cerebral palsy. A person with Down syndrome may have heart complications, hearing problems or joint hyper flexibility. A person with diabetes may have fluctuating blood sugar levels and circulatory problems. He/she may be missing a toe or toes.
- How long has the disability been present? People with a recent injury may be weak or unaccustomed to their current situation. You may need to do extra padding or protection for a recent injury.
- Has the student undergone major surgery within the last year? If so, the student may need a doctor's release and/or may tire easily. An example is that many Cerebral Palsy students frequently have orthopedic surgeries to reduce spasticity by lengthening muscles or tendons.
- Is the student taking any medications and, if so, why do they take that medication and what are the side effects? When did they take their last dose and will they need to medicate during your session? Many medications are susceptible to sun, so take the appropriate precautions and do not expect they will do it.
- Amputations: When did the amputation occur? What is the present condition of the stump and is the stump properly wrapped and padded?
- Functional musculature and strength - which muscle groups can the student use or not use? Is the student strong enough to stand and move without assistance? Is adaptive equipment needed to allow those muscles to function while moving?
- Balance- Can the student stand on one leg? With their eyes closed? Have the student lean to one side and return to upright, repeat to the other side, how far were they able to go without falling over? If in a wheelchair do it without holding on to the wheel on the other side. This may also let you know their functional ability due to the level of injury.
- Coordination-Watch the student perform physical tasks, with an eye for fluidity and efficiency of motion. Watching the student move around the room, open doors, or put on a jacket will help you assess gross motor movements. Watching the student pick up small objects or write will give you an idea of the level of fine motor movements.
- Flexibility and range of motion - Adaptive students often have restricted range of movement due to joint fusion, muscle hyper tonicity (rigidity), or muscle atrophy. Ask them to reach across their body with an arm/leg then to the other side.
- Motor and Sensory Deficits - Use questions and simple tests to determine what parts of the body the student can feel and control. If the student has feeling in body parts with limited function, determine the types of sensations felt: heat, cold, pain, or pressure. If the student has incomplete sensation, determine the extent and consider the consequences. *See Appendix B for more information on functionality at different levels of spinal cord injuries
- Vision and Hearing - Some students may forget to mention secondary visual or auditory impairments that are less obvious than the primary impairment. In the case of a visual impairment, find out what the student

can see, the cause of the visual impairment, any medications or medical precautions and if they have any hearing impairments as well. Vision should be tested both inside and outside to assess the effects of bright light and shadows. Find out if the student sees better out of one eye or the other. Impairment in one eye may cause a lack of depth perception. Test the student's field of vision as well as visual acuity and range of vision. If the student has a hearing impairment, find out how severe it is. Does the student wear a hearing aid, read lips, or use sign language? Does the student hear better out of one ear than the other?

All of these factors will influence how you conduct the lesson. In addition to these physical issues, ask about the student's prior experience with skiing, snowboarding, and other sports. Did the student ski or snowboard or participate in some other sport before becoming disabled? Prior athletes have good body awareness, which is an advantage when learning to ski with adaptive equipment. If the student currently participates in another sport, you can usually draw similarities to help the student learn adaptive Nordic skiing.

4. The Cognitive Assessment continues throughout the lesson. Evaluate the following to help you develop the best lesson plan for the particular student:

- Is the level of cognitive functioning appropriate for chronological age? Always address the student in a manner suitable to chronological age unless contraindicated by the assessment or other sources.
- Can the student hear, understand, and follow simple instructions or answer your questions?
- What is the person's emotional state: motivated, confident, timid, anxious, eager, elated, reserved, confused, or patient?
- Is the student easily distracted? If so, why? Is it a lack of concentration, processing or just a reduced attention span, all characteristics of some disabilities?
- How does the student process information? Can he/she follow simple directions, and stay focused?
- What are the student's long-term goals and the goals for the day? Motivation is key to developing the lesson plan for the day and for the future.

By the time a thorough student assessment has been completed, the instructor will have gained a lot of important insights into the physical and cognitive abilities, special needs, attitudes and personality traits of the student. Such insights are needed to help tailor a specific approach in terms of equipment and teaching style. Assessment never stops throughout the lesson. What you learned initially may determine how you start a lesson, but always be ready to change your approach as you learn more when teaching.



Photo courtesy of Eileen Carey

Chapter 3. Teaching Skiing Basics

Adaptive Stand-up Skiing

To perform stand-up cross-country, students must have two functioning lower appendages, whether their own feet and legs or prostheses, and, in most cases, two functioning upper appendages. Cross-country skiing with one arm is possible and does not require specialized equipment or techniques. Skating or classic skiing with no arms is also an option.

One issue that adaptive instructors commonly face is misalignment of the skis due to asymmetrical leg length or hip position or position of the feet relative to the legs or prosthesis device(s). Depending on the nature of the disparity, a good prosthetist or ski repair shop working with the skier and instructor can usually remedy the problem and make appropriate adjustments over time.

Otherwise, the basis for adaptive Nordic skiing is the same as with able-bodied stand-up skiing. As with able-bodied skiers, there will be unique needs and capabilities for each skier that may require special communication or other teaching skills.

Equipment and Fit

Making sure your student has quality equipment that fits well is an important step to having an enjoyable and high quality ski experience. There is different equipment for skating and classic skiing and students will have the best experience if they have the correct equipment. Length and flex of skis, length of poles, and stiffness and stability of boots are different in classic and skate equipment and for those reasons equipment is not easily transferrable between disciplines. Here are some basic tips for making sure that equipment fits well:

Boots: Students should have boots for the discipline they will be practicing. Skate boots have stiffer soles and higher ankle cuffs to provide more stability. Classic boots tend to be lower cut as high ankle stability is not as important with the demands of classic skiing. Soles are more flexible as the classic stride necessitates constant bending movement of the foot. Combi boots, which can be worn for classic or skate, could be an option for some students. It is important to note that these boots often do not provide the same level of ankle support for skating, so people with ankle stability issues should skate in skate boots. Combi boots do tend to have more stability than classic boots, so they may be a better option for people with stability issues that want to classic ski.

Boots should fit snugly, without heel movement while walking, like a running or walking shoe. For skiers with a prosthetic leg, you may need to add padding or make other adjustments to make sure the foot snugly fits in the boot. In the case of a tight fit, you may find it useful to put the prosthetic foot in a plastic bag for ease of removing the boot at the end of the ski session.

Poles: Variations in pole height will occur among skiers as they develop personal preferences and play to their strengths. Here are some good guidelines to start with: classic poles should fit uncomfortably under the skier's armpit and skate poles should reach between a skier's chin and nose.

Skis: Generally, skate skis are shorter and stiffer than classic skis (there is usually about a 10cm difference between a skier's classic and skate skis). To choose the right ski, skier's need to consider both their weight and height. Weight is the most important variable because the flex of the ski needs to be appropriate in order to ensure good kick for classic and good glide for both classic and skate. Once the proper flex is considered, it is important that the skier can maneuver the skis. Many touring skis are sized shorter to make them more maneuverable for less experienced skiers and have sizes SM-XL with weight recommendations for each size. These are often good options for a beginner recreational skier. Recreational classic skis also typically have a waxless or "fishscale" base. This ensures good kick over a variety of terrain. Skiers interested in racing or who like the idea of skiing at higher speeds may have a more enjoyable experience with a waxable classic ski. It is important to note that good waxing is an important component to having a good experience so either you as their instructor, someone else in your program, or an on site rental shop should have good waxing experience to be able to choose and apply the optimal kick wax for the conditions of the day.

Other Stand-up Adaptive Equipment: For skiers who have difficulty balancing or who have frequent spasms that might make skiing standing up more challenging, there are equipment options that increase stability. The cross-country equivalent of a slider is a walker mounted to skis. Since walkers are adjustable, they can be sized for participants of different heights. The spacing of walkers allow for skiers to ski in the tracks, with the walker on either side of the tracks. The walker ski as it appears in the photo below only works for classic skiing. The walker is mounted to short skis so it is possible to snowplow while using it, but beginner skiers should get comfortable with the equipment on a flat area before moving to any hills.



Skier using a walker ski. Photo courtesy of Eileen Carey

Beginner Ski Lesson Components

The following are basic elements of a beginner ski lesson. Remember, every student is different and it may take some skiers several sessions to be comfortable with these skills, while others may not need to go over every aspect of the lesson as described here. If a student can accomplish a skill safely, it may be more important to move to another part of a lesson or skill to make sure they have an enjoyable experience. This tends to be especially true for kids, who may learn many of the skills mentioned here by playing a game, rather than addressing the skills systematically.

1. Getting in and out of equipment (on flat open terrain):

Show how the boot tip connects to the binding on the ski. Help student stabilize while they do this the first time and until they get the hang of it. Put on poles, by placing hand up and through the bottom of the pole strap, then grip handle. Adjust strap so top of handle is just above the top of the hand. Poles straps should be tight enough that your student can extend their arms behind them with open hands and the poles should be suspended in the air. If the pole drops to the ground, the strap should be further tightened.

2. Review basic ski body position (see beginning of “Technique” section):

This is a great chance to assess the capabilities of your skier. For example, if they have a prosthetic leg, getting into proper body position is a way to learn the capabilities of the leg. You can do this inside (especially on a cold day) or outside before getting into equipment. Since it is easier for students to get into good body position while standing still and without the distraction of equipment and other variables, you will be able to better recognize the capabilities of the skier and the leg. Remember this as the lesson progresses since it will inform how you approach certain skills and will also help you determine whether difficulty with a skill is attributed to the limitations of the prosthetic limb or disability, or just a normal part of the learning process.

3. Getting up after a fall:

If you have a skier who is nervous or has few athletic experiences to draw from, you may want to complete this inside first. Have a skier remove one ski and then move away from it. Have them bend at the ankles knees and hip to lower themselves to the ground so they can fall easily to the ground. Once on the ground have them lie on their back and raise their legs in the air above them so they can untangle skis if needed. Place skis to their side parallel to each other and about hip width. Have skiers remove their poles. When they get close to the ski tip have them raise the leg under their chest that does not have the ski on. Now that they are in a kneeling position they can grab their poles in the middle and get ready to stand up. You can use the same process next time with both skis on. Don't forget you can always take both skis off and stand up if it is difficult for the student to bend their knees hips etc.

4. Stationary turns (also known as tip, tail or star turns):

Draw a circle about 11/2 ft in diameter and have skiers move around the circle in each direction, making sure their ski tips remain just outside, but in contact with the circle. Do this first without and then with poles so they get use to coordinating the equipment and movements together. You may explain this V they are making will be used later to slow down and give a wide stable stance when needed. Names like wedge, snowplow etc. can be coined. Now have skiers turn 180 degrees so their tails are touching the circle and repeat the drill in both directions. Mention that this open V is what they will use to be able to climb steep hills and is also called a herringbone.

5. Stopping and slowing down:

Stand on one left ski so right ski and side are light, then twist the right ski tip in, making a half wedge or snowplow. Switch and do the same thing to the left leg. This is a half snowplow and can be used to slow down when skiers are in tracks. Have your student get some speed up in tracks and practice slowing down by using the half plow. Now, outside of the tracks, twist feet so the toes are pointing toward each other, the tips will close and the tails of your skis will be open and have a wider distance between them than the tips. This is a wedge or snowplow. Have them get in and out of this position, staying in place. Next, have them try it on a slight decline. Legs should be bent and not knock kneed. Skis should be on their edges. Practice with different size wedges 1 being small and 5 being large and explain that the bigger the wedge, the more stopping power they will have.

6. Skills for hills

Diagonal Uphill Walking: If the hill is not too steep you may be able to walk up it as you do on the flats. Simply adjust your stance to be more vertical so your torso and hips are directly above your feet. The pole swing takes a shorter arc and the leg swing quickens to adjust for the difference.

Herringbone: As uphill gets steeper, skiers will eventually need to get into a more stable position, in this case, the "herringbone". Review stationary tail turns again to review herringbone or open V position. Have your student role knees in slightly and begin to walk on the inside edges of their skis with their body in the middle and leaning forward at the hips. Try this first with no poles, and then add poles to their side and slightly behind them so they can use them to push off with. Start with a small climb (remember, they will have to come down it!)

Sidestepping: If skiers are hesitant about climbing a hill, you can teach them to climb by placing skis across the hill so you can take one step sideways up the hill and then bring the next one to it. Have the skier edge into the hill with the uphill side of both skis to allow for greater traction. This technique is by far the least efficient and most cumbersome of the climbing techniques so should only be used if the student is uncomfortable with or having a lot of difficulty with other climbing techniques.

Turning around on a hill: Start the Bullfighter turn by placing poles directly down the fall line (the direction a ball would travel if you let it roll where you are standing) while you place your hands on top of the end of the pole. Push away from them and then perform a stationary tip turn until you are facing the direction you want to be. Practice on the flats before going up the hill.

Basic tips for descending: Review proper body position and stress the importance of a low body position, bent knees and forward lean from the hips. This will lower the skier's center of gravity, making them more stable. The athletic body position will allow them to react to any changes in the track or terrain. Hands should be in

front of them, as though they are holding onto a steering wheel. Most falls on hills occur when a skier is scared or is thrown off balance and reacts by standing up and raising their hands, thereby shifting weight back. If your student falls back, this is likely what is happening. Hands are a good indicator of what the body will do, so teaching them to keep their hands on the wheel will help to maintain good body position and will also help them steer around corners.

Have your student practice descending on a slight decline with a straight run out, using the skills mentioned above. Find a hill small enough that they can descend comfortably without having to slow down. As they become more comfortable, have them move further and further up the hill so they have more speed coming down.

Wedge turns: Once the skier is comfortable with the basic descending body position, they can practice turning while descending. While descending in a V position, have the skier steer toward the direction they want to go. This will shift their body weight to the inside of the turn and drop their outside ski to a skidding position. The more they want to slow down, the more they can put pressure on the inside edge of the outside ski.

Sideslipping: When a student is climbing a hill by sidestepping, they can stay in that position and descend by sliding sideways down the hill. Take a hip width stance and try to flatten the skis with your ankles legs so they are flat and slide sideways. This is called sideslipping. To curb speed, they can simply edge the uphill side of both skis into the hill, just as they did while climbing. If this is too difficult just step down the same way you went up. Just as with sidestepping, this is a technique that should be used if the skier is unable to descend another way.

*When in doubt or in trouble take skis off climb up/down.

7. Step Turns

Step turning is used for rounding corners on either skate or classic skis, when a skier has relatively high speeds. These turns take a high level of balance and control on thin narrow skis, but can be very useful on terrain you are comfortable with. Skiers must have some speed to properly step turn. Simply begin lifting the leg and ski that is to the inside of the turn and point it so you are following the arc of the turn. Take small steps, first inside leg then outside leg until you have made enough mini steps to make it around the turn on the track. On skate skis, skiers can practice step turns by skiing around on a flat, groomed, open area and making figure eights or circles, practicing making a smaller and smaller circle, which requires quicker, shorter and more powerful steps.

Activities

These activities are great for beginner and experienced skiers alike and address skills all skiers can continually improve to make more efficient, powerful or technically sound. Note that there are more ideas for drills following each of the specific technique sections found later in this chapter.

The following activities can be done on both classic and skate skis:

- Call out fast or slow and have skiers shuffle to the command. Have them exaggerate the movements so fast shuffles are as quick (high turnover) as possible and slow are long strides with a long glide phase.
- Have tail and tip turn competitions.
- Jump in the air and into a wedge size that a person calls out.
- Play ultimate Frisbee, nerf football, minnows/whales, red light-green light, capture the flag, tag or soccer. If you can play it on foot, you can play it on skis! If possible, games should be played with no poles for safety reasons and also because skiers will more quickly and effectively learn balance, weight shift and maneuverability.
- Practice wedge turns on classic or skate skis by setting up a slalom course on a downhill with cones or ski poles and have skiers turn around the obstacles. This can also be done on a flat area to practice step turns.
- See how far you can glide before touching down and then try to beat your distance next time. Try doing it with your eyes closed.

- Take one ski and both poles off. The leg without a ski on can act like a scooter and pushes you forward. Go slow and light at first then pick up cadence and a stronger push. Remember it is how long you can stand on one leg and glide that is the challenge.
- Place one ski on and both poles. Stand on one ski and double pole as you glide on that ski. Do it in the track and out. Try doing it in a circle or figure eight. Stress that balance and efficiency will be best when skiers have a good forward and high hip position.

Stand-up Ski Technique¹

Body Position

Body position in all sport is important for enabling the athlete to apply power to each motion effectively and efficiently. For this reason body position in diagonal stride is similar to other ski techniques as well as to other sports.

•**Feet:** Center the weight across the ball of the foot. If the weight is too far forward onto the toes it will be hard to apply enough force through the kick. If it is too far back it will be hard to apply force quickly enough to be powerful. The skier's weight will shift toward the whole foot in the glide phase of this technique but will quickly shift back to the ball of the foot for the kick. Body position drills should focus on keeping the weight on the ball of the foot.

•**Ankles:** The bend in the ankles is vital to directing the power in such a way that the skier is propelled forward down the trail and not up in the air. The degree bend at the ankle is dependent primarily on terrain - the steeper the terrain the more acute the angle at the ankle. Also, the more force the skier is attempting to deliver the deeper the angle will be.

•**Knees:** The angle at the ankle must be closely mimicked by the angle at the knee in order to keep the skier's weight positioned over the feet where that force can be directed through the ski to the snow. Generally, skiers struggle to get the proper angle at the ankle rather than at the knee. What results is a knee angle greater than the ankle angle, which places the skier's weight behind the feet. This slows the speed of the kick, loads a great deal of weight on the quadriceps, and diminishes the amount of force applied to the kick.

•**Hips:** The hips must be high and forward. When it comes to body position this is accomplished by having the skier's weight over the balls of the feet, maintaining the proper ankle and knee angle, keeping the upper body in a "C" position and by maintaining a quick kick. Look for the hips to remain high and forward through the entirety of the diagonal stride cycle.

•**Core/Back:** The upper-body, from tailbone to head, should form a soft "C" shape. Think Neanderthal man, big foot, gunslinger. Do not think of the Queen of England or of the postural advice of your parents. This "C" position will help keep the hips over the feet, relax the lower back as well as position the muscles of the core to apply force to the poles. This "C" can be very shallow leaving the skier quite upright or rather pronounced putting the skier in an aggressive forward position. The depth of the "C" is also dependent upon terrain with most skiers adapting a more up-right shallow "C" position as the terrain becomes steeper. An "S" shape in the back is the most common core body position mistake and puts a lot of pressure on the lower back. This can also force the hips back. Another common mistake is to fold at the waist into an "r" position. This forces the hips back and makes it hard to deliver power to the kicking ski.

•**Shoulders:** Shoulders should be rounded leaving the arms hanging free and loose in front of the body. Even skiers who ski in a very shallow, upright "C" position should have a forward attitude at the shoulder. This position allows for a smooth pendulum swing of the arms as well as a good position from which to apply both body weight and force to the poles.

•**Arms:** In the neutral or starting position the arms should hang loose from the shoulders. The angle of the arm at pole plant should enable the skier to apply maximal force with the core and back as well as the weight of the upper body to the poles. This means that the arm will be much closer to 90 degrees in steeper terrain, and slightly straighter in more gradual terrain. At pole release the hand should be low. The follow through of the arm is dependent upon speed and terrain. The faster the skier is moving the longer the follow through. The shoulders and hands should reach forward down the track in front of the skier rather than across the skier's body or out to the

¹ This section (until "Teaching Visually Impaired Skiers") is compiled of excerpts from the following, with permission from the publisher: Vordenberg, Peter. "Technique, Level 100". *Cross Country Coaches Education Level 100*. US Ski and Snowboard Association. Park City, UT: version 1. From pgs 28-60. PDF.

side.

Power

Power results from force applied quickly. Power relies on being in a position that allows both the application of a skier's strength and the application of that strength over a short period of time. The above description of body position aims to put the skier in that position. Timing allows power development while maintaining the forward momentum of the skier.

The effective, efficient and repetitive application of power to the skis and poles is the goal of learning proper technique; this includes body position and timing. Once the skier can grasp the idea of proper body position it must be ingrained through repetition. This repetition will also develop the strength it takes to maintain this position and develop power from it. The practice of proper timing will help develop the speed of force application.

Classic Techniques

Diagonal Stride

Diagonal Stride is the first gear in the classical transmission. It is used when climbing steeper hills where double poling or kick double pole will only bog the engine down.

Timing

In all techniques the whole body works together to transfer the skier's weight from ski to ski and down the track. Timing of the diagonal stride mimics that of a running stride. The skier's opposite arm and leg are forward together. In skiing the upper-body contributes forward momentum by applying power through the pole as the skier glides, plants, compresses and explodes forward off the kicking ski thus propelling the skier down the track. At the same time as the kicking ski and poling arm pass back behind the skier the opposite arm and leg swing forward (just like running) adding forward momentum to the propulsion down the track. This technique uses the same timing as running but has the added power of the upper-body, and the speed and efficiency of the ski gliding on snow.

The term "kick" is used to describe the forward propulsion of the skier from one ski to the next (as in a runner striding from one foot to the next). This term is misleading, as the skier does not actually kick backwards any more than a runner kicks backwards. This "kick" could better be described as a jump or the propulsive component of the stride, but the term "kick" is utterly entrenched and will do fine.

The kick of the diagonal stride can better be likened to the explosive jump of a long jumper than the foot strike of a runner. In either case imagine the jumper or runner attempting to kick the foot back at take off. In actuality the foot and leg is left behind the athlete in the follow through after the jump or foot strike. The same is true for the skier. In fact the skier's "kick" is similar to the jumper's jump in that the foot is planted on the ball of the foot. The athlete then compresses down on the planted foot, and explodes forward off the foot down the trail or, in the case of the jumper, through the air. The time the jumper spends in the air is the time the skier is gliding. The more powerful the jump the further the jumper sails through the air. The more powerful the "jump" for the skier the further the skier can glide. The major difference is the direction of this jump - the jumper must orient some power into the air while the skier is oriented entirely down the trail.

This jumping sequence is so linked as to be a single motion containing all the elements of glide, plant, compress, explode, glide.

Power

The job of the kick in diagonal stride is two-fold. The first part is compressing the ski to the snow, which is vital to gaining the platform from which forward propulsion is performed. The second part is making that forward propulsion powerful enough to propel the skier further and faster than the competition.

A large part of this power comes from weight transfer. This could easily be put in the "body position" section. The entirety of the skier's weight must be over the gliding/kicking ski for the skier to both glide with relaxed balance

and apply maximal power to the kick. In fact, the ski will carry 100 percent of the skier's body weight in the glide and all the skier's weight plus the force added by the kick itself during the kick phase.

In diagonal stride the speed of the kick is of primary importance to power development. This is because the skier must execute the kick fast enough in order to stop the ski in the snow without interrupting their forward momentum. In the short period of time that the ski can be stationary while the skier is still moving forward, that ski must be planted, flattened against the snow, and loaded with the force of the skier's weight plus muscular strength (compressed) until the skier can finally explode forward off that foot onto the other ski. This entire sequence must be split-second fast, and that speed is the primary contribution to power in diagonal stride.

Power from the upper body is generated in a similarly quick application of force down onto the pole. The force is developed with a crunching motion of the core as well as the use of the lats and application of the upper body's weight onto the poles. This motion actually takes place over a longer period of time than the kick as the poling motion begins before the initiation of the kick. Nevertheless, power is still developed by applying this force quickly. To enable this, the poling motion should not be overly drawn out. The forward swing of the other arm is simultaneous to the poling arm. It should be swung low, relaxed and directly down the track so its momentum can be best be utilized.

Drills

•**Hot Feet:** The goals of the Hot Feet Drill are to teach the skier about proper hip positioning, weight transfer and correct stride length in the technique of diagonal stride. To achieve these goals, a 10-meter section of the track is marked on each end by a flag or a coach's pole. Be sure the terrain is steep enough to demand diagonal stride, yet gradual enough to support beginner skiers. Instruct the athletes to begin striding roughly 50 meters before the marked section begins. When they reach the marked section the skier runs on their skis from one marker to the next with quick but controlled tempo and no glide, and then skis out of the marked section with traditional diagonal stride for an additional 50 meters. The coaching point to look for in this drill is an improvement in hip positioning during the 10-meter hot-feet section, and within the final 50-meter section. The success of this drill is due to the mechanics of a normal running stride on dry land where the hips are high and only one foot is on the ground at a time. With high hips, the skier's weight is over the ball of the foot and is supported to a large extent by the near-vertical femur bone. From this position, the run, or quick falling forward from the ankles floats the skier from a good body position on one ski into a good body position on the other. Because the weight is falling forward from the ankles, the hips do not have the opportunity to sink back behind the heels. Ask the skier where they feel their weight. If it is over their heels, watch for sinking hips and a kick that is too long, or late. If the weight is over the ball of the foot during the kicking phase, expect to see good hip positioning. Finally, proper running technique emphasizes full weight shift from one foot to the next. Note that proper weight transfer should not be the result of the upper body tipping laterally from side to side, rather, the transfer happens subtly within the hips. This will ensure that the wax pocket is compressing firmly into the snow so that the ski does not slip backwards. This is a good way to teach transitions from gradual to steep terrain as well.

•**Minson's Last Dance:** The goal of Minson's Last Dance is to teach the skier about proper hip positioning and forward lean from the ankles within the diagonal stride technique. In order to accomplish this drill have the skier drop their poles and find a section of track that is flat or a gentle uphill grade. To emphasize the difference between high hips and hips that are sitting back, have the skier begin by standing still in the tracks, posed in a poor hip position. The skier can place their hands on their hips to gain a better feel of the proper positioning. Slowly, the skier should bring their hips higher and further forward so the body weight shifts from the heels to the ball of the foot. As this happens the skier will begin to fall forward from the ankles. With high hips, begin the forward propulsion by catching the bodyweight with one foot. During this catch the hips remain high and avoid sinking down and back. Continue to fuel forward propulsion by falling forward from the ankles. Left right, left right. Begin with a shuffle and no glide. Every five meters add several inches of glide over the course of 50 -100 meters until the skier has reached a full stride. Note that the length of the glide is not determined by the size of the step, but by the force with which that ski is driven forward. Coaches can observe the entire progression and look for a point in which the stride length becomes too long so that the good body position is overwhelmed by an over-stride resulting in sinking hips. If this occurs, try cutting the stride length down by several inches, or use the Hot Feet Drill. During Minson's Last Dance, the skier should also see to it that weight is fully transferred before kicking. A

good way to see this is that there should be only one foot on the ground at a time. With beginner skiers, the tendency is to stay safe and comfortable by keeping the weight in the middle. This will only weight both skis evenly with half of the body weight and will fail to compress the wax pocket. It is not always the coach that bombs the kick wax!

•No Pole and One Ski Drills: The goal of these balance drills is to stretch the skier's comfort zones by removing a stabilizing component from their skiing like poles or a ski in the technique of diagonal stride. The coaching points to look for in skiing with no poles are: 1) a relaxed upper body with rounded shoulders, proper arm and hand swing that if holding a cup of water would throw the water down the track and not up, across the body, or out to the side, 2) high hips, 3) weight that is over the ball of the foot and not the heel, 4) full weight transfer from ski to ski. Also look for a snappy kick that sets the wax sharply down into the snow before exploding off of the ski, but do not mistake this movement for a full-body bounce. If the terrain being used is either fast or on a gradual down, see that the skier is kicking quickly enough so that the wax can grab purchase in the snow. This is good timing and quickness training. To progress within this drill, try holding the glide for several seconds before kicking. For a little extra fun and to take balance to the next level, ski down a gradual hill on only one ski. It might be a good idea to keep the other ski on so that if balance wavers and the foot touches down, there is not a yard sale of poles, hats and sunglasses to clean up.

•Skipping: The goals of the skipping drill are to gain a better understanding of high hips, weight shift, balance, timing, and of a powerful kick in the technique of diagonal stride. To perform this drill, the skier might first want to practice skipping without skis on, so as to learn the proper timing of the drill. Proper timing in this drill involves completing each glide with a gentle and vertical hop or skip. As the skier comes down from the skip, the kick is initiated and the next glide phase begins. This drill accomplishes a few things. First, the skipping action insures that the hips are in a high and forward position. Additionally, the body weight that is driven down into the snow as a result of the skier coming down from the skip insures that the wax pocket is fully compressed into the snow for better kick. Remember, too, that more power not only means better kick, but longer glide as well. In the diagonal stride technique, full weight transfer over each kicking ski is imperative. This means 100 percent of the body weight is over the kicking ski, minus what is suspended by the pole. This weight is transferred into power when the kick initiates where a small amount of the power closes the wax pocket shut on the snow, and the majority kicks the skier forwards and down the track.

Kick Double Pole

Kick double pole is the second gear in the classical transmission. It is used on gradual uphill terrain when double pole would bog the engine down or diagonal stride would over-rev the engine.

Timing

In all techniques the whole body works together to transfer the skier's weight from ski to ski and down the track. The kick double pole begins with a double pole. This leaves the arms slightly behind the skier, the upper body in a relatively low position and the skier's weight spread evenly over both skis. The skier must then transfer all their weight to the kicking ski, plant, compress and explode forward off the kicking ski (as in diagonal stride) in absolute synchrony with the forward swing of the arms, the return of the upper body back to a high double pole position, and the forward swing of the back leg. The opposite leg becomes the kicking leg in the next cycle.

In kick double pole the kick is very similar to that of the diagonal stride kick. In the same way the kick can be likened to the explosive jump of a long jumper's jump in that the weight is planted on the ball of the foot, the athlete compresses down on the planted foot, and then explodes forward off the foot down the trail or, in the case of the jumper, through the air. In both diagonal stride and kick double pole the kick propels the skier down the track and onto the other ski and into an extended position. In kick double pole the skier is now gliding on one ski with both arms forward in a double pole position. The skier applies a double pole similar to a normal double pole.

Power

The job of the kick in kick double pole is the same as in diagonal stride. Just as in diagonal stride the speed of the kick is of primary importance to power development. At the same time weight shift is just as vital. Many people attempt to kick with their weight spread evenly over both feet in the double pole kick. All the skier's weight must

be on the kicking ski in order to apply maximal power to that ski. In fact the ski will receive 100 percent of the skier's body weight plus the force added by the kick itself.

In kick double pole the arm swing forward must be as quick as the kick itself. This powerful forward swing will help gain forward momentum. This brings the skier into a double pole position. In kick double pole the double pole will likely be notably shallower with less follow through and less upper body compression than in regular double pole. This is due to the technique being carried out on generally steeper terrain and the need for the hips to stay high for the kick portion of the technique.

Drills

•**Locked 'n Loaded:** The goal of the Locked 'n Loaded Drill is to teach the athlete about proper initiation of upper body power, the role of the core, the importance of the body weight falling forward from the ankles, and finally, proper initiation of power in the kick. These goals are accomplished by beginning the cycle with high hips and hands. From this position, the skier crashes onto the poles with a strong abdominal crunch to initiate the power. To isolate this impact, have the skier envision that their upper body is fixed in cement. The only flex point is in the core and in a slight bend in the knees. By eliminating the full release of the poles as typically utilized in the double pole technique, the skier now must rely on only the force of the impact and the strength of the core to generate forward propulsion. Because the upper body is locked, the retrieval of the poles and the lifting of the core to the high position are simultaneous. This generates forward momentum and causes the body weight to shift from the mid- foot to the ball of the foot, thereby initiating forward lean from the ankles. With the assistance of body weight now involved in the compression, the crashing onto the poles is more effective. Last but not least, let's take a look at the kick and link it to the retrieval of the upper body and poles. With a snappy retrieval, the kick also will be snappy, powerful and effective. What occurs in the upper body is reflected in the lower body, and vice versa. Be sure to weight the kicking ski with 100 percent of the body weight as the kick occurs.

•**Ankle Float:** The goal of the Ankle Float Drill is to teach the athlete about proper weight transfer, a powerful kick and good balance that are all required for effective kick double poling. To accomplish these goals the skier must recognize that to close the wax pocket firmly onto the snow, approximately 100% of the body weight needs to be applied to each kick in addition to the weight generated by the force of the kick itself. This weight transfer does not happen by tipping the upper body over the ski. Rather, the weight is shifted through a subtle hip movement from right to left, left to right. To execute this drill properly, abbreviate the return of the leg after it has completed its kicking motion. Leave the ski suspended briefly behind the gliding leg, or floating lightly in the track if proper balance is a drill-prohibitive challenge. In either case, there is little or no weight riding on the returning ski, and 100 percent of the body weight is applied to the kick, thereby setting the wax firmly in the snow and finding a solid purchase so as to propel the skier down the track. Again, the motion of the kick is a quick but powerful pop down into the snow that grabs the frozen crystals and sets the wax, thereby allowing a powerful bound forward onto the glide ski. If proper balance is a challenge after lowering the height of the suspended ski, try the drill in slower snow or slightly steeper terrain.

Double Pole

Double pole is the third gear in the classical transmission. It is used on gradual uphill and downhill terrain where kick double pole and diagonal stride will over-rev the engine.

Timing

In double pole the upper body is used to apply power onto the poles to propel the skier down the trail. The key to double pole timing is in the application of power to the poles. With the arms and body in the proper position the body weight falls on top of the poles as the core contracts, thus crunching down powerfully on top of the poles. The back and arms simultaneously push on the poles. This application of force must be quick and timing tight in order to be maximally powerful. The return of the upper body to a high start position is also important to this technique. The forward arm swing must be dynamic and in synchrony with the return of the upper body to a high position in order to gain forward momentum and in order to return to a high position quickly and smoothly.

Power

A good mantra for double poling is "high hands." The power position in double pole is with hands high, arms at 90

or less degrees, poles against or nearly parallel with the forearms, and body leaning from the ankles dramatically forward. From this start position the body weight will crash down onto the poles, the core will crunch and the arms and back will contribute force simultaneously. The poles will connect with the snow delivering all this power directly to the snow. With the arms held in tight there will be minimal power lost to a collapse of the arms, and the forward movement of the skier will push the tips of the poles back and the handles down translating power to forward movement.

Hands that start low steal most of the body weight as well as the ability of the core muscles to do their job at the start of the poling motion. At the same time the skier will not be able to seek as great a forward lean. While the pole angle more immediately translates to forward motion (baskets planted further back) there cannot be as much force applied to the poles. This force is applied late in the cycle and leaves the skier in a very low finishing position. It should be noted that the arms can be planted at straighter than 90 degrees. In this case, however, some of the applied force will be given away as the arms collapse to a structurally strong position. The force in this case cannot be applied as quickly, thereby resulting in less power. Cycle time will also increase making it difficult to maintain momentum as the terrain goes uphill.

Drills

•**Standing Broad Jump:** The goal of the Standing Broad Jump Drill is to teach the athlete about the importance of proper timing in the retrieval of the poles back to the high position in the double pole technique. To achieve this goal, have the skier take off their skis or roller skis and poles and visualize a standing broad jump. Now have the skier perform two jumps. The first jump retrieves the hands to a high and forward position after the feet have landed. The second jump retrieves the hands as the jump happens, or rather, simultaneously with the lifting of the upper body—just like a standing broad jump. Compare the two distances. The latter of the two jumps will be longer and the movements more efficient. Proper timing of hand retrieval in double poling can be likened to the form used in a proper standing broad jump. The snappy forward and upward momentum generated by returning the hands and lifting the upper body to the high position in unison does several things. First, the body stretches out like an elastic band, pulling the hips forward and the hands high so that the skier is ready to perform a powerful compression. If the hips do not come completely forward, the spring that is the body will not be fully stretched and ready to snap effectively into the power phase. Additionally, the momentum generated in a timely and snappy return will cause the skier to fall forward from the ankles. With the assistance of body weight now involved in the compression, the crashing onto the poles is all the more effective.

•**Bathroom Scale:** The goal of the Bathroom Scale Drill is to demonstrate the importance of proper upper body position in the double pole technique and how it pertains to power application. This drill is named as such because a skier can perform the exercise without the assistance of a coach, simply by using a scale. Be sure to put a board down on the scale so carbide tips do not get the skier in trouble, and so that the poling technique is not hampered by a narrow scale. To achieve the goal of this workout the athlete extends their arms straight out in front of them with little or no bend at the elbow. The coach supports the hands, or the scale supports the tips, as the athlete drives downward in a double poling motion. Now adjust the hands and arms of the athlete to a proper double poling start position. That is, hands are high with the pinky finger roughly even with the eyes, and also shoulder width apart. Elbows are bent at approximately 90 degrees and shifted comfortably away from the centerline of the body. This time the coach supports the elbows or holds the skier's wrists as they drive the upper body down into a double poling motion. The scale can be used in the same manner as earlier. The difference in power will be overwhelming as the latter drill is far more forceful. The factors at play here have to do with the structure of the hands and arms. High hands with elbows bent at 90 degrees allow for a strong support system, and body weight can momentarily hang on the poles for more power, whereas arms straight out in front eliminate the role of body weight in the poling motion. In addition, elbows shifted comfortably away from the centerline activate and add strong Latissimus Dorsi muscles to the poling motion. Another way to look at this positioning when out double poling is to extend the hands and arms straight out in front of the body. Instead of bringing the hands in toward the body, bring the body toward the hands and into a strong position by falling from the ankles. This is your forward lean. Now the skier can apply the Bathroom Scale drill to snow.

Skating Techniques

V1

V1 is the first gear in the skating transmission. It is used when climbing steeper hills where V2 or V2 alternate will only bog the engine down.

Timing

In all techniques the whole body works together to transfer the skier's weight from ski to ski and down the track. The V1 technique is described in terms of the hang arm. If it is the skier's left hand that is placed high and next to the head at the start of the poling motion, the hang side, also called poling side is the left side.

On the poling-side the entire upper body and poling-side leg push simultaneously down and over to transfer weight to the non-poling side. There is little to no time spent inactively gliding in the V1 technique. As soon as the skier's weight is shifted onto the non-poling side the arms begin to swing back up and forward as the skier begins the push-skate back onto the poling side. When the skier transfers weight back to the poling side the poles and poling-side ski meet the snow simultaneously. While for some skiers the poles plant a little earlier than the ski, and for others the opposite is true, for most it is simultaneous. In all cases the push from each leg is as equal, smooth and powerful as possible and the use of the upper-body is dynamic through a relatively shallow compression and short follow-through.

Power

Power is developed on the poles through the application of body weight to the poles. This happens through the dynamic use of core, back, and to a lesser degree the arms themselves. A lot of power comes from the upper body in the V1 technique. Some skiers rely more on the upper body than others. A common mistake is to let the use of the legs suffer by focusing too much on using the upper body. Ideally, as is the case with all techniques, the whole body not only works together, but the work of one complements and aids the work of the other.

Power to the skis is achieved through a push position similar to that used by speed skaters. Whereas in the classical diagonal stride the ski must stop for the kick, in skating the skis must never stop. The biggest error in V1 power application is a weak-side – strong-side approach. This means relying on the poling side to build momentum or power and using the non-poling side as a recovery side. This results in a loss of momentum on the recovery side. It is much more efficient to maintain momentum than to build it, lose it, and build it again. This is similar to what cyclists call peddling in squares where you only apply force on the down stroke. The best cyclists apply force around the whole circle resulting in smooth continuous power and often, as in the example of Lance Armstrong, at a higher cadence.

While the cyclist peddling in squares can still rely on the downward-bound leg to apply force while the upward-bound leg rests the skier has nothing to maintain momentum with while on the recovery side. Generally the weak-side approach means the skier will stand up or peg- leg on the recovery side leg. The weak-side ski decelerates as the skier stands up on it. To correct this the skier must focus on driving with the non-poling side knee as soon as that ski hits the snow and until weight is transferred back to the poling side. The skier may look at this concept as a volley of the body weight back and forth, like a tennis ball, in which the legs are the rackets. Being dynamic with the return of the arms to the poling side and synchronizing that arm swing with the skate will help maintain momentum on the non- poling side.

A large part of power development comes from weight transfer. Optimally the entirety of the skier's weight must be over the gliding/pushing ski for the skier to both glide with relaxed balance and apply maximal power to the skate. In skating, weight transfer is achieved through the shifting of the hips from side to side. Many focus exclusively on shifting the weight with the upper body. This can result in a tipping or twisting of the upper body but no real weight transfer. The body's mass is best moved by shifting the hips.

In all skate techniques complete weight shift, where the skier is actually directly on top of the ski at the beginning of the push phase, can compete with the need to shift weight more quickly to avoid bogging down on steeper terrain. This is especially true in the V1 technique because it is used almost exclusively in steep terrain. One way to accomplish both good weight transfer and maintain momentum is to keep the feet in a wide position and never

letting the feet come close together. When this is the case the skier's body will stay inside the feet and the skier will never be directly on top of the ski. Weight shift will still be effective however, so long as the hips are shifting from side to side and pushing against one ski and then the other.

Drills

•**Minson's Last Dance:** The goals of Minson's Last Dance are to teach the skier about proper hip positioning and forward lean from the ankles within the V1 technique. In order to accomplish these goals have the skier drop their poles and find a section of corduroy that is flat or a gentle uphill grade. To emphasize the difference between forward hips and hips that are sitting back, have the skier begin by standing still and posed in a poor hip position, sitting back, with skis in a V. The skier can place their hands on their hips to gain a better feel of the proper positioning. From this poor position the skier should press forward with the knees bringing the hips forward over the feet. It is important that the knees press forward creating a sharp ankle flexion. As this happens the skier will begin to fall forward from the ankles. With hips that are forward over the foot, begin the forward propulsion by catching the falling body-weight with one small skate step. In order to maintain proper body position, as the skier moves forward the step from ski-to-ski must be kept small and all attention must remain on the fall forward at the ankles. Left right, left right. Begin with a short glide. If the skier is able to maintain a good position they can gradually add several inches of glide over the course of 50 meters until the skier has reached a full skate. The coaching points to watch for are complete weight transfer from left to right. With beginner skiers, the tendency is to stay safe and comfortable by keeping the weight in the middle. Also watch the hip and see that it remains over the mid section of the foot. If the hips fall behind the foot then the skier should press the knee further forward. Remember, it is the forward lean from the ankles within the V1 technique that drives forward propulsion.

•**Saddle Feet:** The goal of the Saddle Feet Drill is to train the skier to utilize even kicking from side-to-side as well as maintaining momentum by moving from skate-to-skate in the V1 technique. In order to accomplish these goals, the skier should drop their poles and find a gradual uphill. Poles can be added later. In an effort to skate evenly and maintain momentum the skier should experiment with two trials. In the first pass, have the skier skate up the gradual hill in V1 and bring their feet close together to the point that they are clicking their heels just prior to setting down the glide ski. Observe the skiers and be sure they are aware of how this feels. In the second pass instruct the skier to ski the same section but do not let the feet come close together at any time of the skate cycle. In this drill the height of the skier will affect how wide their stance should be, though somewhere between 1 1/2 and 2 feet will suffice. In a race the terrain will dictate feet width where the steeper the hill the wider the feet will stay. That is, when the glide ski is set into the snow, the feet are 1 1/2 to 2 feet apart. Compare the two passes. With narrow feet, weight transfer may seem to be simpler but in fact that is only because the feet come in under the skier rather than the skier getting over the foot. The difference is that when the foot is directly under the skier there is no leverage to apply force to the ski. Even if the leg is loaded and in a strong position any kicking motion will only push the skier straight up. With saddle feet the ski is set down in a position that immediately allows the skier to laterally kick their weight over to the other ski. It should be emphasized again that by using the saddle feet stance, weight transfer becomes a matter of moving the hips from side-to-side rather than leaving the hips in the middle and attempting to bring the feet in under them.

•**No Pole Drills:** The No Pole drills are actually a bit of a misnomer as the skier will use the poles as indicators of whether or not they are twisting in the core or tipping over in the upper body in the V1 technique. Let's first take a look at holding the poles horizontally in front of the skier, perpendicular to the direction of travel. The goal is to skate up a section of trail without twisting the upper body. A twist will quickly be evident if the poles stray from their position of being perpendicular to the direction of travel. If a twist is detected, it is important to quiet the excess movement in the upper body as the important motion of the upper body movement in the V1 technique is a quick and shallow compression downwards and a lateral shifting of weight. Now, let's stand the poles on end so that they are parallel with the skier's spine. Using the same stretch of trail and remembering not to twist, skate up the trail and observe any tipping motion to the left or right in the poles. If this is happening the skier is attempting to shift their weight by tipping the upper body over the ski. However, this weight transfer should come first from the hips as they are kicked back and forth over each gliding ski. Using core strength and stability the upper body should remain on top of the hip platform, as if the shoulders and hips form a panel, thereby insuring that the body's mass is shifting from ski to ski and not just the mass of shoulders and head. These no pole drills are also great specific strength training in for the lower body. To maintain proper position core strength is also important.

V2

V2 is the second gear in the skating transmission. It is used in flat to uphill terrain where V1 would over rev the engine and V2 alternate would bog the engine down. All skate techniques have small variations that make them more versatile over different terrain. This is especially true for V2 and V2 alternate.

Timing

In all techniques the whole body works together to transfer weight from ski to ski and down the track. In V2, the upper-body pushes in a double pole motion as the skier pushes simultaneously with the skating leg onto the gliding ski. The double pole and the skating push is complete as the gliding ski hits the snow and the skier's weight is transferred to that ski. While the skier is gliding, the arms and whole body return to the high position to initiate the double pole and skate-push that will take the skier back onto the initial ski. In this way the V2 technique is entirely symmetrical, with the upper and lower body working together and in the same way on both sides. The push from the upper-body must be dynamic and powerful and the depth of compression variable depending on terrain. The skate push with the legs must also be dynamic and from a high to low position.

The biggest mistake in the V2 technique is a matter of timing. Often skiers will attempt to pole down the skating leg like a one-legged double pole, complete or nearly complete the poling motion and then begin the skating motion with the leg and weight shift to the other leg. To correct this the skier must remember that the whole body works together at all times to transfer weight from ski to ski and down the track.

Power

Power is developed on the poles through the application of body weight to the poles, and the dynamic use of core and back. To a lesser degree, the arms themselves also add power. A lot of power comes from the upper body in the V2 technique. Some skiers rely more on the upper body than others. A common mistake is to let the use of the legs suffer by focusing too much on using the upper body. Ideally, as is the case with all techniques, the whole body not only works together but the work of one complements and aids the work of the other.

Power to the skis is achieved through a drop of weight down on to the ski from a high position into a push position similar to that used by speed skaters. Whereas in the classical diagonal stride the ski must stop for the kick, in skating the skis must never stop. Therefore, the skier will not spend time on a straight leg, but will glide with proper angles at the ankle and knee and then use the rise onto a straight leg as a quick initiation for the skate push. Being dynamic with the return of the arms to a high position helps enable this quick initiation. Just as in double pole, this arm return will lend forward momentum to the skier.

A large part of power development comes from weight transfer. Optimally the entirety of the skier's weight must be over the gliding/pushing ski for the skier to both glide with relaxed balance and apply maximal power to the skate. In skating, weight transfer is achieved through the shifting of the hips from side to side. Many focus exclusively on shifting the weight with the upper body. This can result in a tipping or twisting of the upper body but no real weight transfer. The body mass is best moved by shifting the hips.

In all skate techniques complete weight shift, where the skier is actually directly on top of the ski at the beginning of the push phase, can compete with the need to shift weight more quickly to avoid bogging down on steeper terrain. This can even be true in the V2 technique because while it is a technique where complete weight transfer is mandatory, at high speed it is still used in uphill and even steep terrain by strong skiers. Just like in the V1, a good way to accomplish both good weight transfer and maintain momentum is to keep the feet in a wide position by never letting the feet come close together. When this is the case the skier's body will stay inside the feet and so the skier will never be directly on top of the ski. Weight shift will still be effective, however, so long as the hips are shifting from side to side and pushing against one ski and then the other.

On faster or flatter terrain the skier should seek complete weight transfer. At the start position of the technique the skier will be completely over a single ski. While many skiers begin transferring their weight prior to initiating the skate/poling motion, the way to maximize power is to begin the initiation of the poling motion and skate with the weight directly over one ski. This will feel like the weight is dropping directly down on the ski and poles. This drop initiates the immediate transfer of weight to the other ski.

Drills

•**Locked 'n Loaded:** This drill will teach the athlete about proper initiation of power, the role of the core, the importance of the body weight falling forward from the ankles, and synchronizing the timing of the upper-body compression and the kick in the V2 technique. These goals are accomplished by beginning the cycle with high hips and hands, just like in double poling. From this position, the skier crashes onto the poles with a strong abdominal crunch to initiate the power. At the same time the skier initiates the kick by dropping their weight down onto the kicking leg. Once the skier can time this drop onto the poles and the ski they may use that drop onto the ski to initiate the transfer of weight to the other ski. To isolate the powerful impact of the poles have the skier envision that their upper body is fixed in cement so that their arms do not move relative to their core. The only flex point is in the core and the lower body. By eliminating the full release of the poles as typically utilized in the V2 technique, the skier now must rely on only the force of the impact and the strength of the core to generate forward propulsion from the upper body. This short and powerful compression will catalyze a quick and snappy kick. Because the upper body is locked, the retrieval of the poles and the lifting of the core to the high position are simultaneous. This generates forward momentum and causes the body weight to shift from the mid- foot toward the ball of the foot thereby initiating forward lean from the ankles. With the assistance of the body's weight now involved in the compression, the crashing onto the poles is all the more effective. To demonstrate how this drill applies to full-scale V2 start with the Locked 'n Loaded drill and gradually progress to a full V2. Be sure the skiers maintain a snappy kick and powerful upper body compression.

•**Agility and Stability:** The goal of the agility and stability exercises is to challenge the skier's comfort level as it pertains to balance and coordination. To accomplish this goal begin each exercise on easy and slower terrain to allow the athlete to develop better confidence in their balance and a feel for their skis. For gliding drills the skier should focus on riding a flat ski. To do this center the upper body over the glide ski hip, which is centered over the knee, which is centered over the ski. Core stability and strength are a chief component in mastering this skill. The next evolution of this drill is to add two poling motions on each side of the V2 technique. This will force a longer glide and will help the skier develop comfort and patience in staying with the glide ski until it is time to simultaneously compress and kick to the other side. All too often the skier will fall away from the gliding ski before they have initiated the kick or achieved a good start position with the poles. This will partially unload the leg before the kick happens, much like unloading your gun and then trying to shoot the deer. In addition, the poling motion or compression will be off-balance. Timing is everything and balance is a crucial ingredient. The skiers must be comfortable throughout these drills with the idea of failing. It is okay to fall down, and is in fact mandatory that they occasionally lose their balance. This is the sign that they are pushing their own limits. What is not okay is staying within the comfort zone and failing to present challenge. Even the very best skiers must push their basic limits in order to improve.

V2 Alternate

V2 Alternate is the third gear in the skating transmission. It is used in gradual terrain where V1 and V2 would over rev the engine. All skate techniques have small variations that make them more versatile over different terrain. This is especially true for V2 and V2 alternate. The V2 alternate and a V2 alternate/V1 hybrid is being used on steeper and steeper uphill terrain.

Timing

In all techniques the whole body works together to transfer the weight from ski to ski and down the track. In V2 alternate, the method of propulsion on the poling-side is exactly the same as it is in V2. The upper-body and lower body compress together to transfer weight to the gliding ski. However, in V2 alternate the skier does not return to a high position on the gliding ski but stays in a relatively low position. The return to the poling-side is accomplished from this lower position with a skating push aided by the momentum of the arms swinging up, forward and back over to the poling-side ski. The synchronization of this forward arm swing and skate push is integral to the effectiveness of this technique.

V2 alternate and V1 are similar in that there is a poling side and a non-poling side. That is why it is called V2 alternate. Skiers use the V2 on the poling side but the advantage of this technique occurs on the non-poling side. While the skier is gliding on the non-poling side ski the arms are behind them. The skier rides that ski in a

relatively low position. From this position the arms swing dynamically forward in synchrony with a powerful skate push back onto the poling side ski. The synchrony of the dynamic arm swing and skate push is what makes this technique so fast. On the poling side the whole body returns to the high position to initiate the double pole and skate-push that will take the skier back to the non-poling side. While the V2 alternate utilizes the double pole on only one side it is symmetrical in that the upper and lower body work together powerfully on both sides.

As in V2 the push from the upper-body must be dynamic and powerful and the depth of compression variable depending on terrain. The skate push with the legs must also be dynamic and from a high to low position. On the non-poling side the arm swing is always a dynamic and non-stop motion.

The biggest mistake in the V2 alternate technique is a matter of timing. On the poling side skiers will often attempt to pole down the skating leg, like a one-legged double pole, complete or nearly complete the poling motion and then begin the skating motion and weight shift to the other leg. To correct this the skier must remember that the whole body works together at all times to transfer weight from ski to ski and down the track. On the non-poling side skiers tend to make the same mistake they make in V1. They use the non-poling leg for recovery. This not only kills momentum in the glide but also does not enable the arms or leg to work together in shifting weight back to the poling side. The arms will not swing dynamically from the follow-through position, and the skier will simply fall back over to the poling side rather than skate back over to the poling side. This variation of the V2 alternate is very common and steals all power and speed from the technique.

Power

Power is developed on the poles through the application of body weight, as well as the dynamic use of core and back. To a lesser degree, the arms also add power themselves. A lot of power comes from the upper body in the V2 alternate technique. Some skiers rely more on the upper body than others. A common mistake is to let the use of the legs suffer by focusing too much on using the upper body. Ideally, as is the case with all techniques, the whole body works together where the contributions of the upper body complements and aids the work of the lower body, and vice versa.

In the V2 alt the upper body also contributes power to the technique in the arm swing. When the forward swing of the arms is timed with the skate push on the non-poling side and is dynamic and quick, the skate will be more dynamic, quick and powerful.

Power to the ski on the poling side is achieved through a drop of weight down on to the ski from a high position into a push position similar to that used by speed skaters. While in the classical diagonal stride the ski must stop for the kick, in skating the skis must never stop. Therefore the skier will not spend time on a straight leg, but will glide with proper angles at the ankle and knee and then use the rise onto a straight leg as a quick countermovement to the skate push.

A large part of power development comes from weight transfer. Optimally the entirety of the skier's weight must be over the gliding/pushing ski for the skier to both glide with relaxed balance and apply maximal power to the skate. In skating weight transfer is achieved through the shifting of the hips from side to side. Many focus exclusively on shifting the weight with the upper body. This can result in a tipping or twisting of the upper body but no real weight transfer. The body mass is best moved by shifting the hips from side to side.

In all skate techniques complete weight shift, where the skier is actually directly on top of the ski at the beginning of the push phase, can compete with the need to shift weight more quickly to avoid bogging down on steeper terrain. This can even be true in the V2 alt. While it is a technique where complete weight transfer is mandatory at high speed it is still used in uphill and even steep terrain by strong skiers. Just like in the V1 a good way to accomplish both good weight transfer and maintain momentum is to keep the feet in a wide position by never letting the feet come close together. When this is the case, the skier's body will stay inside the feet and they will never be directly on top of the ski. Weight shift will still be effective however so long as the hips are shifting from side to side and pushing against one ski and then the other.

On faster terrain the skier should seek complete weight transfer. At the start position of the technique the skier will

be completely over the poling side ski. While many skiers begin transferring their weight prior to initiating the skate/poling motion, the way to maximize power is to begin the initiation of the poling motion and skate with the weight directly over one ski. This will feel like the weight is dropping directly down on the ski and poles. This drop initiates the immediate transfer of weight to the other ski.

On the non-poling side the knee must continue to drive forward until the skier has completed the skating push. A variation on this technique allows a slight countermovement rise on the non-poling ski and then a quick drop down into the skate push position. This variation is used at cruising speeds and is very rhythmical and relaxing.

Drills

•**Speed Skater:** The goal of the speed skater drill is to generate full weight transfer from one ski to the next through the use of aggressive arm swing for the technique of V2 Alternate. To perform this drill properly the skier should swing their arms quickly from side-to-side without using poles - just as speed skaters do on the straightaway. The momentum generated from this arm swing directs and pulls the skier's body weight completely over each ski. See that the weight is being shifted completely not as a result of the head and upper body tipping over from side to side, but from the head and the upper body centered directly over their gliding foot. It is all in the hips. A coaching point to look for as this drill is performed is placement of weight over the foot. Weight should be over the mid section of the foot so the hips can remain in a forward position with weight supported by the skeletal system as much as possible. See that the skier rides a flat ski. If tipping of the upper body occurs a coach will be able to see from a head-on angle that the ski is on edge and the body is not in a structurally strong position.

Teaching Visually Impaired Skiers

As mentioned above, cross-country ski technique for standing skiers with disabilities, individuals skiing with two skis and one, two, or no poles, is virtually identical to the technique used by able-bodied skiers. Various disabilities will require slight nuances. Visually impaired (VI) skiers have a tendency to ski in a "guarded position" or with their weight back. This is understandable: if you have difficulty seeing where you're going, you're a bit cautious and not committed to being forward. With this in mind the movement analysis remains the same in both classic and skate technique when teaching VI skiers.

VI skiers are one group of stand-up skiers who require some special assistance. In competition, VI skiers are classified into three different categories: B-1, B-2, and B-3. An individual classified as a B-1 is totally blind with some possible light perception and a B-3 individual is considered legally blind. B-2's are in the middle and usually have a very narrow field of vision. B-3's are the least disabled in this category and have limited sight. Regardless of the classification or category, all disabilities are unique. Prior to instruction, it is a good idea to interview your student. Ask about their sight and whether they can see an image at a particular distance. This information will prove helpful to you later when guiding or instructing.

Providing assistance and paying attention to the immediate surroundings is very important while working with a VI student. Make sure to offer your arm when leading a student through doors, going down stairs, or walking to your ski equipment. Keep in mind you may be the eyes for this person.

Helpful Instructing/Guiding Hints

Often while instructing a VI student, it is easier to relay information through the use of analogies such as the hands of a clock. Mentioning to your student, "The tips of your skis are pointed at 12 o'clock. Now, keeping the tails of your skis together, I'd like to you to take small steps to your right until the tips of your skis are pointed at 3 o'clock." This is a clear and concise method of giving directions. Another suggestion for leading or guiding your student is to say, "Follow me, follow my voice." Continue talking so the student is able follow you by the sound of your voice. This is beneficial for guiding a VI individual to a trailhead, into a set of classic tracks, or out on the trail system.

Many times during a lesson your student may have difficulty locating the tracks. It is common for the right foot to end up in the left track or visa-versa. An easy solution to this problem is to explain the situation. Simply state, "Your right foot is in the left track. I'd like you to take your right foot and move it over to the right one-half step. Good, now bring over your left foot. Good, both skis are in, let's go." Another term for one-half step is "half track" to

the right or to left. Establish the communication method you will use with your student at the beginning of the lesson and be consistent.

Normally the most effective guiding is done from ahead of the VI skier. It's much easier to follow a sound or a voice rather than being told where to go. Guiding from the front takes constant communication and proper spacing between the guide and the blind skier. Since voice communication is continual, and the guide is frequently looking back over their shoulder, it's helpful to get into the habit of always looking over the same shoulder. It's easy to confuse left and right when looking back to check on your skier. For example, if your habit is to consistently look over your right shoulder and a direction change is needed to the right, then very little thought process is needed to relay this information.

Since the guide is the "eyes" of the VI skier, it is very important to keep proper spacing between the two of you. If the guide is too far out in front, then the skier cannot hear the information being provided. If the guide is too close, then the skier will be on top of you. Keeping a comfortable space between a guide and a VI skier is not easy so the guide should be a proficient skier with the ability to maintain roughly a ski length distance between them and the VI skier.

Sometimes, a guide will utilize a voice-activated speaker mounted on a fanny pack. This works well for the VI skier to hear more clearly, but it does not eliminate the guide's responsibility to be constantly looking back to check their skier.

Skate vs. Classic

VI skiers do well with both classic and skating, and each technique presents its own challenges. Classic skiing in well-groomed tracks is a bit easier because the guide and the skier are somewhat locked in, and the track will also serve to guide the VI skier along. Problems arise on corners and downhills, when the track has been lifted or when it has been washed out. As a guide, this is where providing clear communication is extremely important. Look down the track in order to assess its condition and be able to pass on the correct information. "We have a left turn coming up. I'd like a little more weight on your right foot. You may lose the track. Step left. Good!" It was mentioned above that VI skiers have a tendency to ski with their weight back. In addition to this VI skiers also have the tendency to make large steps when direction changes are needed. Emphasize small consecutive steps in the direction of travel.

Many VI skiers really enjoy skating. The feeling is much freer than classic technique, and there are no tracks to negotiate during a lesson or out on the trails. Being a guide while skating requires steadfast supervision and talking. The luxury of a track and a long straight-a-way offering a break from speaking does not exist.

A large, flat, well-groomed open area without obstacles is ideal for teaching a VI individual to skate. With this type of terrain a guide/instructor can allow the student to ski without the fear of leaving the trail or running into something. The guide/instructor will have the freedom to rotate, skiing in front, on the side, or in back providing instruction rather than focusing on giving directions.

Downhills

Depending on the skill level of your VI student, there are various ways to maneuver on a downhill. With a beginning skier locate a gentle slope with no obstacles and a straight out run. Initially, a guide may "hold" the VI skier. This is done from a tuck position, with the guide skiing along side of the VI skier and holding the pole immediately under the hand of the student. Allow the pressure of arm-to-arm, shoulder to shoulder, and flexibility with the knees and ankles to stabilize the VI skier. When the student feels comfortable with a gentle straight run, then the maneuver can be repeated on a slightly steeper slope. The guide may utilize a braking wedge on one ski to control speed. Eventually, it is important for students to learn a braking wedge to control their own speed.

Within international competition "holding zones" are designated on a race course when needed. Guides will normally ski in front allowing the athlete to control their own speed, or beside the athlete "holding them" and controlling the speed.

Sit Skiing

Students with more severe disabilities, especially involving paraplegia or loss of one or both legs without prostheses, are directed to sit skiing as their passport to Nordic skiing. Many skiers with leg amputations or other mobility impairments who walk, either using prostheses or not, may also prefer to ski sitting down, as they may find greater success and comfort in acquiring the sport. This is especially true of individuals who are interested in competing, as sit skiing is relatively less technically intensive than stand-up skiing, which includes both classic and skate techniques.

Equipment and Fit

Most adaptive cross-country skiers use a sit ski constructed of metallic tubing with restraining straps, a bucket or seat, and a removable ski mounting system. Frames are constructed in a variety of styles and are often custom built for skiers who are interested in a commitment to the sport.

The sit ski serves the function of a stand-up skier's boots and bindings by affixing the skier to the equipment in a way that transmits the skier's movements to the ski. The frame should hold the skier in a dynamic yet comfortable position that allows effective use of the musculature. Components of a sit ski include the following:

Seat: The fit of the skier into the seat should be as snug and comfortable as possible. The fitting of a skier to a sit ski can be compared to the snug fit of a boot to a stand-up skier. This means selecting a sit ski so that the hip area corresponds to the skier's hip width. Padding may be necessary to enhance performance and feel and to prevent pressure sores, common in people with spinal cord injuries. The students who require extra seat padding may sometimes use their wheelchair padding. The adjustable seat may be tipped forward or back depending on preference and optimal poling position. Straps augment the fit and enable efficient transfer of the skier's movements to the ski. Be sure that straps do not cross a collection bag or catheterization tube.

The height of the seat back is important. The seat back should be high enough to support the highest muscle group that has paresis. A seat back that is too high will limit range of motion and impair balance, rotary movements, and angulations. To brake and turn the sit ski, the student must be able to touch the ground with both hands at the same time. A frame lower to the ground enhances control and performance and makes it easier to right the equipment after a fall. Skiers with higher spinal cord disabilities may require a wide, flexible chest strap, depending on their ability to sit erect on their own.



Skier with truck support strap. Photo courtesy of Candace Cable

The foot brace, seat angle, and knee rest may be adjusted to create a 25° to 180° angle in the knees of the seated skier. A bend in the knees serves three purposes. Typically, skiers with high-level spinal cord injuries (SCI) should have a tighter angle of the knees, sometimes with knees being tight enough that the knees almost touch the chest. For these skiers, the acute knee angle serves three purposes. First, it improves circulation and reduces spastic contractions in the legs. Second, it forces the hips back into the seat for a more secure fit. Third, it allows skiers with little or no core function to stay in an upright position.



Sit skier with an acute knee angle position. Photo courtesy of James Upham

Some skiers prefer to sit in a position with their legs bent under them and their seat. Essentially the same position is used for double leg amputees, with the obvious difference that they have no lower legs to tuck under the seat. This position is possible for skiers who have core function, as there is little core stability provided by the seat. It allows for the sit skier's neutral position to be one of power and enables a more dynamic poling motion.



Double leg amputee position: high, forward, little back stability. Photo courtesy of James Upham

Two types of seats are commonly used: molded or canvas/mesh. A molded seat is typically heavier than a canvas

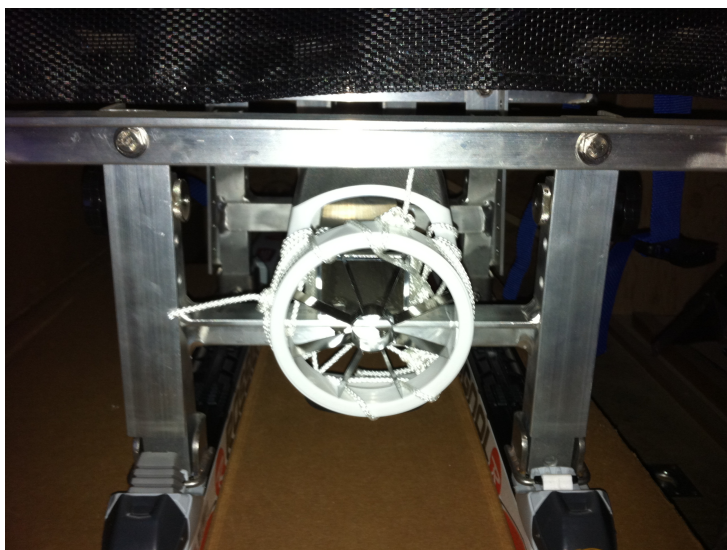
seat but keeps the skier better connected to the equipment. Most custom seats are made with a molded material. A canvas seat needs more straps to secure the skier. The flexibility of a canvas seat allows it to be used by a wider range of skiers, but can allow excessive movement that may impede precise control.

Bindings: Racers and serious recreational sit skiers use the same bindings used by stand-up cross country skiers, except that two pairs (or one pair for the front and a screw system for the rear) are needed instead of one to secure the frame to the skis. Because of the quick release system, these bindings, allow for ease of storage, transport, and ski waxing. They also allow the selection of different skis based on terrain, snow conditions, and type of activity planned on any given day. The bindings are mounted with the front mounting shoe placed roughly on or just forward of the balance point of the ski.

Skis: Ski length and type are a matter of personal choice as skiers advance. Longer skis (185 to 200 cm) provide extended glide at the expense of maneuverability. Shorter skis are easier for beginner/novice students but do not hold well at high speeds. Short stiff skating skis may not allow full contact with the snow, resulting in excessive sliding and reduced control. Softer skis are generally better for control and edging. When the student is seated, the mid-section of the skis should contact the snow. Skis should be waxed regularly to enhance glide. Spray or rub-on glide waxes are convenient, fast, and require little equipment. Waxless skis or waxing for grip should not be used.

Poles: Think of poles as extensions of the arms. Cross-country skiers need to use their arms and upper body for forward locomotion, turning, and braking. Appropriate pole length varies depending on terrain, ability and strength of the skier, and personal preference. To measure for pole length, have the student sit in the frame with the tip of the pole in the snow. The top of the grip should reach between the chin and top of the head. Try different lengths to determine what size works best. Longer poles, while uncomfortable at first, provide better power, especially on flat terrain. Shorter poles are generally easier for beginners and individuals with certain disabilities and allow for a faster turnover rate and are easier to use on uphill. Poles with small baskets are necessary for groomed trails. The smaller triangular baskets allow the poles to plant with minimal resistance and maximum push. Durability is an important consideration when choosing poles. Sit-skiers apply more force to poles than stand-up Nordic skiers. Overly fragile “high-performance” poles, while reducing weight, may not hold up.

Assistance: Cross-country skiing, especially in a sit ski, is a physically demanding sport. Depending on the disability, fitness level, or type of snow and terrain, many students will need assistance. To aid in forward propulsion, the preferential method is for the instructor to push the sit ski with their pole while moving forward. The most effective and simple way to do this is to attach an apple corer to the frame of the sit ski, just below the seat. This method creates a large target for an instructor to aim their pole tip and is often the safest and most efficient method of assistance.



Apple corer “target” attached to the rear of a sit ski frame. Photo courtesy of Eileen Carey

If that method does not produce ample results, the volunteer may wear a belt with a shock-corded line (climbing gear works well for this), or simply attach a tether line to the foot rests, or use rigid poles attached to the frame with a carabineer. Volunteer's pole grips can also be looped into the foot rests and pulled along. Once attached, the volunteer skis or walks in front of the student while assisting in forward propulsion. A student who is fairly fit and independent may need help only occasionally or not at all.

As an alternative to attaching themselves to the frame, volunteers may give a push from behind as needed. To help control speed and stop the sit ski, the tether may be attached at the back of the frame with the volunteer snowplowing behind. Gently tightening tether tension either left or right assists in directional change. All tethering movements should be gentle and gradual and are most effective and safest at low speeds. Use a tether or find another route whenever you have any doubt about the student's ability to handle the terrain independently. Knowing the trails well to be able to avoid potentially hazardous terrain is one of the most important steps to ensuring the safety of you and your student.

Miscellaneous equipment: Before heading out on the trail, whether for an hour or more, bring the following:

- Water for student and volunteer
- Snacks for student and volunteer
- A pack with extra warm/dry clothing for longer outings
- Spare gloves, as sit skiers use their hands frequently in the snow for turning and balance
- Sunscreen and lip balm
- Sunglasses
- Trail map
- Tether system (even for strong skiers, in case of a broken pole or injury).
- Radio or cell phone (for longer trips to check in with base lodge)
- Warm footwear or a foot-leg blanket
- It is recommended that the volunteer carry a wrench in case adjustments are needed while on the trail.

Most basic adjustments can be accomplished without tools. Most of the items on this checklist apply to stand-up skiers as well as sit-skiers.

Sit Skiing Teaching Progression

This progression should be done on an open, flat and groomed area and may take many outings to complete depending on the skier's proficiency and fitness.

Before You Start the Lesson

- Emphasize proper equipment fit for comfort, security, and performance, with adjustments as necessary to refine the fit.
- Introduce yourself and the lesson, and then familiarize the student with the equipment and how to achieve and maintain balance. Explain the dynamics of a flat ski on snow and what sliding feels like. This will be practiced on snow.
- Help the student achieve an athletic stance that is skeletally aligned, slightly flexed, and balanced with the poles in a parallel position. Note that this position will vary depending on disability and personal preference.
- Once on snow speak about the importance of aggressive body language while skiing ("ready, forward, aggressive").
- Begin each lesson by explaining and demonstrating the skill first.

Teaching Basics

**Note that elements of body position, power application and double pole technical elements found in the stand-up section will also apply here, although to varying degrees depending on the type and level of disability.*

- Work on body position and balance by placing the poles or hands on the snow and then at the sides. Relax the arms and keep the elbows unlocked, shoulders relaxed, head up, and eyes forward. Rock back and forth from one ski to the other, rotating the upper body left and right and swinging the arms forward and back in opposition and together. This is often most effective to try first without poles.
- Teach how to move about in a perfectly flat area with minimal skier traffic and good smooth grooming with and without tracks. It may be necessary initially to help with turning and exiting tracks. To help exiting tracks, an instructor on stand-up equipment may put the front of one ski (the skinniest part of the ski) perpendicular across the tracks and instruct the sit skier to ski over their ski. Once the majority of the weight of the sit skier is over the instructor's ski, they may pivot, thereby allowing them to exit the tracks.
- Demonstrate how to push forward using double poling and diagonal poling techniques. Keep the poles parallel to the rig.
- Pole plant drill (this is a stationary drill): Plant poles with forearms vertical and humerus horizontal so that elbow has a 90-degree angle. The initial pole plant is between the knees and about 3 to 4 inches behind the knees, this all depends on the length of the arm as long as the body is for the most part erect with a very slight lean forward. (The power of the stroke comes from the abdomen and latissimus dorsi or commonly known as the "the lats." These are just under the armpit and wrap around to the center of the back. The trapezius, triceps, deltoid, are also important poling muscles.) When initiating the stroke have student pull with the elbows and not the hands will engage the lats and abdomen muscles. This will feel like squeezing the shoulder blades together and engaging the abdomen muscles. The student is not propelling the sit ski during this drill. Repeat this drill several times placing a hand on the students back for proper engagement of lats. Once the student is comfortable with where the power of the poling motion comes from, instruct them to incorporate that pole plant initiation into a full double poling motion. For skiers with higher level SCIs, they may not have access to these muscles and will use a higher proportion of their arm muscles to accomplish this motion.



Skier demonstrating flat-terrain pole plant positioning. Photo Courtesy of Candace Cable

- Teach the student to lean from side to side, using hands and/or poles for support.
- Demonstrate how to push backwards by placing the pole tips angled forward toward the front end of the sit

ski. By extending the forearms forward and “pushing away” the sit ski will slide backwards. This also creates a stabbing motion that is used for slowing down the sit ski at low speeds (it should be noted that this technique is dangerous and ineffective at higher speeds so should primarily be used for maneuvering and not for slowing).

- Let the student become familiar with braking on slight declines by dragging and feathering hands or pole grip ends.
- Have your student practice falling and getting up with support. Falling should not be practiced until the instructor is familiar with the student and sure of their ability to take a bump and have the strength to help themselves up. The student should not try to break a fall until they have developed sufficient strength and recovery techniques. When falling students arms and poles should reach out and away from the body so that no parts of the body or equipment are pinned under the frame. After falling, help the student position across the fall line with upper torso up the hill. To assist the student to returning to a upright position the instructor places the uphill ski or boot against the upper ski near the balance point and can pull on the frame or if the student is strong enough by clasping wrists so that both the instructor and the student are assisting in the recovery. During the assist the student can raise up the sit ski with the arm against the snow to assist also. Once in an upright position the student and instructor need to be aware of the terrain so that the sit ski does not slide backwards.
- Teach how to turn by skidding the sit ski in a circle using asymmetric pole pushes and body movements. For bigger turns, the outside pole may be planted at an angle relatively far away from the ski (similar to a canoe or kayak “sweep stroke”). This enables the skier to turn more with each pole plant, which is good for tighter radius turns or turns at higher speeds.



Skier demonstrating asymmetrical pole plants to round a gentle corner. Photo courtesy of Candace Cable

- Review emergency stopping. If a hazard lies ahead that cannot be negotiated while moving down the trail, yell “fall down”, and have the student fall feet first to avoid a head injury. Always emphasize throwing the arms and poles away from the body to avoid pinning arms under the sit ski frame or breaking poles.

Advanced Techniques

- Refine gliding, propulsion, and direction change. The goal is rhythmic flow of movement and ability to change direction and techniques with ease and efficiency. Good rhythm also aids in good pacing and retention of speed.
- Work on matching poling techniques to terrain and speed:
 - For flats and gentle uphill (when skier has good speed): Hands swing forward from the shoulder to between knees and hips (or in front of knees for skier with an acute knee angle). Stroke is relatively long, with a slower cadence. Poles reach, skier leans forward from their waist and bring shoulders forward, pole plant, then follow through to the hips or beyond with a push and a crunch if possible (note: skiers with higher spinal cord injuries that will be wearing a higher supportive chest strap will not be able to hinge at the waist and reach forward with the poles and upper body). Poles should be kept parallel to rig throughout motion, then return to reach position.
 - For uphill and getting up speed and momentum (when skier has low or no speed): General poling principles apply with some variations. Poles are generally planted further back and with pole tips at a more acute angle with the snow. This provides more leverage and also helps from sliding back on uphill. Cadence is high, center of mass stays centered, and pushes are short.
- Practice changing direction more sharply or at higher speeds. With hand or pole, pressure snow to create differential friction and turn rig. To change direction or avoid sliding down a side hill, drag hand on the side toward the direction of intended travel and simultaneously use the opposite pole to stab out laterally (in a “sweep stroke” motion). This will help the sit-ski turn or avoid sliding, especially at higher speeds.
- Work on getting up from a fall unassisted. To do this, the student places the sit ski across the fall line with both poles uphill. The uphill hand is placed close to the body on the snow. The downhill pole should be on the same side of the body as the uphill hand and is pressed against the torso at a 45° angle to provide final leverage. The uphill hand first pushes off the snow, followed by a final push with pole hand that brings the sit ski to an upright position. For skiers who also kayak, you may also compare this to a roll. An advanced move is teaching the student to “turtle,” rolling on to their back and shifting weight from side to side or spinning around, so to position the frame across the fall line can be useful in some situations.
- Demonstrate hop turns; small lifts or “pops” to lift and turn the whole sit ski. The student extends quickly from a slouched position while pushing vertically with poles, which lifts the chair. This maneuver is also necessary for the skier to exit set tracks. This is an advanced move and may take skiers many sessions (or seasons) to master. It is also very difficult for skiers with minimal core function. For these skiers, assistance may be necessary. Some skiers also prefer to ski outside the tracks for this reason.

Chapter 4. Adaptive Biathlon

Biathlon is a sport that combines cross-country skiing and rifle marksmanship. Adaptive biathlon differs slightly from the Olympic version, though the challenge of shooting precision while under extreme physical and mental duress still remains.

Safety

- The shooting range must comply with all local laws.
- Always point the rifle in a safe direction. Never point the rifle at anyone!
- Always treat the rifle as if it was loaded.
- Never point the rifle at anything you do not want to destroy.
- Do not load the rifle until it is pointed downrange and the competitor is ready to shoot.
- Do not touch the trigger until ready to shoot.

Rifles

Air rifles are used for adaptive biathlon LW classes. A five-shot magazine allows five shots to be fired at each of the five targets with a charging handle or reloading bolt to load each pellet. Peep sights only are allowed. Snow covers are a must for outside competitions. A shooting sling is allowed. LW 2-8 classes can use a shooting stand if necessary.



Athlete using a shooting stand support. Photo courtesy of James Upham

Eko-Aims laser rifle systems are used for B, or visually impaired, classes. Aiming is achieved through audio cues with headphones.

Competition Basics

- The distance between the front edge of the shooting ramp and the line of targets must be 10 m (+ - 1 m).



Example of makeshift range with proper distance and height adjustments. Photo courtesy of James Upham

- Only prone shooting is allowed. Sitting is allowed for LW 10-12 (sit skiing) classes but is generally not used. Sit skiing prone position is altered from a standard position so the sled can lie on its side or rest upside down on top of the competitor. It must still be attached to the competitor during shooting. Poles may be removed during the shooting phase or left on if the position is not compromised.



Sit ski prone position for athlete with spinal cord injury. Photo courtesy of James Upham



Sit ski prone position for double amputee. Photo courtesy of James Upham



Prone position for standing skiers. Photo courtesy of James Upham

- During training and competition, competitors must enter the range from the left and exit on the right side.
- The surface of the shooting ramp and the surface on which the targets stand must be near the same level as possible. The firing ramp and the surface on which the targets are placed must be at a higher level than the ground between them by at least 30 cm, and more if required by local snow conditions.

Competitors do not carry their own rifles during competition. During races, rifles are placed on a rack in the coaching zone. Coaches carry the rifle to the firing point as the competitor approaches the range and hand the rifle to the competitor as they set up their position on the mat. Sight covers should be opened at this time. Once the rifle is pointed down range and the competitor is ready to shoot, the magazine may be inserted and firing can commence.



Coach handing off rifle to athlete. Photo courtesy of James Upham

Shooting Basics

All basics of shooting apply. The main challenge in biathlon is controlling breathing and limiting physical and mental stress. There are no tricks or gimmicks. Focused practice will achieve the best results.

- **Position** should be relaxed and naturally aligned on the target
- Rear and front **sights** should be aligned
- **Breathing** should be relaxed and held briefly during the act of firing
- **Sight picture** should move vertically during breathing and then be steady on the target during the shot
- First stage (that can be gently squeezed without firing a round) of **trigger** should be taken up immediately and the final stage (that which releases the pellet) should be released smoothly
- **Follow through** on the target with the aiming and trigger until the target paddle falls

Biathlon Race Formats

- 7.5km: all classes (2 shooting rounds). 150-meter penalty loop for each miss.
- 10km: LW 10 - 12 women (4 shooting rounds). 1-minute penalty for each miss.
- 12.5km: LW 10 - 12 men (4 shooting rounds). 1-minute penalty for each miss.
- 12.5km: LW 2 - 9 men, women (4 shooting rounds). 1-minute penalty for each miss.
- 12.5km: B1-3 men, women (4 shooting rounds). 1-minute penalty for each miss.

Sample Training Session

Combination, or combo, training is the name for training sessions combining biathlon specific shooting with skiing, sit skiing, running or any other endurance exercise. It is perfectly designed for interval sessions as many loops can be repeated and the shooting phase can start the recovery period. Combo training allows for athletes to practice with a high heart rate and labored breathing and is a training tool biathletes use frequently to replicate race conditions.

Sessions start with zeroing the rifle. 15-30 rounds are fired at paper targets while adjusting the sights. This can be done before or during a 20-30 minute warm up. Then a loop is skied at the appropriate pace or heart rate zone and finishes at the range and five shots are fired at the metal targets. This can be repeated many times. Loops are typically 3-8 minutes long. They are often repeated 4-12 times. Time should then be allowed for a cool down period followed by stretching.

Conclusion

Hopefully this manual has provided a glimpse into adaptive Nordic skiing and can be a resource for you moving forward. Of course, the best way to hone your skills as an adaptive instructor or coach is to get hands-on experience. Regional and local adaptive and skiing organizations are probably the best place to start. These organizations and programs often provide volunteer and instructor training as well as opportunities for you to use the skills you learn by coaching or teaching adaptive program participants how to ski.

Throughout this manual, you may have noticed many themes. There are many aspects of instructing or coaching that resonate across sports and disciplines that will ensure that your student has the best possible experience. As you gain experience in the adaptive Nordic world, here are a few things to keep in mind to ensure a great experience for everyone involved:

Communicate – Constantly communicate with your skier. This is important from a safety standpoint (making sure your student is comfortable in any given situation-temperature, terrain etc.) and also so you can make sure you are teaching in the most effective way possible. As an instructor, you can learn a lot from a student through constant communication.

Embrace the Process – Most students will not process concepts fully the first time they are taught to them, which provides the opportunity to delve into the learning process. Finding the best methods to teach each skier is a challenge and can also be the most exciting and rewarding part of instructing or coaching. A challenge as an instructor is to make the information accessible to each student. This might mean explaining things in a different way, showing by example, doing a drill or playing a game. Think about the elements you teach, break them down, ask others how they think about them, and challenge yourself to come up with different methods of teaching the same concept. You will learn something in the process and you will be a better instructor for the thoughtful approach.

Challenge Yourself – Don't forget to work on your own skiing! Take some time to ski with people with different skills and work with a coach or instructor who has different teaching methods or strengths than your own. Expanding your own skill base is a great way to improve as an instructor and can also re-energize you and provide some fresh new material for your instruction arsenal.

Share- Try teaching a fellow instructor a new concept or method before bringing it to a lesson. Collaborate with them and work through the process. You will both learn something in the process and your students will benefit.

Keep it fun! - Ski in groups, play games (even adults like games), create fun races, and have small goals your student can work toward.

Keep an open mind – If your student has difficulty with a skill, don't immediately assume it is a result of their disability unless it is obvious. Remember that all skiers have different ways of processing information and they likely just need to practice. Learning new capabilities is one of the most rewarding aspects of learning new sport skills and it may just take time and different teaching tactics for your student to learn those skills.

Appendices²

Appendix A: Disabilities We Teach

The following information is a general overview of some common physical disabilities found in students we teach to ski. In all cases, ask questions to learn as much as you can about the individual. Each student is an individual and each individual will be affected differently by his/her disability.

AMPUTATIONS: Congenital, surgical or traumatic loss of a limb or part of a limb

Look for the hidden causes: if due to cancer, recent or current, chemotherapy may cause fatigue or impaired temperature control. If amputation is due to Diabetes, the individual may lack sensation in other areas (often hands or feet), plus may need to eat or take medication on a certain schedule. Injuries resulting in amputation may encompass other hidden disabilities for example, minimal brain damage, need for a bladder control device, or hearing impairment. The residual limb (stump) needs to be protected while skiing. An ace wrap should be applied to prevent swelling and/or the limb should be padded and covered to avoid damage from falls or cold. Deciding whether or not to ski with a prosthesis is determined by considering the length of the residual limb in addition to advice from a prosthetist to be sure it is strong enough to withstand the stresses of skiing.

AK: Above knee - usually skis without prosthesis.

BK: Below knee - An agreed upon guideline is if the stump is four inches or longer and the skin is in good condition, the individual may ski with prosthesis.

AE: Above elbow

BE: Below elbow

Hip Disarticulation: Amputation at the hip joint, this preserves the pelvis and the soft tissue to the buttocks - usually skis without prosthesis

Syme's: Amputation at the ankle.

HP: Hemipelvectomy - The most severe level of amputation. This amputation includes half of the pelvis and the limb leaving, only the soft tissue of the buttocks.

Shoulder Disarticulation: Amputation at the shoulder joint.

Unilateral: Amputations on the same side. Although obtaining and maintaining dynamic balance when skiing is difficult, unilateral amputees do ski. (i.e. a unilateral BK/BE could ski on both skis with one outrigger).

Bilateral: Amputations on both sides. This can include: 1) amputation of both legs, 2) amputation of both arms, 3) amputation of an arm on one side and leg on the other (arm and leg amputees usually ski on one ski with one outrigger).

APHASIA: Aphasia is an acquired communication disorder that impairs a person's ability to process language, but does not affect intelligence. Aphasia impairs the ability to speak and understand others, and most people with aphasia experience difficulty reading and writing. The disorder ranges from having difficulty remembering words to being completely unable to speak, read, or write. Aphasia disorders usually develop quickly as a result of head injury or stroke, but can develop slowly from a brain tumor, infection, or dementia, or can be a learning disability. To communicate, give the person with aphasia time to speak and do not finish the person's sentences unless asked. Be sensitive to background noise and turn off competing sounds such as radios or TVs where possible. Be open to means of communicating other than speech, e.g., use drawing, gesturing. Confirm that you are communicating successfully.

ARTHRITIS: An inflammatory disease of the joints as well as other parts of the body. It causes pain and loss of movement. This disease is chronic.

Ankylosing Spondylitis: Chronic inflammation of the spine. Bones will often fuse together.

Juvenile: A general term that is used to define any arthritis that affects children.

² All appendices are excerpts from the following, with permission from the publisher: Professional Ski Instructors of America-Eastern Division. *Adaptive Exam Guide*. Albany, NY. October 2011 revision. Pgs 49-61, 64-65.

Osteoarthritis: Degenerative joint disease common in seniors, the most common form of arthritis.

Rheumatoid: Total body inflammation of moving and weight bearing joints. This is the most disabling form of arthritis.

ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD/ADD): Many people use the generic term of ADD for all types of ADHD but ADHD is the official clinical diagnosis term. According to the Attention Deficit Disorder Association (ADDA, <http://www.add.org/>), approximately 4% to 6% of the U.S. population has ADHD, which is 8 to 9 million people.

Children and adults who consistently display certain characteristic behaviors over a period of time are diagnosed with ADHD. The most common features include:

- Distractibility/Inattention (poor sustained attention to tasks)
- Impulsivity (impaired impulse control and delay of gratification)
- Hyperactivity (excessive activity and physical restlessness)

The exact nature and severity of ADHD symptoms varies from person to person. Approximately one-third of people with ADHD do have the hyperactive or overactive behavior component.

There are three subtypes of ADHD: Combined Type, Predominantly Inattentive Type, and Predominantly Hyperactive-Impulsive Type.

Predominantly hyperactive-impulsive: Most of the person's symptoms are in the hyperactivity-impulsivity categories with fewer symptoms of inattention.

Predominantly inattentive type: The majority of symptoms are in the inattention category and fewer than six symptoms of hyperactivity-impulsivity.

Combined: Six or more symptoms of inattention and six or more symptoms of hyperactivity-impulsivity. Most people have the combined type.

Hyperactivity symptoms include:

- Fidgeting, squirming when seated
- Getting up frequently to walk or run around
- Running or climbing excessively when it's inappropriate
- Having difficulty playing quietly or engaging in quiet leisure activities
- Being always on the go
- Often talking excessively

Impulsivity symptoms include:

- Impatience
- Difficulty delaying responses
- Blurting out answers before questions have been completed
- Difficulty awaiting one's turn
- Frequently interrupting or intruding on others to the point of causing problems
- Initiating conversations at inappropriate times

Inattention symptoms include:

- Difficulty paying attention to details and tendency to make careless mistakes
- Producing work that is often messy and careless
- Easily distracted by irrelevant stimuli and frequently interrupting ongoing tasks to attend to trivial noises or events that are usually ignored by others
- Inability to sustain attention on tasks or activities
- Difficulty finishing paperwork or performing tasks that require concentration
- Frequent shifts from one uncompleted activity to another
- Procrastination
- Disorganized work habits

- Forgetfulness in daily activities (missing appointments, forgetting to bring lunch)
- Failure to complete tasks
- Frequent shifts in conversation, not listening to others, not keeping one's mind on conversations, and not following details or rules of activities in social situation.
- Have difficulty processing information as quickly and accurately as others.

Treatment of ADHD

The most effective treatment for ADHD is a combination of medication (when necessary), therapy or counseling to learn coping skills and adaptive behaviors. Many adults receive ADHD coaching.

Medications

The most common type of medication used for treating ADHD is a stimulant, which may have a calming effect on people with ADHD. The medications can reduce hyperactivity and impulsivity and improve the person's ability to focus, work and learn. Medication may also improve physical coordination. Common ADHD medications are: Adderall, Concerta, Dexedrine, Focalin, Ritalin and Strattera.

Teaching Tips for People with ADHD

Many children with ADHD may have a specific behavior management or therapy program. If possible ask the student or parents how the behavior program works so you can support the student. Additionally, Try to limit distracting stimuli; give one direction at a time; try to maintain eye contact; avoid complex instructions; and be clear and concise. Since these children are easily frustrated, maintain a calm attitude. Some students may exhibit inappropriate fear in new situations. Due to side effects of the medications, some students do not take their medication during the weekend or holiday periods.

Sources:

- *National Institute of Mental Health* (<http://www.nimh.nih.gov/health/publications/attention-deficit-hyperactivity-disorder/complete-index.shtml>)
- *Attention Deficit Disorder Association* (http://www.add.org/?page=ADHD_Fact_Sheet)
- *WebMD* (<http://www.webmd.com/add-adhd/guide/adhd-symptoms>)

AUTISM SPECTRUM DISORDERS: ASDs are a group of developmental disabilities that can cause significant social, communication and behavioral challenges. There are three different types of ASDs:

Autistic Disorder (also called “classic” autism): This is what most people think of when hearing the word “autism.” People with autistic disorder usually have significant language delays, social and communication challenges, and unusual behaviors and interests. Many people with autistic disorder also have intellectual disability. Characteristics can include impaired social interaction, impaired communication, and restricted and repetitive behavior

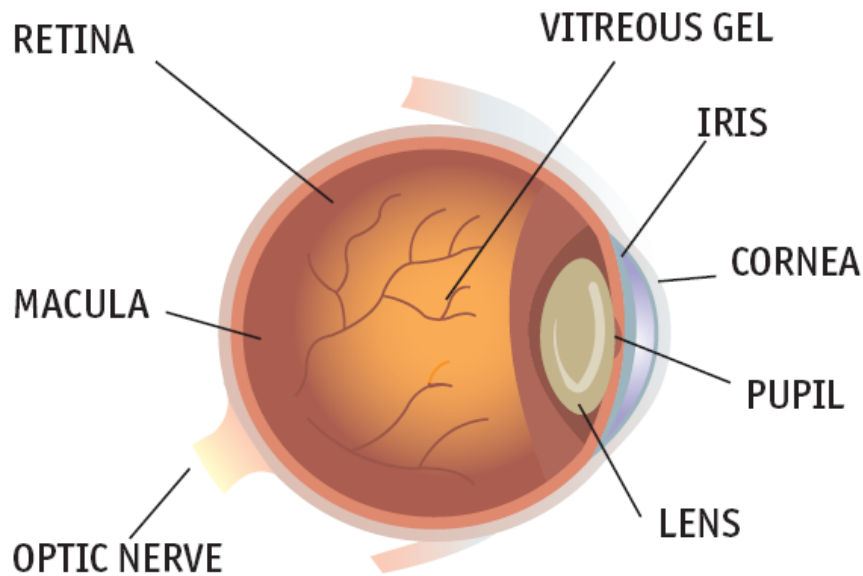
Asperger Syndrome: People with Asperger syndrome usually have some milder symptoms of autistic disorder. They might have social challenges and unusual behaviors and interests. However, they typically do not have problems with language or intellectual disability.

Pervasive Developmental Disorder: Not Otherwise Specified (PDD-NOS; also called “atypical autism”): People who meet some of the criteria for autistic disorder or Asperger syndrome, but not all, may be diagnosed with PDD-NOS. People with PDD-NOS usually have fewer and milder symptoms than those with autistic disorder. The symptoms might cause only social and communication challenges.

BLIND / VISUALLY IMPAIRED: Partial or total loss of vision which may include, but not be limited to: tunnel vision, peripheral vision, myopia, or loss of depth or distance perception. Some causes include: Diabetes, Glaucoma, Detached Retina, Eye Injury, Multiple Sclerosis, Brain Tumor or Head Injury. Ask specific questions and define the student's range of vision.

PARTS OF THE EYE

To understand eye problems, it helps to know the different parts that make up the eye and the functions of these parts.



Here are descriptions of some of the main parts of the eye:

- Cornea: The cornea is the clear outer part of the eye's focusing system located at the front of the eye.
- Iris: The iris is the colored part of the eye that regulates the amount of light entering the eye.
- Lens: The lens is a clear part of the eye behind the iris that helps to focus light, or an image, on the retina.
- Macula: The macula is the small, sensitive area of the retina that gives central vision. It is located in the center of the retina.
- Optic nerve: The optic nerve is the largest sensory nerve of the eye. It carries impulses for sight from the retina to the brain.
- Pupil: The pupil is the opening at the center of the iris. The iris adjusts the size of the pupil and controls the amount of light that can enter the eye.
- Retina: The retina is the light-sensitive tissue at the back of the eye. The retina converts light into electrical impulses that are sent to the brain through the optic nerve.
- Vitreous gel: The vitreous gel is a transparent, colorless mass that fills the rear two-thirds of the eyeball, between the lens and the retina.
- See Well for a Lifetime: An Educational Series on Vision and Aging

Myopia: Also known as nearsightedness. Common type of refractive error where close object appear clearly and distant objects appear blurry. Images are focused in front on the retina rather than on it.

Glaucoma: A group of diseases that can damage the eye's optic nerve and result in vision loss and blindness. It is one of the main causes of blindness in the United States. Eye disease in which the normal fluid pressure within the eye raising slowly. The increased pressure may damage the optic nerve causing partial or total blindness.

Cataracts: Clouding of the lens that affects vision and mostly related to aging. The lens is a clear part of the eye that helps to focus light, or an image on the retina. Light passes through the transparent lens to the retina. The lens must be clear for the retina to receive a sharp image. If the lens is cloudy form a cataract the image is blurry. If bad enough, vision can be improved by surgery where the cloudy lens is replaced with an artificial lens.

Diabetic Retinopathy: A complication of diabetes and is a leading cause of blindness. It occurs when diabetes damages the tiny blood vessels inside the retina, the light sensitive tissue at the back of the eye. As the condition worsens it causes eye damage. It usually affects both eyes. The retinal blood vessels may (1) swell; (2) become blocked which signals the body to grow new blood vessels; (3) advanced stage (proliferative retinopathy) when new blood vessels grow; (4) new vessels are fragile and leak causing severe vision loss and even blindness.

Retinitis Pigmentosa (RP): Group of inherited retinal diseases that cause progressive deterioration of specialized light-absorbing cells in the retina. RP damages the retina's light-sensitive photoreceptor cells that connect other nerve cells to transmit visual information to the brain. As the cells slowly degenerate, the rod photoreceptors that control night vision are impacted most often so the person develops night blindness and gradual loss of peripheral vision. By about age 40, most have tunnel vision but may retain good central vision. Between the ages of 50 and 80, they typically lose their remaining sight.

Age-Related Macular Degeneration (AMD): Disease associated with aging that gradually destroys sharp, central vision (the macula) because of damage to the retina. It affects the macula, the part of the eye that provides vision of fine details for reading, writing, driving and central vision. AMD occurs in two forms "dry" and "wet."

Wet AMD: When abnormal blood vessels behind the retina start to grow under the macula. The new blood vessels are fragile and leak blood and fluid, raising the macula from its normal place at the back of the eye. The damage occurs rapidly so the loss of central vision can occur quickly. It also known as advanced AMD and does not have stages like dry AMD.

Dry AMD: The light-sensitive cells in the macula slowly break down, gradually blurring central vision. As it worsens, a blurred spot in the center of vision may develop. Over time, as less of the macula function, central vision is gradually lost in the affected eye.

Retinal Detachment: The retina is lifted or pulled from its normal position. If not treated promptly it can cause permanent vision loss. In some cases small areas of the retina are torn (retinal tears or retinal breaks) which can lead to retinal detachment. There are three types of retinal detachment.

Rhegmatogenous: A tear or break in the retina that allows fluid to get under the retina and separate it. These types are the most common.

Tractional: Scar tissue on the retina's surface contracts and cause the retina to separate. (Less common)

Exudative: Frequently caused by retinal diseases, including inflammatory disorders and injury/trauma to the eye. Fluid leaks into the area underneath the retina without any tears or breaks in the retina.

Tunnel Vision: Loss of peripheral vision with retention of central vision resulting in severely constricted visual field.

Congenital Nystagmus: Constant involuntary, cyclical movement of the eyeball. There are many causes for this disease. Congenital nystagmus is a condition that begins at birth or early infancy where the eyes oscillate continuously and uncontrollably.

Ophthalmoplegia or Ophthalmoparesis: Paralysis of one or more of the extraocular muscles responsible for eye movement.

Diplopia: Double vision (Simultaneous perception of two images of a single object occurring in one or both eyes. Usually the result of impaired function of the extraocular muscles, where both eyes are still being used, just not in focus. It can be one of the first signs of a systemic disease and may disrupt a person's balance, movement, and/or reading abilities. (<http://en.wikipedia.org/wiki/Diplopia>) Seen in diseases of the eyeballs, cranial nerve affections, and disease of the cerebellum, cerebrum, and meninges.

CEREBRAL PALSY: A non-progressive disorder caused by brain damage before, during or after birth. It is characterized by abnormalities of muscle tone and difficulties with voluntary motor control. It usually results in delayed motor development. The individual may have one type or a mixture of types. Individuals with cerebral

palsy may or may not have cognitive impairment. Medical associations and text varies as to types and numbers of classifications. The below list are common CP classifications.

Spastic (hypertonic): Increased muscle tension and difficulty with relaxation, may have lack of full mobility at some joints. *Tense contracted muscles.*

Low Tone (hypotonic): Decreased muscle tension, may appear floppy, often have joint hyper-mobility (double jointed). *Diminished muscle tone.*

Athetoid: Muscle tone fluctuates from high to low therefore motor control is inconsistent. *Extraneous uncontrolled movements.*

Ataxic: Muscle tension often appears okay but control of movement and balance is impaired so that the individual may appear drunk. *Jerky uncontrolled movements.*

Rigid: Muscle tension often is very tense. *Stiff uncontrolled movements.*

DEAF/HEARING IMPAIRED: Hearing Impairments refer to a reduction in sensitivity to sound. This may also be accompanied by some loss in the ability to correctly interpret auditory stimuli even after amplification. The deaf/hearing-impaired population is often noted as being the largest of all chronic physical disabilities. Hearing loss occurring after 19 years generally does not affect speech. Hearing losses occurring from birth to three years are referred to as *pre-lingual deafness*. Deafness occurring from three years to 19 years is termed as *prevocational deafness*. Hearing Impairments fall into three categories:

Conductive Impairments: Defects in the auditory system. Which interfere with sound waves reaching the cochlea. Damage or lesion lies in the middle or outer ear (i.e. ruptured ear drum). Generally, conductive losses are often lesser in degree not exceeding moderate impairment.

Sensorineural Impairments: Defects to the auditory pathway beginning with the cochlea and auditory nerve, brain stem and cerebral cortex. Damage here prevents or disrupts interpretation of the signal (i.e. maternal rubella and noise).

Mixed Impairments: Defects involve both Conductive and Sensorineural impairments (middle ear infections).

DIABETES: A disease in which the body cannot properly metabolize glucose. In Type I diabetes the pancreas cannot produce insulin. In Type II diabetes, cells are resistant to insulin and/or the pancreas does not produce enough insulin. Two possible concerns with diabetes are:

Hyperglycemia: High blood sugar level.

Hypoglycemia: Low blood sugar level. Hypoglycemia is a major concern, as it can be triggered by exercise (skiing), and delays in meals. Sugar is needed immediately if it occurs.

DOWN SYNDROME: A birth defect, which causes mental retardation. Down Syndrome is caused by a chromosomal abnormality, usually chromosome #21. Down Syndrome may sometimes be referred to as Trisomy 21. Individuals with Down Syndrome often have loose joints and low muscle tone. Additionally, there may be a predisposition for cervical subluxation, whereby a cervical vertebra dislocates and can cause a spinal cord compression. X-Ray can easily detect this. Surgical repair may be necessary to prevent injury.

EPILEPSY / SEIZURE DISORDER: A seizure is an abnormal electrical impulse in the brain. Seizures may consist of a brief suspension of activity (focal or petit mal) where an individual stares into space, or may be generalized tonic clonic (grand mal) with full body involvement. There are many types of seizures that range between focal and tonic clonic in appearance. Most seizure disorders are controlled by medication. If a seizure occurs, try to protect student from injury. Discontinue skiing as the individual may be disoriented.

Tonic Clonic (Grand Mal): Seizures are generalized and affect the entire brain. An aura (strange feeling, taste, vision or smell) may indicate the start of a seizure. The seizure proceeds with loss of consciousness and movements alternating between contraction and relaxation of the muscles. Incontinence may occur. Seizures may last from seconds to minutes.

Focal (Petit Mal): Seizure with loss of consciousness, eye or muscle fluttering, and sometimes loss of muscle tone. There may be a period of unconsciousness so brief that neither the individual nor observers would be aware of it.

Psychomotor Seizures: Seizures characterized by a loss of contact with surroundings. The individual is mentally confused, may stagger, perform purposeless movements, and make unintelligible sounds. Possibly individuals do not understand what is said and may refuse aid. These seizures can develop at any age and are usually associated with structural lesions in the temporal lobe.

LEARNING DISORDERS: An abnormality in cognitive processing (deficits in vision, perception, linguistic processes, attention or memory, or combination thereof) resulting in a substantially below standard achievement in academic skill testing (i.e. reading and math). These individuals have difficulties processing messages to the brain making it difficult for the individual to learn in one or more areas. However, normal or above normal intelligence is not uncommon. It is conservatively estimate that approximately 1.8 million children between the ages of 3 to 21 in the United States have learning disabilities severe enough to warrant special education services. The prevalence of learning disabilities is far greater among boys than girls. The ratio seems to range from 15:1 to 25:1.

INTELLECTUAL DISABILITIES: According to the Centers for Disease Control and Prevention, “Intellectual disability is characterized by a significantly below-average score on a test of mental ability or intelligence and by limitations in the ability to function in areas of daily life, such as communication, self-care, and getting along in social situations and school activities. Intellectual disability is sometimes referred to as a cognitive disability or mental retardation.”

There are different degrees of intellectual disability, ranging from mild to profound. A person’s level of intellectual disability can be defined by their intelligence quotient (IQ) or by the types and amount of support they need.

Degrees of Intellectual Disability

<u>Degree</u>	<u>IQ Level</u>	<u>Population %</u>
Mild	50-55 to 70	85
Moderate	35-40 to 50-58	10
Severe	20-25 to 35-40	3-4
Profound	20 to 25	1-2

Intellectual disability can start anytime before a child reaches the age of 18 years. It can be caused by injury, disease or a brain abnormality. For many, the cause of their intellectual disability is not known. Some of the most common causes are Down Syndrome, fetal alcohol syndrome, and fragile X syndrome, all of which occur before birth.

MULTIPLE SCLEROSIS (MS): A progressive disease that causes the myelin sheath around nerve cells to disappear so that they no longer transmit the necessary signals. The disease may go into remission, but generally worsens over time (varies from individual to individual). It occurs more often in women than men; initial onset is usually in the late twenties or early thirties. Fatigue and heat tends to make the symptoms worse. Muscle paralysis may be partial or full in any limb and loss of sensation may also be partial or full in any area. Visual problems are very common.

MUSCULAR DYSTROPHY (MD): A progressive degeneration of muscles. Caused by a defective gene that is passed from parent to child. MD is more prevalent in boys.

Duchenne Type: The most common and most severe form of MD. Onset is usually between ages 3 - 10. Males are affected more than females. Generally a delay in learning to walk with frequent falls. A waddling gait is usually apparent by 6 years of age.

Facio-Scapular-Humeral Type: The most common form of MD in adults. Symptoms do not appear until adolescence and are not recognized until adulthood. Prognosis is good. The disease may arrest itself at any stage. Effects facial, shoulder, and arm muscles.

Limb Girdle Type: This type may occur at anytime from age 10 or after. The onset usually occurs during the second decade. Both genders are equally affected. Effects movement in upper/lower extremities including ability to move.

Mixed Type: Rapidly progressing and usually fatal within five years. Affects all voluntary muscles.

NEUROMUSCULAR DISEASES: A group of central nervous system diseases affecting the motor system, causing weakness or clumsiness with voluntary motion and involuntary movement. These diseases include: Huntington's Disease, Parkinson's Disease, Friedreich's Ataxia, Amyotrophic Lateral Sclerosis (ALS), Guillain-Barre Syndrome, and Myasthenia Gravis.

POLIO: Muscle weakness or paralysis in any specific muscle or muscle groups caused by the polio virus. The involvement is specific to each person.

POST POLIO SYNDROME: A progressive, degenerative disease impacting nervous and skeletal systems. The disease can be disabling since resulting problems are added to preexisting damage that occurred at the initial polio infection. There is no cure. Symptoms include: fatigue, muscle atrophy, muscle spasms, disc disease, and nerve damage resulting in muscle weakness, scoliosis, and other symptoms.

STROKE - Cerebrovascular accident (CVA): Interruption in circulation to the brain that diminishes oxygen supply and commonly causes serious brain damage. Typically individuals will suffer from hemiplegia (one-sided paralysis) of either upper or lower extremities or both. Balance may also be an issue. Some stroke victims have difficulty speaking or processing auditory input.

SPINA BIFIDA: A birth defect resulting in abnormal development of the spinal column during the early stages of pregnancy. The covering over the spinal column forms a sac-like pouch, the vertebrae fail to enclose the spinal cord, which may affect the connection between the brain and the spinal cord. Damage may occur anywhere along the spinal canal. Disability may range from weakness in the legs to full paraplegia with trunk weakness.

SPINAL CORD INJURY: Spinal cord damage due to some type of insult to the spinal cord, such as trauma, infection or tumor. Individuals are classified as complete or incomplete based on preservation of function in the S4/5 spinal segment. *See Appendix B for more specific information on levels of functioning

Paraparesis: Partial paralysis affecting the lower limbs.

Paraplegia: Paralysis of lower portion of the body and of both legs.

Quadriplegia (also called Tetraplegia): Paralysis of all four extremities and usually the trunk.

TRAUMATIC BRAIN INJURY (TBI): Acquired brain damage caused by some type of insult to the brain. There are three categories:

Closed head injury (diffused injury): This is caused by trauma to the head that does not cause a fracture to the skull.

Focal injury: Part of the skull is forced into the brain.

Hypoxia: Injury caused by the lack of oxygen.

Appendix B: SPINAL CORD DIAGRAM AND INJURIES

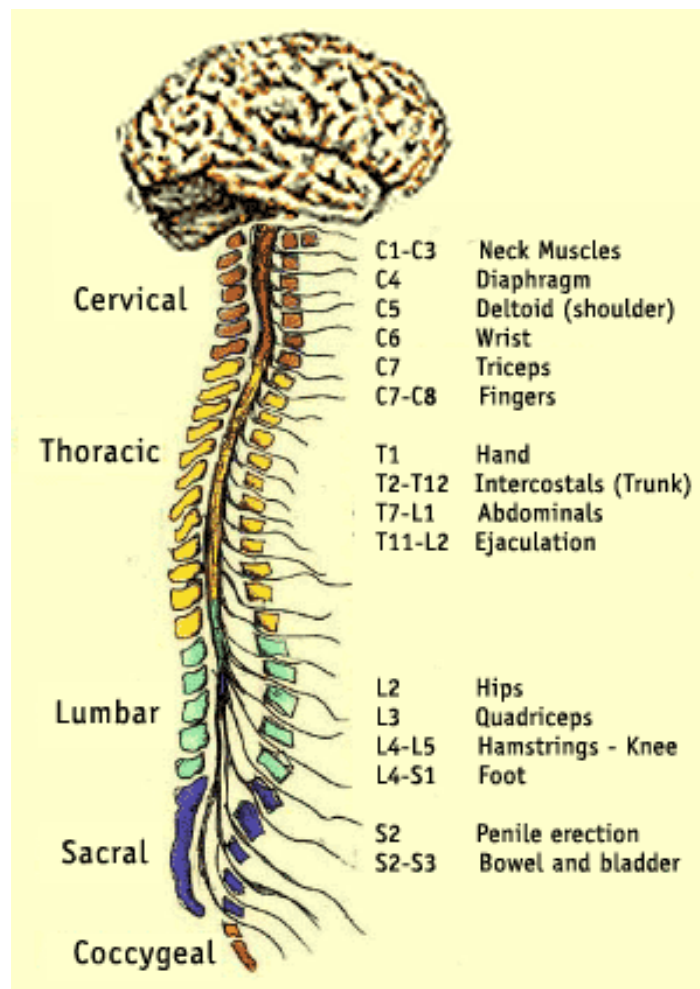
The Spinal Column is divided into five regions:

- 1- **Cervical Region** (Neck):
This region contains the first seven vertebrae and the first eight spinal nerves.
- 2- **Thoracic Region** (Chest):
This region contains the next twelve vertebrae and the next twelve spinal nerves.
- 3- **Lumbar Region** (Lower Back):
This region contains the next five vertebrae and the next five spinal nerves.
- 4- **Sacral Region** (Tail Bone):
This region contains the next five vertebrae fused into one and the last six spinal nerves.
- 5- **Coccyx**:
This region contains four vertebrae fused into one and no spinal nerves.

Damage that occurs in the cervical region is described as quadriplegia. Damage in either the thoracic, lumbar or sacral region is considered paraplegia. Approximately 50% of all spinal injuries cause quadriplegia.

Individuals are classified as complete or incomplete based on preservation of function in the S4/5 spinal segment. However, the function of each individual will vary depending on the level and severity of the injury and the spinal segment where it occurs.

Some of the most common levels of injury are C5-C6, T6-T7 and T12-L1.



Appendix C: MEDICATIONS

People with disabilities may take medications for a variety of reasons. Any medication has the potential to cause a side effect. Some of these side effects may impact performance. As an adaptive instructor, a basic understanding of medications, their use and the side effects is important. The following is not a complete list.

A word about medication side effects: When you look up a drug, all side effects will be listed. Researchers are required to list ALL side effects that occur, whether one person or one hundred people had the side effect. Your student may have none of the side effects or several. Check with the student or their guardian about the response to medications.

As you read through the medication section, recognize that ANY medication has the potential to cause nausea, vomiting or diarrhea. Therefore, these three side effects will not be listed.

ANALGESICS: PAIN RELIEF (two categories, narcotic and non-narcotic)

Tylenol
Aspirin

Non-narcotic:

Codeine
Oxycontin
Demerol

Narcotic: Sedation, lethargy, dizziness, confusion, increased sweating

ANTIBIOTICS: TREATMENT OF INFECTION

This drug category has a wide array of medications that fall into a variety of classes. Generally, the side effects are nausea, vomiting, diarrhea or sensitivity to sun. Examples of common antibiotics include:

Amoxicillin, Augmentin, Levaquin, Zithromax, Bactrim, Keflex, Cipro, Pen V K.

ANTICHOLINERGIC: TREATMENT OF BLADDER SPASM

Ditropan

Decreased sweating, dizziness, rapid heart rate, constipation, dry mouth

Detrol

Dry mouth, headache, constipation, abdominal pain

ANTICOAGULANTS: PREVENTION OF BLOOD CLOT FORMATION

Coumadin

Easy bruising, excessive bleeding (nose bleeds, cuts)

ANTIEMETIC: CONTROL OF NAUSEA AND VOMITING

Compazine
Phenegan
Zofran

Drowsiness, lethargy, dry mouth, blurred vision

ANTICONVULSIVE: TREATMENT OF SEIZURE DISORDERS

Side effects for anticonvulsives are very similar to other medications (drowsiness, dizziness, headaches etc.). Many anticonvulsives are used in conjunction with each other. Also, some anticonvulsives are used for non-seizure problems, so be sure to check why your student is taking the medication. Examples of anticonvulsives are:

Dilantin, Depakote, Tegretol, Clonopin, Phenobarbital, Neurontin, Keppra and Gabitril.

ANTI-INFLAMMATORY: PREVENTION OR REDUCTION OF INFLAMMATION

Ibuprofen
Decadron
Prednisone

Non-steroidal: headache, dizziness

Steroids: Dizziness, headache, fluid retention

ANTISPASMODIC:	REDUCTION OF MUSCLE SPASM
Dantrium Lioresal Valium	Drowsiness, dizziness, fatigue, dry mouth
ANTI-HYPERTENSIVE:	CONTROL OF HIGH BLOOD PRESSURE
Norvasc Toprol Tenormin	Dizziness, headache, fatigue, lethargy
SEDATIVES:	REDUCTION OF ANXIETY
Ativan Xanax	Drowsiness, sedation, fatigue
ANTIPSYCHOTICS:	MANAGEMENT OF SYMPTOMS FOR PSYCHOTIC DISORDERS
Haldol Thorazine Clozaril	Drowsiness, dry mouth, tremors Drowsiness, vertigo, dry mouth, nausea, urinary retention
ANTIDEPRESSANTS:	TREATMENT OF DEPRESSION
Zoloft Paxil Prozac Effexor	Headache, drowsiness, dizziness, sweating
CNS STIMULANTS:	BEHAVIORAL CONTROL
Dexidrine Ritalin	Over-stimulation, restlessness, dizziness, dry mouth, high blood pressure

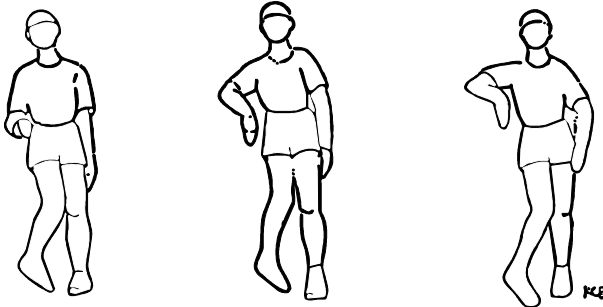
Prepared by: Adaptive Sports Foundation, 2004

Additional Information sources: Many new drugs are being introduced annually. Drugs not found in this guide can be referenced through the *"Physician's Desk Reference"*, any nursing drug guide or web sites such as www.webmd.com.

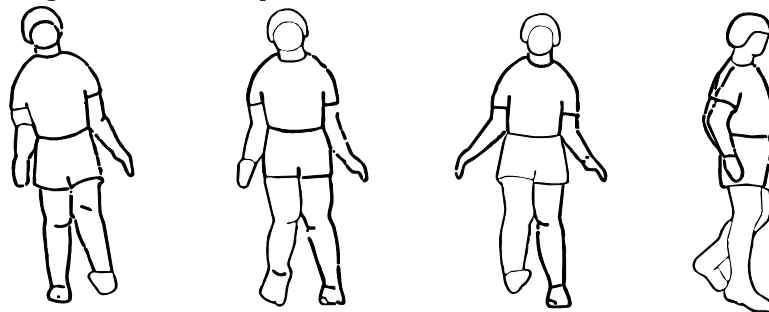
APPENDIX D: COMMON GAITS FOUND IN ADAPTIVE SKI STUDENTS

Careful observation of the student as they walk into the room or facility can reveal what muscles are affected and what the degree of impairment is. Sometimes impairment of gait may be caused by mechanical factors, such as disease of bones, tendons, joints or muscles. Damage or lesions at different levels of the nervous system are common causes of gait abnormalities. A few of the most common gaits are listed and illustrated below:

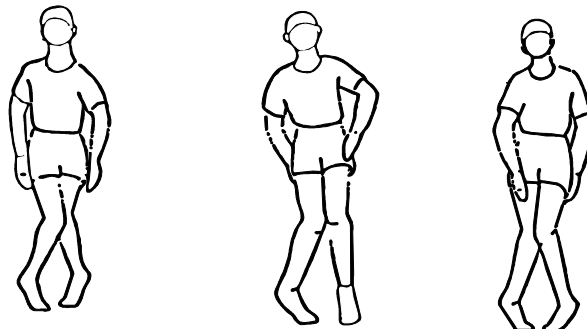
- **Hemiplegic gait:** Both arm and leg on the same side are involved. Individuals lean to the affected side, may use alternate muscle groups to move into the next step and the arm on that side is held in a rigid, semi flexed position.



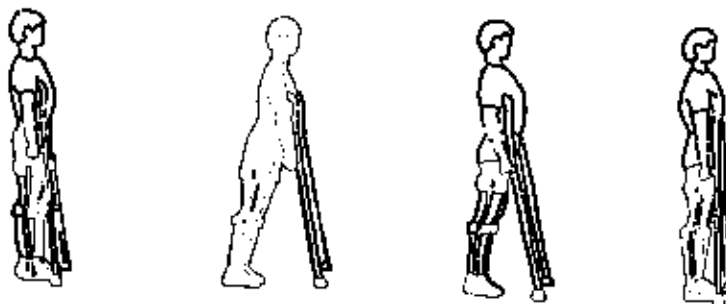
- **Cerebellar gait:** Irregularity of steps, unsteadiness, and tendency to reel to one side. Problems are increased when the ground is uneven. Individual will often lean to the weighted side in order to move the opposite side through to the next step.



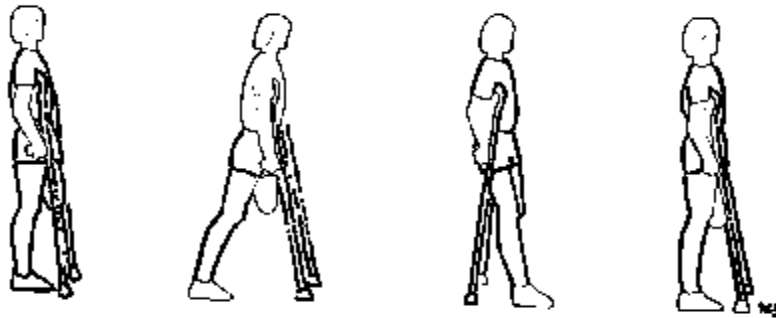
- **Scissors gait:** The legs are flexed and abducted at the hip joint causing them to cross alternately in front of each other with the knees scraping together.



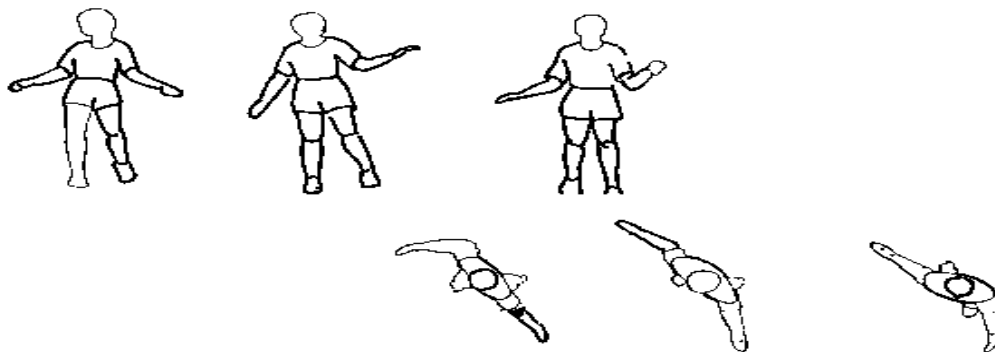
- **Step to, swing to, or drag to gait:** All the weight is taken by the arms while the legs are lifted and swung or dragged forward. The pattern is lift and drop, lift and drop. A good example would be a person with spina bifida in long leg braces.



- **Swing through gait.** The body is swung through the crutches so that the good foot lands in front of the crutches. Then the crutches are brought forward and the sequence is repeated. This gait is used by most leg amputees.



- **Waddling gait:** This gait is very similar to the muscular dystrophy gait. Characterized by an awkward side-to-side waddle, the muscles are often used to initiate stepping.



Illustrations by Kathryn Bevier