

Nordic Skiing Technique Concepts to Coach Students and Facilitate Self-Learning.

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Preamble:

Nordic skate skiing techniques have evolved significantly after Bill Koch's Olympic Silver Medal debut in 1976 and first time World Championship medal for an American in 1982. The "Field Skate Technique", Bill successfully used initially has been replaced by the V2, the predominate technique utilized in recent years to great success (more on this later). To learn the correct mechanics necessary for efficient skating requires a basal aerobic capacity, general strength for plyometric style movement and balance skills. It is worth noting that every skier has a different body type and will therefore ski slightly differently due to natural strengths and weaknesses. That said, a number of specific body positions within the ski motion are necessary no matter the body style, strengths or weakness. The following are notes to help facilitate correct technique for skiers from beginning to advanced ability. This document can be used as a reference to High School skiers and their coaches when learning and or coaching skiers. It does not claim to represent high level competition technique and some analogies are specific for skiers in not more than their 3rd or 4th year. More advanced techniques can follow at college or elite levels and should be integrated when the student has evolved enough as a skier to accommodate nuances in their technique toolbox.

It is assumed that the skier has been correctly fitted to their equipment. While a limited degree of variation can occur in pole/ski selection, technique is adversely affected when improper equipment is used. A short commentary will cover fit in a limited capacity. Getting your equipment fitted at a highly qualified Nordic specific shop is recommended.

Each section in this booklet covers a specific point required in order to ski properly and when to apply the technique. Students learn in different ways, skiing is not unique in this manner. As a result, each section may include a "how it should feel" analogy to help create a mental vision or image students can use to help them think about technique. Video is highly encouraged to accompany the text – CXC provides excellent resources on this matter. Also included are drills to help facilitate improved technique and key aspects for the coach to identify. Not included or covered here are dry land training skills and drills that are critical to developing technique on snow. While seemingly mundane and removed from being on snow, top athletes repeat key dry land skills several times per week throughout their ski year in order to reinforce the important components used in technical skiing. Learning to ski well does not come from skiing alone. It can be accelerated significantly by proper muscle and reflex training performed in any exercise environment. The dry land skill sets necessary to ski proficiently are not covered here.

Core steps must be completed with a degree of proficiency before going on to the next level technique. Some students require longer periods of time to accomplish a goal than others, sticking to the basics is always valuable before moving on in this case. Bottom line, fast easy skiing is a marriage of body position, explosive powerful movement and balance.

Lastly, this document attempts to cover in a few pages what can only be covered in the length of a book with video accompaniment. It is also a work in progress just as learning to ski well is a life long endeavor. Therefore, take what you can, add what you know is correct, and keep in mind that skating will continue to change in the next few years as it has in the previous years. Enjoy the ride.

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Ski Pole Length:

Height	Metric size	Classic pole	Skate pole
2' 9"	84 cm	70 cm	80 cm
3'	91 cm	75 cm	85 cm
3' 3"	99 cm	80 cm	90 cm
3' 6"	107 cm	85 cm	95 cm
3' 9"	114 cm	90 cm	100 cm
4'	122 cm	95 cm	105 cm
4' 3"	130 cm	100 cm	110 cm
4' 6"	137 cm	105 cm	115 cm
4' 7"	140 cm	110 cm	120 cm
4' 8"	142 cm	115 cm	120 cm
4' 9"	145 cm	115 cm	125 cm
4' 10"	147 cm	120 cm	125 cm
4' 11"	150 cm	120 cm	130 cm
5'	152 cm	125 cm	130 cm
5' 1"	155 cm	125 cm	135 cm
5' 2"	157 cm	130 cm	135 cm
5' 3"	160 cm	130 cm	140 cm
5' 4"	162 cm	135 cm	140 cm
5' 5"	165 cm	135 cm	145 cm
5' 6"	167 cm	140 cm	145 cm
5' 7"	170 cm	140 cm	150 cm
5' 8"	172 cm	145 cm	150 cm
5' 9"	175 cm	145 cm	155 cm
5' 10"	178 cm	150 cm	155 cm
5' 11"	180 cm	150 cm	160 cm
6'	182 cm	155 cm	160 cm
6' 1"	185 cm	155 cm	165 cm
6' 2"	187 cm	160 cm	165 cm
6' 3"	190 cm	160 cm	170 cm
6' 4"	192 cm	165 cm	170 cm
6' 5"	195 cm	165 cm	175 cm
6' 6"	198 cm	175 cm	175 cm

Figure 1. Ski pole length sizing chart*

*Note: The chart is a beginning reference, not a hard and fast rule. Start slightly long and cut downward as necessary or comfortable. Poles may be slightly longer as the skier becomes stronger.

Section 1. **Ski and Pole fit.**

Selection of skis and poles is critical toward skiing efficiently. Students with too short or too long poles not only lose efficiency, they learn to ski improperly. Following are basic fit points to consider when equipment is selected.

A. Poles.

Pole selection is relatively straight forward. When deciding how long the pole should be, have the student stand upright in their ski boots. Place the pole beside the student in the center of the torso, they should be looking straight ahead and stand upright. Backing up to a wall can help greatly. The grip should come up to the mouth or upper lip area when they are standing upright and not slouching. Touching the nose is too tall –the area just below the nose is great if the student is strong in the upper body. That said a pole too long causes a stroke timing delay or incomplete poling cycle so the legs are waiting for the arms to catch up before they can transfer weight to the opposite ski as detected by a dead spot in pole motion. The coach may see a delay in weight transfer when this occurs and the student will loose momentum. You will also note an abbreviated compression. If poles are short you will see the arms working but not the natural up and down of the body falling onto the poles. If you see a student that does not return to a full standing up ready to ski position after a cycle this is often the problem. Poling looks strange in this case as well and is easy to I.D. Of all equipment elements, correct pole length ranks among the top in performing technique well. A sizing chart is provided in figure 1 to use as a reference.

Pole straps should be snug into the thumb and finger so that the pole is always positioned without having to grip it. Look for students giving the pole a death grip causing havoc with the fluidity of the stroke. It also freezes the hands quickly due to reduced blood flow. A strap adjustment may be all that is needed to help this student out. Grips that support the hand well are best - the plain strap system of old is harder to ski easily. Current grips have a fair degree of adjustment so no one should be skiing with loose straps anymore.

B. Skis

Ski selection is based on camber flex and tip and tail flex – how the ski reacts under a load is a combination of the two figures. Ski length is not very important but it is easier to ski a shorter ski if it fits. The idea is to ride only the tips and tails and rebound the ski after compressing from a weight transfer. Skis that are too soft will collapse under the student thus increasing surface area significantly creating very slow skis that act “dead”. If skis are too stiff the student can not collapse enough of the ski under full weight and the ski will slide all over the place due to lack of full length edging. This makes students very tentative as the ski will slide out instead of supporting a push to the side. Students are reluctant to get over their ski in this case. Any store with skis should have a trained technician

who has all the correct tools to fit a skier. It is highly recommended that serious skiers patronize a very knowledgeable store either on-line or in person. Ski fit is far and away more important than base structure or wax in terms of fast, efficient technique.

One note about skis; the most expensive skis have a narrow flex range and the entry level skis have a much wider flex range. Top level skiers have many (minimum of 10) pairs of skis flexed and structured to hard pack snow, soft pack, extreme cold, extreme warm and everything in between. A single ski to do it all is difficult to find but practicality must bear witness and a “do it all ski” can be very effective if cared for. Again, an entry level ski works fine for most of the students but if the student aspires to be very competitive then an upper level ski with tighter fit parameters may be more suitable.

Section 2. **Ski Body Position**

Every student should be introduced to the starting body position before anything else and be told this is where your body needs to be using all skate or classic techniques. The drill here is to have someone look at you and honestly assess your body position or better yet look at it in video since movement is dynamic, not static. Figure 2 shows the body position in stick figure, this is the first and most important component students should understand for a myriad of reasons. **Dry land technique work should focus on this before getting on skis, snow or no snow.** It takes TIME for many students to keep their weight forward as the figure shows. Of utmost importance here is keeping weight forward at the ankles (bent) and not sitting back on your haunches. In fact the **WEIGHT FORWARD CONCEPT** is paramount to fast easy skiing. More about weight forward and its importance in designated techniques sections.

Coaches look for the following:

- Slightly Bent knees, however keep an upright stand in upper body (relieving pressure off of back muscles!)
- Hips tucked under the spine rotated forward.
- Bad posture – slouching type posture.
- Upright position of the torso with shoulders slightly rounded forward in a “C”. This keeps the chest open for breathing and pre-loading compression phase. If head were attached to a string the body would be pulled up in line with the vertical string. Due to forward angle from bent ankles the head (and whole body) should be naturally angled forward angled down a bit.
- Head in line with the spine – not looking up or down. Look about 5 yards in front of you and look up the trail only periodically for orientation.

- Relaxed form – able to absorb bumps and change in trail conditions without tension in muscles or knees.
- **WEIGHT FORWARD FROM BENT ANKLES** – this is the big one!!!! The weight of the skier must be forward of the boot center to ski forward. If the weight is forward because the back is bent then the butt is pushed back the student is defeating the purpose. Look for bent ankles – it doesn't happen any other way. If you don't see them then the student should be skiing without poles. It takes time to develop this notion. Be patient and encouraging. The knees have to be ready to drive down and forward toward the ski tips to load up before a skate occurs.
- Hands open and relaxed as if going to shake hands with someone.

What it should feel like

1. Feels like you're Bigfoot or an ape walking around.
2. It feels like a small tack is under your heel and you don't want to set your heel down.
3. It feels like your going to fall forward on your face if you tip any further forward.
4. You feel like a gun fighter with hips tucked forward ready draw fast to shoot.
5. Feels like bad posture but it is really relaxing.

Try This: With skis on, facing down a very slight downhill at full stop, sit way back with the weight shifted back. Then begin moving the hips and center of gravity slowly forward. What happens? How can you apply what you just learned to skiing fast and easy?

Coaching check list



1. Ankle Flex
2. Shin parallel to core
3. Knees slightly bent
4. Hip tucked under spine
5. Arms right angles shoulder width
6. Hands shoulder width – elbows a tiny bit out.
7. Hands/arm eye level and in close to torso not close together (bad habit)– purpose is to transfer power of core to poles.
8. Grip – loose and relaxed
9. Head in line with spine – look just in front
10. Chest open – shoulders only rounded like a “C”

Section 3. –When and what kind of force to apply in the skate stroke - putting the “S” in skating.

Skate skiing is fun at any level because the experience is very personal yet it is easily shared with a group, but as speed and proficiency increases, so does the need to spend the skier’s power reserves wisely. This section could also be called, “plyometric skiing” because quick and explosive movements developed through plyometric training turn out to be the most efficient application of power. “Technique” in this case not only applies to body position but also the timing involved in forces created by the skier’s body.

If the student is in a good body position they should be introduced to the idea of applying their efforts in both upper body poling and lower body weight transfer in an explosive manner. This technique is amenable to dry land training in the form of plyometrics and it serves as the analogy here. In plyometric training the athlete is working to improve the rate that their body weight can move – effectively the definition of power. Poling motion and skate motion, as we will see later, becomes more efficient when applied intensely during the beginning portion of the effort leading to a much snappier follow through and relaxed recovery afterward. Consider other sports such as baseball or golf. The player wants to impart a lot of energy to the ball. He (or she) doesn’t slowly swing at the ball in slow motion. Instead, the swing is a sharp acceleration of the bat or club that impacts the ball, hopefully sending it long and straight.

A long steady muscular contraction from either upper or lower body has three limitations. First is the inability to transfer blood, this simply prevents the removal of lactic acid as well as preventing oxygenation of the muscle. A contracted muscle reduces blood flow and the example here is giving a death grip to your pole handle, how quickly does your hand freeze when the gripping action is tight? Quite fast and the same reasoning applies to the major muscle groups during the skate or pole. Fast applications of power allow the muscles to relax longer. A second issue with a long steady push is that it doesn’t allow pre-loading the muscle. Because muscle acts similarly to a rubber band, we can get far more from it if it is stretched long first to increase potential energy. The use of potential muscle energy in a long slow release is counterproductive because it is the initial application, when the band is stretched most, that provides the most potential. Why waste it? Last but not least is the terminal issue of lost momentum due to the long slow push – no pun intended – O.K. that’s a fib, some pun intended. The key here is that spending a greater amount of time with your center of gravity over your ski gliding is far more beneficial than spending it between your skis. If your power application is slow and concerted then it takes longer to transfer and you spend less time with your center of gravity gliding and more of it hanging in the middle where glide isn’t as directed.

The argument may be that a vast majority of skiers prefer the experience over race results so this section doesn’t really apply to them. The contrary point is that applying force in an explosive manner at the start of the double pole and the at the start of the skate push allows for faster skiing at any level with a lower heart rate and the gained efficiency is always fun.

So how much force should be applied and when? Garott Kuzzy of the USA ski team and Central Cross Country (CXC) team feels that about 85% of the entire effort should be applied in the first 10% of the movement be it pole, torso or leg. The remainder of the effort applies to a snappy follow through with the arms or the effort required to return the body to the starting ski position after the power application. Any plyometric training will be beneficial but direct application techniques based in skiing movements compounds the benefit.

To institute quick and powerful (mass over distance) plyometric muscle responses admittedly requires some concentrated dry land dedication to training. It is a matter of training the neuro-network to move quickly as much as it involves preparing skeletal muscles to handle the load asked of it. The nice aspect of this type of training is that it comes quickly once focused on. Good examples of training to orientate toward explosive movement include CXC's coaching series.

What it should feel like

1. Explosive muscle movement feels like your jumping from one place to another by loading your legs up as opposed to taking long steady strides or steps.
2. Early initiation of power should also feel like your sitting in an easy chair relaxing in front of the fire! What? Yes, your muscles should be done early in their effort, the rest of the time they act to hold you up or do nothing at all and that is nearly 90% of the stroke. How cool is that? No wonder those top guys go so fast without working at it, they are only working 10% of the time!

Section 4. Skiing without poles – skating free of complication

This is a primer of not only how to start skiing but also a reminder for everyone of every level to practice key elements throughout the year and skiing without poles is paramount. Using poles more often than not is discombobulating to skiers. The brain can process a finite amount of information from the muscles. Because skiing is a sport that incorporates all muscle groups and balance at the same time, the neuro-network becomes a city traffic jam trying to handle the load. Poles tend to add to the system over load quickly, slowing the learning down in most cases. Imagine trying to learn several new languages at the same time – it's not easy. Skiing without poles over and over for long periods of time really changes how a person understands application of leg power. One coach worked on it while nursing a broken collarbone for a year – it really helps because your body needs to know that most of your momentum and speed comes from both legs evenly. It is really amazing how fast one can ski with legs only and it reinforces the body forward at the ankles concept – a major key to skiing well. You can ski any course end to end without poles – personal experience is with the City of Lakes and Birkie courses!

Full commitment is necessary on each ski and the reason is that the push leg needs to rest and recover (as mentioned above) it is less able to do this while contracted. The long dedicated transfer of weight and subsequent gravitational leg fall toward the supporting leg allows it to get blood and oxygen. Let it relax fully during this period. Abbreviated compressions shorten the recovery phase between strokes. While it is non-intuitive, a long, dedicated, powerful push is actually more taxing than explosive or quick transfers of weight for this reason. Just look at Olympic skiers, they never look like they are forcing their efforts even when sprinting at the end. They use a combination of explosive effort with very

fluid motion and complete transfers are standard. Only use the muscles necessary in order to allow the body to transfer over to the other ski and let everything else rest.

Things to keep in mind while skiing legs only:

- Hips stay horizontal to the trail and body stays slightly more vertical because you don't have poles to fall forward onto. Avoid dropping a hip side to side. The drill here is to use a pole behind the back to assure body stays in the vertical plane. Note: The torso can rotate slightly back and forth on a pivot point of the spine to facilitate weight shift. Placing the poles in the horizontal plane behind the back quickly indicates if the hips rotate or twist.
- Feet should be 6" wider than shoulder width and stay there, don't bring legs back in to touch ankles – its wasted time.
- Take small side to side steps instead of large ones – never step forward or backward. This helps keep the ankle angle and weight shift over each ski. Putting feet down early doesn't pose a penalty in mechanics and allows a skier to "skate" onto a ski as opposed to stepping over to the ski.
- Leg push is completely perpendicular to direction of motion. In other words straight out to the side, not angled back or forward. Skis angle out to a greater degree when going slower, for example up a steeper hill, less so when up to speed. If your weight isn't forward of your feet, skiing without poles becomes very hard if not impossible.
- Inner part of ski is used to push off from, landing the ski flat is key but pushing off it requires some angling.
- Push is with whole foot but ball leaves last.
- Like a speed skater emphasize weight shift with the upper body (as opposed to keeping a motionless upper body and the legs acting like pendulum) –One way to think about this is, is to lead with the hips, meaning the entire body goes with the center of gravity over each foot. Again, weight (i.e. center of gravity) over the ski in the vector of motion moves the ski forward. Watch for cheating by folks tipping over with the upper body first, torso and hips stay over each other in a vertical line.

Drills for skating without poles:

1. Vertical pole behind the back to check vertical plane movement. Repeat with a horizontal pole behind the back. Look for excess twisting or rotation.
2. Arms folded and crossed at shoulder height. This quickly shows if skier is rotating body or not as well. Shift body side to side instead. Keep arms up and horizontal, not dropped to torso. Frame up the trail

between the elbows with the eyes to prevent rotation of torso and outstretched arms.

3. Speed skater with hands locked behind the back. Emphasize weight shift with upper body here. Hips stay in forward stance in direction of trail with minimal rotation. For older skiers who were taught to face each ski before shifting – things changed because it is possible to face a ski with the head and not have a complete weight transfer. Think of a rod run through your hips coming out both sides; keep the rod ends perpendicular to the trail with minimal turning.
4. V2 alternate arm swing. Swing opposite arm and ski down the trail. Point finger straight down the trail if it helps keep body perpendicular to the trail and prevent excess rotation of upper body or hips. This builds strength as well.
5. Ski not only straight down a trail but also in tight circles, around corners, through cones or in conga lines. Play games with the feet like soccer and have races without poles.

Coaches should look for:

1. Good weight transfer with upper body over the hips – lead with hips, not shoulder. Center of gravity at belly button at least to inside of ski minimum. Complete dedication to ski so opposite leg can lift off the ground. Does student immediately fall to other ski or not leave the safety of living between the skis?
2. Place reflective dots on the center of gravity and on the boots to help align the two points as the skier gets over each ski.
3. Place dots on knees and skis near tips – does student drive the knee forward and down so the dots get closer to each other?
4. No hip or upper body rotation – at least minimal hip rotation.
5. Small steps skating onto each ski rather than stepping to each ski. Knees must be bent along with ankle to do this.
6. Vertical, slightly forward angled body without rotation.
7. Good forward body position at the ankles - acute angle, more so steeper uphills.
8. The knee of the ski you're transferring to should be angled slightly toward the ski you're landing on. Hips stay low all the time; in other words, there is no standing up straight. This loads the muscles, assures weight transfer and prepares the body to explode over to the other side. The skier can't push off a straight leg.
9. Look for glide distance but also look for a loss in momentum before the transfer occurs. There is never a dead spot in the weight shift from side to side; the body is in constant motion.
10. High hips – this means up and forward (i.e. tucked under the spine) to get the center of gravity ahead of the feet. Look for students sitting on their haunches. No sitting back!

What it should feel like

1. Remember the tack in the heel of your boot? Push with the whole foot but your weight should feel like it is on the balls of your feet at the end.
2. Feel your weight riding over one ski completely and if you screw up it should feel like your only hope of recovery is by adjusting the ski under you, not the off side ski.
3. Hips feel like a scolded dog with its tail between its legs, they rotate forward. Also feels like you're a gun fighter ready to shoot, turn hips so the guns come out faster.
4. Feels like your hips stay low the whole time, you don't feel like you ever stand up straight.

Section 5. Double Pole – how the upper half lives

The purpose of this document was to act as a reference to beginning High School skiers and coaches and not obsess over a myriad of details to complicate skiing. But, here we are many pages in and finally getting to one of the most core concepts in classic and skate techniques, the double pole. Because all techniques share the same basic double pole principal, it is worth while spending extra time enforcing these points before moving on to skating with poles concepts. High School students often lack the strength to propel their body down the track efficiently so spending time, including entire practices, double poling will promote technique and stamina overall.

Coaches must keep in mind that a correct double pole does not correlate exactly to each skate technique (unlike classic double pole). For example V2 has an abbreviated stop in hand/arm rotation where the hands stop at the hips and do not progress further on each stroke - due to lack of time to recover poles before weight transfer must occur again. Likewise the extent of double poling in terms of degree of bend at the hips is dynamic with changing conditions. Up hills and slow snow conditions demand faster but abbreviated turn over rates. None the less, all skating techniques are fundamentally based on double poling whether abbreviated or complete. It helps to keep in mind that the arms do very limited work in skate skiing compared to legs and torso!!!! Their muscle mass is not enough to maintain speed for more than short periods before fatigue. The arms merely support the body on the poles as it falls while combining gravity with a torso muscle crunch to propel the body forward. The arms do play a major role as they snap through at high speed once the torso is finished working. Again, the arms take over forward propulsion but only after the core torso muscles have accomplished the majority of the task. Think of arm use as a "speed maintenance tool" and not an initiator of speed. That said, tremendous upper body strength is now playing more of a role it didn't years ago as speeds are pushed to a higher level.

For the purpose of this guide, the double pole will be divided into three descriptive parts.

1. Body position with weight forward
2. Mechanics of the down stroke
 - Crunch phase
 - Arm application
3. Mechanics of the recovery or up stroke
 - Loading the rubber bands

Body position has been covered previous but it needs to be brought up again here because a good double pole effort will be wasted without a forward stance. Once body position is understood we can get right to it with the mechanics of poling in two parts, the down stroke and the recovery. Step one of the down stroke is the crunch phase. It involves the torso and is explosive. The more active and involved the initiation toward the downward motion using the abs, the faster the skier goes. Merely falling or just a crunch doesn't do it – they have to be in synergy. Step two occurs when the torso crunch is finished, usually about the point where the elbow or humerus reaches the torso (think dynamic and not static here to meet conditions). This is where the forearms kick into action and snap back past the body in the open field or snaps to the hips in V2. The function of the forearms is to maintain speed gained from the crunch. The final step is to actively recover the arms back to the starting skier's position. The important aspect here is to over stretch the muscles so they can apply more force than they are able to do otherwise. This is also the point where skiers are reminded to not put a delay in their stroke by stopping the arms behind them, they return quickly as soon as they complete their back motion.

Body position – is your weight forward from ankle bend?:

Starting the double pole requires the skier stand in the basic body position as stated earlier. The most important component is a nice angle in the ankles to move the skiers' body forward. –A BEND FROM THE LOWER BACK doesn't cut it; the butt just shifts back and pulls the center of gravity behind the feet with it. While standing in one place this position is easy to obtain without skis, but once in motion it is easier to fear the forward falling motion and the potential created to propel you forward. Center of gravity must be positioned in front of the feet!!! How far forward? As far as possible without endangering the lower back – some skiers even “throw” their body forward in a jumping type effort but this is advanced. Skiers find difficulty moving in the forward vector without a forward body position and the problem with this has always been with the brain. Why is it so hard to get the center of gravity in front of the feet? From 38,000 or so years of evolution the brain has been wired to protect itself. It basically has a default mechanism to react toward safety, not unlike jumping when a snake is discovered suddenly next to your foot. Safety means not throwing your center of gravity ahead of your feet while flying down the trail in brain language. You have been walking upright with center of gravity over your feet all your life, “why should you change now?” Young children rarely care a bit if they fall over and in fact do so on a whim or for entertainment. Adults have a harder time picking up fast easy skating because the years of wisdom built into their brain tells it to not induce danger upon itself. Ski skating is like teaching your brain a

new language but the only statement that needs to be enforced is, “trust that your muscles are capable of learning the forward balance just like learning any new language”. The “I’m going to fall on my face and bruise or injury myself” thoughts that come up subconsciously are poisonous to skiing free and with abandon. Train the brain and enjoy the ride. Snow is generally pretty forgiving.

Another key to the starting body position is getting the arms up high enough. We are looking for a 90 degree bend at the torso and in the elbow. A collapsed position severely degrades the potential for a strong crunch coming in the next section. Think of getting into the boxers position with hands protecting the head while keeping them shoulder width. Many people try to cheat by pulling hands too close together –they should stay shoulder width apart.

Once a good body position is obtained while moving down the track, double poling happens in a simple “down-up” rhythm that the skier can chant if they so choose to keep their timing. Let’s look at the mechanics of both down and up strokes.

Mechanics of the down stroke

a) Down Stroke Crunch Phase:

As a reminder, the head and hands follow together for the first one third or so of the down stroke, this is what I’m calling the crunch phase. It is assuming the muscles have been stretched out from the previous up stroke and the body is forward and loaded to explode again. Recall that gravity and muscle compression should take center stage here. Falling on the poles and the crunch occur synonymously. The effort is a series of details once the concept is understood in the following set of points:

- Fall forward at the ankles and land the poles, do not bend at the lower back alone, the knees are slightly bent but don’t bend them further if any more after this. This is the gravity-based phase of the stroke in conjunction with torso contraction. The chant is “crunch” down to remember the arms only hold you up at this point.
- Land the poles from your falling body near or behind the feet when starting out or going up inclines. Plant them in front of the feet as you go faster – this should change dynamically with terrain.
- Allow the head to drop with the hands at the same rate for the first one third of the stroke. This means the body stays in front of the center of gravity, do not allow the center of gravity to fall backward behind the feet at any point. Again, if going up hill the entire stroke may only be the first third of the stroke to prevent stalling out.
- Compress with the abs upon placing poles in contact with the snow doing a stomach crunch. Gravity and muscle work synergistically at this point. Head moves toward the belly button in crunch.
- Arms should be at a 90 degree angle between forearm and humerus. The humerus and torso should likewise be at a 90 degree angle – this is called “leading with the elbows”.

- Compress the abs with the forearm and humerus maintained at 90 degrees. The waist is bending and the butt moves back here allowing for a powerful contraction from the abdominals. Approximately at the time the humerus comes even with the torso, the head and hand motion should no longer be linked and the next phase begins. The head stops in downward motion at this point as well (unlike skiing years ago). Only the arms go on from here.

b) Down Stroke Arms Phase:

The first portion of the stroke from the crunch is over and the second segment of the double pole is about to begin. The body stays bent over as the arms apply their work. The arms snap through to whatever point of completion that is dictated by the conditions at hand. There is no time to reach in your pocket to check for the snickers bar you thought you brought along, the hands need to snap fast. If the forward motion of the body begins to slow down the objective is lost and a rapid return the starting phase needs to begin.

Snapping the arms back to a specific location (hips or behind the back) at this point in an active motion to carry through with the cycle is a dynamic process. Remember that the hands stop at the hips in V2 and behind the back in open field. In V1 they stop at the hips as well. However, this is very dependent on conditions. In fast snow some feel better using V2 but powering in a slower turnover meaning they have time to let the hands pass behind the hips. It is critical to understand that everybody is different and each person is charged with playing around until they know what works best for them. Coaches should drill the idea of dynamic arm use meaning a fast stroke that ends where it needs to, depending on the terrain and snow conditions. Way too many people are stuck in a single rate of turnover speed and it carries over from V1 to V2 to open field. Use the arms only application and where it stops to help accommodate and best fit conditions at hand as is the easiest to change as needed. The legs follow just as in running. The crunch is not adaptable, it occurs as explosive as possible each time and the arm speed is not adaptable, just where they stop before the return.

Recovery Phase or the Up Stroke

Now the body is down and can start the up motion. All work has occurred except for recovery. Thus starts the “up” segment of the stroke. This is where the arms return at the same time as the torso gets back into starting position. The two work together with the arms carrying momentum as they are literally thrown down the trail for free speed.

- The body returns to the starting position again in the up stroke, going back toward vertical to load the body again.
- Swing the arms from the shoulders in an active forward motion.
- Elbows should be angled only slightly, around 30 degrees at most. In other words the swing is from fairly straight arms as if you were tossing a cup of cold coffee out with a big arm swing.

- While the arms are returning in a very natural and very relaxed swing, the upper body should be moving from the crunch compression back up to the bad posture starting position.
- The up phase for the arms, as alluded to earlier in a slightly more advanced level, does not stop at the starting position point. Instead it goes right past it. By doing this the momentum and weight of arm swinging accomplishes two major points. First, it pre-stretches the muscles like an elastic band, allowing much greater downward force to occur compared to non pre-loaded or static muscles. Second, the weight of the arms is used to “throw” the body forward with its built up kinetic energy. Of note however, the brain has to be comfortable with being “thrown” forward past its evolutionary trigger zone for safety.

Coaches should look for:

- a. A ninety degree bent elbow and a ninety degree angle between humerus and torso.
- b. Hands shoulder width apart, not close together.
- c. Good acute ankle angle
- d. Compression from dropping slightly at knees with hips dropping the same amount.
- e. A good strong stomach crunch. Check this by using slight inclines to ski up and see where student bogs down. They should be able to stomach crunch up most inclines if they don't have to follow through with arms.
- f. Head follows the arc of the hands for the first portion of the stroke.
- g. Poles are planted close to the skis.
- h. Arms become primary modus of movement when the humerus reaches the torso, but not before.
- i. The butt does move back as the torso compresses down, however the weight is forward at the ankles so the center of gravity doesn't go back past the feet.
- j. Arms swing straight up on return and hands return above the starting position.
- k. Elbows are not angled away from torso more than 30 degrees at the very most but the 90 degree rule still applies between torso and humerus bone.
- l. The hands should come back up to eye level so the pole hangs above the ground ready land next to the skis again. If there is a delay in the ski stroke, and there shouldn't be, this is where the delay should occur, not while at the hips or behind the back.

<i>What it should feel like</i>

- The crunch should occur just like you're throwing a medicine ball down on the ground to bounce it. This requires experience.
- Your chin should feel like it is going to touch your bellybutton.

- You should feel like your stomach muscles contract while you're falling with gravity.
- The arm speed is like hitting gophers on the head at the county fair game.

Try This: Jump as far as you can with your feet together without using your arms. Mark how far you went. Now jump again but this time swing your arms and throw them in front of you during the jump. How much farther did you go? Add this much to each ski stroke as you swing arms past the starting position and see what effect it has.

Section 6. **V1 Technique - combining free skating and double polling together to triumph over the hills.**

The V1 technique is the style of skiing most people start with because it requires the least amount of balance to perform. It is also both the most important because significant time is lost in the uphill during a race but at the same time it is typically the least frequented technique of the three. V1 is often correlated to first gear in a manual shift car, a gear necessary for going up very steep hills. You use first gear to start from a dead stop, go up hills or go through snow where conditions are really slow with little glide such as very cold dry conditions. Most racers lose a significant amount of time on the uphill so the technique is critical to learn well but it is often over used elsewhere when a V2 would be a better choice.

The advantages to V1, other than it requires limited balance, is that a skier can ski any course using only this technique and many unfortunately try. The compression phase of the V1 acts just as the double pole we started with above but rather than starting the double pole while on both skis, the poling action starts when one foot is placed down in the snow synonymously along with both poles. The difference is that the concentration of the body's weight is over one pole on one side and the other pole (non-weighted) is slightly angled out. Other than that, V1 is a double pole when both poles and one ski land on the snow at the same time. This technique follows the same drill as a plain double pole with the exception of the "up" phase. In a V1 skate the "up" phase of the double pole transfers weight over to the opposite ski (V1 should become proficient on both sides, not just the favored side). The weight transfer allows enough time for pole recovery before the cycle starts over again. One key to be brought up at this point, even at the steepest slopes some glide should come from every step of the skate. Both legs contribute equally unlike some zombie like skiing noted in beginners who ski with a straight leg. To accomplish glide, the ankle angle has to be very acute, the steeper the

hill, the more acute the angle. The skier should never see their boots below their knee for example.

With a good double pole type compression and acute ankle angle the last step is to squash the bug. This basically means to pre-load the muscle by putting a little extra push down on the balls of the feet as if you had your foot on a bug and gave a hop on it to make sure it was dead mushed. This hop effectively blasts you off over to the other side. What you don't want to do is give a long steady push, snap over the other side instead.

Original V1 teachings suggested the skier turn their body toward the direction of each ski when pushing with the legs. This has finally been laid to rest and the torso needs to go straight down the trail. A little torso rotation is okay and in fact may be helpful but not much, the body goes straight down the trail otherwise and the legs push perpendicular to the direction of skiing. On that note shoulders are square to the trail in both the vertical and horizontal planes while they follow the "down-up" mantra of the double pole, shoulders stay over the hips. Following are the steps that need to take place during each stroke remembering that poling should be switched from one side to the other to help reduce fatigue.

- Start with the skier's stance - nice relaxed knees and tight ankle angles.
- Pick up one leg (right or left) and lift the poles with the leg.
- Plant the leg and poles at the same time (one side or the other).
- Double pole crunch while center of gravity is over whichever ski the body is focused over.
- One pole does most of the work on the "power" side and the other pole is slightly offset but as minimally as possible. This is still a double pole.
- Literally follow the double pole motions. The **hands stop sooner than the normal double pole on the down stroke, usually at the hips**. The reason is that the body must shift to the opposite leg quickly before losing momentum and if arms are too far back to catch up, this can't happen.
- Ankle angle is key here, hips stay low. No standing up or use of straight legs!!!!!!
- The non-primary poling side will push the skier toward the poling side with an enthusiastic push.
- Remember to squash the bug before the transfer to the opposite side.
- Setting the ski down early to glide onto isn't a penalty.
- There is no step forward or return of a trailing leg from behind, legs are always in line with each other and squared up with the hips.
- Legs stay wider than other techniques; do not recover legs to the center between strokes.
- Complete shift to the other side and repeat. This is a fast stroke, most failures occur by making it last too long between transfers of weight.

What coaches should look for.

- a. Students lead with elbows, close to pole, with hand in close to body on the “power” side.
- b. The shin is parallel with the forearm.
- c. Dedication to setting one ski and both poles down at the same time (with focus on one side).
- d. Poles come down together and leave snow together (although a little alternate poling isn’t a big issue)
- e. Upper body transfers over the hips to each ski. FULL DEDICATION OF WEIGHT.
- f. Again, hang arm (weighted side) is tight into the body, not hanging out in front. Elbow is almost at the pole.
- g. Compression is critical – you should see clear downward motion as opposed to setting poles down softly and not leaning on them.
- h. Can’t see the boots because ankle angle is so tight.
- i. Active return to the poling side by a clear and concerted effort from the non-poling side. I.e. Squash the bug on both sides every time.
- j. As always, ankles flexed, chest forward and pushed out a bit, forward body lean at ankles, hip and ankle over each other, head looking a few yards ahead, not down the trail. This is basic body position.
- k. No or very little loss in momentum before transfer!!!!!! Very common mistake. This is a quick stroke.

Notes on V1

- Shorter movements with high tempo are much better than slogging with a slow turnover. Very common problem.
- Shoulders should stay even i.e. don’t drop them and keep them parallel to the trail. They stay over the hips.
- The feet make a “C” shape during the stroke.
- Skis rotate out more or less as terrain changes. Tempo changes as a result as well – Hammer tempo into students – this is a high speed technique.
- Ski stays under the body as opposed to “reaching out” with each foot. It takes too long to get back over other ski.
- Poles need to be leaning forward. An upright pole doesn’t propel the skier down the trail well. Poling direction is directly down the trail in the vector of the skier, not off in the right or left direction the ski is pointing. This is a pure physics and kinesiology issue that most people have a hard time with. Ditch the nose, knee, toes concept.
- High hips – the knees stay compressed but the hips must stay in front of the center of gravity. If they trail back behind it the effort is all lost and momentum will be dead. Body position is super key.

Section 7. **V2 technique - Synergy at its best.**

V2 is a dichotomy of reward vs. challenge. On the one hand, it is by far the most efficient of all the techniques in terms of speed per effort. On the other hand, it is one of the hardest to learn in terms of balance. Establish the V2 and your student will be a long way toward being an excellent skier. Timing is relatively natural once stroke rhythm is established; many students catch on only after they reach a distinct comfort level of balance however. This is one technique that sits high on the pyramid but can only be obtained after a certain base level of proficiency is garnered. It takes time to get it but the pay off is definitely worth the work.

When should anyone V2 during casual skiing or in a race? The short answer is, “all the time”. Most gradual up hill sections are handled with a V2 once a skier’s strength allows. Of note, strength is needed to V2 up inclines; beginning skiers should not be discouraged if this is a challenge. The key to knowing when to turn to a V2 is any time a V2 alternate turnover slows down or when terrain isn’t steep for a V1. The remainder of the time a skier should be using V2. Just so the point doesn’t get lost, try V2’ing a lot more than you do now and see where it leads.

Why does V2 work so well? The answer is simply synergy. When any effort is extended through the core, adding arms at the same time multiplies the effect. Think of two people raking the lawn instead of one – it goes faster and neither is worn out as much compared to doing all the work individually. When two segments of the body work in synergy they produce greater thrust than each can do individually. Therefore, less effort is required individually and less lactic acid is built up to go the same speed – simple Biochemistry. You may say, “Well the torso and arms are working in synergy in the V1 and the V2 alternate so what is the difference if I use one or the other?” If you use 30 strokes to go a distance of 30 yards, and you assume you go the same distance with each of the three techniques (which is a long stretch to believe but it suffices for the example), then each stroke yields a yard of distance. In that yard during V1 and V2 alternate, half of your body is working synergistically with arms/ and core while the other half of the stroke is legs only. Specific muscle groups for the technique must work harder to go the same speed when they work alone. With V2 synergy, groups of muscles are working as a team. Combining muscle group efforts on more strokes adds a little more efficiency each time and it adds up to be a lot of efficiency in the end, especially in marathons. V2 equals kinesthetic harmony and efficiency – work toward it and reap the rewards.

How to V2.

The V2 is like all the other strokes, it is very dependent on a good double pole form but more so because the efficient double pole is applied twice as often as V1 and V2 Alternate. It is also applied on one leg. So, if you are not comfortable with double pole technique then go back and review it first. Essentially a V2 starts by transferring a skier’s weight and center of gravity over to one ski and using the momentum to gain glide. Before a skier’s mass begins to slow down from glide friction, the skier begins to plant their poles, as in any double pole, with both poles applying equal force. This all occurs while on one leg, thus the balance issue. Again as in double pole, the torso drops at the knees with hips straight down (no back bending) to load the ski while the upper body does the standard crunch. The standard double pole action applies using

stomach and later arms. Squashing the bug applies at the ball of the foot before a transfer of weight to the opposite side to repeat the effort. Very simply V2 is a one legged double pole on each side before a transfer of weight to the other side.

Weight transfer to the other side occurs is an explosive push after the crunch phase but the arms may be in action during the transfer. If you don't wait for the right moment weight shift occurs too early and the effort is wasted. Having imbalance issues promotes early transfer and loss of momentum. Dedication to each ski is still paramount, maybe more so here. Students most often have trouble with timing because they want to fall to the other leg to supplement limited balance. The Shift from side to side happens just after the compression is completed or when the humerus reaches the torso if you want a rough que to work with. Here again, no twisting of the body and the body stays in perpetual motion –dead spots in body motion do not exist in V2.

Poles and body point straight down the trail, not facing the trail sides. Legs kick out perpendicular to the direction of motion, not back or sliding forward. Angle of the ski is dependent on terrain, tempo and snow conditions but in general they stay in line with the direction of the trail. Again, KEY POINT, hands do not pass the hips unlike the pure double pole. Double polling alone is not exactly how you use your arms in a V2. There is no time for recovery of your arms if you pole past your hips causing a mess with ones timing. Once hands are even with the hips in the compression phase, the skier can reload for the next compression by standing up a little bit to stretch muscles like a rubber band and lift arms back to the skier's stance. Of great importance is the maintenance of forward hips but never stand up straight, the knees always stay bent enough to be ready to transfer weight quickly. The body is always loaded to compress on the opposite side – this is new as of 2009.

V2 is that simple but there is nuance and subtlety that initially makes it more confusing than it really is.

What should coaches look for?

- a. Are students actually V2'ing or using V1 or V2 alt. instead? Many are confused for quite a while.
- b. As per usual is the student's weight forward? Look for acute angles in the ankle and prevent them from leaning forward at the hips.
- c. Is the student leading with the elbows?
- d. Is the student starting the double pole before the center of mass transfers to the opposite ski rather than during the transfer?
- e. Do you see the student compressing on each side using the stomach as opposed to setting the poles down and letting them pass by without effort?
- f. Is range of motion with arms short or is the skier throwing arms back like a V2 alt? Arms should stop before hands passing hips.
- g. Is body movement constant? In other words are the legs, arms and center of mass constantly moving or is there a dead spot in the motion.
- h. Is the push off with the legs lateral and effective as opposed to falling over to the other side?

- i. Is the transfer of mass rushed so no dedication to ski occurs? If so the student may not have the balance yet. Students gain balance faster by working on V2 however.
- j. Remind students that they should change tempo in the V2 according to terrain and conditions like all other techniques. Slow going means shorter quicker turnovers; try not to gear down to V1.
- k. Arms and elbows shoulder width apart although the elbow can and should point out a little.

Notes on V2

- It helps to ski on a very gradual down hill at first when working on V2 so propulsion is less of an issue.
- Keep in mind every student has a comfort level in terms of balance and they can't be pushed past that level – it is internal. Lots of skating without poles is the best support mechanism to teach V2. Double pole by itself adds a lot. V2 is the combination of the two so go back to each basic if the student doesn't seem to get the concept.
- Talk about V2 as being the goal technique to use so fewer students fall into and get stuck in the V1 single gear for life mode.
- Hips move side to side, body straight over the top of the hips. Slight twist in hips necessary due to loading but otherwise square to the trail direction.
- Push with the foot but leave with the balls of the extending.

Section 8. **Open Field Technique or V2 Alternate - road gear for skiing.**

V2 is the mainstream technique for any skier but some situations call for a road gear. These conditions include downhill's, very fast snow with hard pack, some flats, especially with a tail wind, and whenever the rate of poling is too fast to allow reasonable center of mass transfers in V2. V2 alternate is also a nice way to take a breather while one side rests during the non-stroke side. Conditions ripe for V2 alternate are pretty clear but keep in mind that many V2 in situations where V2 alt. is also appropriate.

Many students fall into a V2 alternate naturally because balance is less of an issue compared to V2. This is often a problem because they turn over far too slowly as a V2 is often more desirable. This leads to premature muscle fatigue from lactic acid. None the less, sometimes the V2 alternate is the segway students need to reach the V2 stage of their skiing career. The really nice aspect of V2 alternate is the dance like rhythm it involves with the down-up cadence of the double poling, it is very relaxing mentally.

So what does the V2 Alternate look like? In essence it is half a V2 in that poling motion only occurs on one side instead of two but that is the extent of the similarity. Poling timing is slightly different, or at least feels different. Where as V2 is a constant compression down, transfer to the other side, compress down again etc, V2 alternate transitions to and rides a fast ski for a bit longer before starting compressing. As a result, the hands have time to completely go past the hips in a full on swing to carry the momentum longer. The non-polling side allows for a longer recovery phase unlike the fast turn over V2. The compression or down stroke still occurs and must be completed before complete weight transfer to the other side exactly as the V2, but because the skis are moving quite fast, it feels like there is a dead spot in body movement. The “free ride” gained by this aspect makes V2 alternate quite appealing and fun. In other words the skier glides slightly longer over the ski before compression with poles starts. This is completely dependent on conditions of course but a skier should be skiing a V2 if they aren't at all positive they can V2 alt. effectively.

So transition to V2 alternate only after being in V2 first to have the speed needed. Skip poling on one side and make a concerted effort to push back over to the poling side equally with the non-pole side leg, remember to squash the bug. Sometimes it makes more sense to free skate with poles at your side and just throw in a pole stroke every now and again to learn the technique. It is an effective way to teach leg use in the V2 alternate as well.

What coaches should look for:

- a. Is the student V2 alternate skiing or just using V1 with bad timing?
- b. Can the student free skate and throw in a poling motion now and again – a sign they understand the technique well?
- c. Look for all of the double pole issues mentioned above. Good compression and completed stroke before complete transfer of the center of mass.
- d. Is the skier using the non-pole side leg effectively or merely falling over to it and falling back to the poling side?
- e. Look for balance issues. If student is unsteady then have them V2 and skip a side once in a while until they gain balance for V2 alternate.
- f. Look for the usual forward lean at the ankles and not at the waist – very common theme issue.

Notes –

- This is one of the last techniques to teach but one of the first for some kids to do naturally. The draw back is that they learn a “one size fits all” stroke speed between V1 and V2 Alternate. It feels like there is more rest time but there is definitely greater taxation on muscle contraction at slow turn over rates. Shoot for V2 before broaching V2 alternate so the faster turn over is learned first. There are fewer “speeds” to V2 alternate.
- Teach this technique on flats or slight downhill sections only.

- Really key in on a good compression of the body on one side and a good leg kick on the other. This is one technique that students tend to become lazy on and just fall back and forth without a kick or compression.

DRILLS

Notes from various folks and some drills Piotr mentioned. This can be expanded on extensively via CXC.

Leg Only Drills:

1-small steps falling forward-- weight shift OVER each ski, putting feet down rapidly due to small steps being taken; side push-- using inner part of ski to push off-- MUST have knees bent and ankles flexed to do this properly.

2- Vertical pole skiing: hips horizontal, shoulders should not "rotate" but rather swing with the shifting of skier's body over each ski, body vertical

3- Arms folded and crossed at shoulder height skiing: focus on not rotating body, rather shifting body from side to side; do not let folded arms (in this exercise) fall-- upright, crossed and forward

4- Speed skater: hands behind your back; emphasize weight shift with upper body; hips remain in forward stance with minimal rotation

5- v2 alternate : timing and arm swing: down up--down up-- down up-- down up-- down up

6- tuck skate-- using drills to increase muscle strength and stamina; 1 minute rotations of tight tucks and tired tucks, with bumps and one leg balancing drills thrown in... for the "cocky ones"!

Remember tight and tired tucks=good; bad tuck=bad-- need to remain "closed" in your tuck stance- hands in front of face, arms tucked in, poles straight back

Cornering Drills:

1- Using big circles to demonstrate the "turning" skills-- diminish the size of circle which will make the skill harder and harder

2- Pushing off on the outside ski (inner edge of outside ski); teaching skiers HOW to turn very important

3- Figure 8's utilizes both sides of the "turning" skills-- right and left

4- Key Concepts taught: use of outside ski as "dominant" strength ski, quick feet, stepping vs. sliding, aggressive pushes when going around curves, putting your hands "into" the corner to emphasize shift

5- Maintaining much more speed with side stepping vs. sliding and/or slowing down

6- Games on skis to emphasize these skills: small races with cones; ultimate, tag

Poling Drills-- two types of Double Poling

1- Start Position: Key concepts-- ankles flexed, shoulder and elbow angles, center of mass position, chest forward, parallel lines (torso and lower leg)

2- Torso Only Double Pole-- keep elbows locked, short-fast motions= Sprint Double Poling-- short and quick

3- Full Range Double Pole-- Emphasize good arm position and let ankles flex; work on timing of arms and head movements

- 4- Specific Strength Drills: 5x45 sec max Double Poling, 5x45 seconds SS, 5x20 second DP up steep hill
- 5-- Key Concepts: ahead moves with hands, bent elbow, open shoulder angle, use of abdominals, high elbows and swings
- 6- Double Poling swinging relaxed-- exhale on compression, good start position, relaxed back, natural head position, "free" (swinging) and active recovery of arms
- 7- Illustrate the power of High elbows vs. straight arms (partner demonstration pushing down with bent arms)

Technique Briefs: These are short notes on techniques combined from several peoples' perspectives. This can be expanded on extensively if using short reminders helps.

V1 Techniques:

- 1- Timing: 3-1 timing-- poles come down together and leave snow together
- 2- Start Position: hand and pole position at pole plant-- hip and ankle should be over one another; head looking forward; ankles flexed and shift in weight over to dominant starting side
- 3- short steps-- keep tempo high and feet under your body; no stopping in hand motion
- 4- minimize rotation of torso-- keep shoulders even (do not drop shoulders and keep them perpendicular to forward direction of movement)
- 5- Shoulders should compress together
- 6- Small "c"s -- path of feet during V1
- 7- Tempo will change due to terrain
- 8- Teaching elements for V1 technique: a) do NOT step into ski technique with LONG stride-- take small steps; b) shorten up strides and place ski "under" skier's body; c) flex ankles; d) plant poles and crunch abdominal muscles; e) minimal difference of distance between poles; f) poles need to be leaning forward (in direction of skier's forward movement);

V2 Alternate: also called "open field"

- 1- Timing: rhythm, swing of arms; maintain the "down--up" cadence
- 2- Start position
- 3- Use BOTH legs-- synchronize leg push using even push offs by both legs and recovery arm swing
- 4- Glide followed by immediate pole plant followed by glide; 1-ski down, 2-weigh over ski, 3- plant poles, 4-glide over to off leg, 5-push off
- 5- Long straight torso and long relaxed arms
- 6- Put feet down quickly
- 7- Usually will use full range of motion with arms
- 8- Fully extend right leg-- hip, knee, ankle of left leg in alignment

9- Drop ankle when shifting from ski to ski

10- Arms extended from hips back-- then upward swing with snapping of hands up-- synchronize with leg

V2: pole on both sides (most difficult to ski due to balance issues)

1- Timing

2- Start position-- same as Double Poling and V2 Alternate

3- Use of TORSO-- short range of motion, little follow through with arms

4- step-step-step

5- Lateral step and push

6- Keep ankles bent as poles are placed

Strength Routines

1 - Jump rope warm ups

2 - Lunges with and without poles-- step up slowly, knees up straight-- good for ankle strengthening

3 - v-ups and pole sit-ups

4 - Push ups and dips

5 - Side throws (with medicine balls)

6 - kayakers-- throw balls, catch while on up swing of sit up

7 - Poles over heels

8 - legs: figure 8's, circles and semi-circles

9 - supermans with weights-- pass weight around body as doing exercise

10 - Storks

11 - Weight in hands-- down on one leg

12 - Hitler's dog