Subaru Factory Team
Pocket Guide to Cross-Country Ski Training

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Introduction
The Subaru Factory Team is the nation's top professional cross-country ski team. While winning races is the team's primary goal, ski racing is only the beginning of our program. We offer clinics, academies and coaching as well as information and inspiration to the cross-country community through skipost.com and we are a sports marketing tool to the industry's top names and the world's best brands.

How to Maximize Training for the Part-Time Skier

By: Scott Loomis

This past season marked my last year as a full-time cross-country ski racer. After eight very worthwhile years of racing and training all over the world I have decided to move on to a new phase in my life. Whether that next phase involves working as a roadie for the next Van Halen world tour, joining the World Horseshoe Throwing circuit or attending graduate school only time will tell.

In the meantime, I am working 40 hours per week in Park City, taking two classes at the University of Utah and working a second job one day per week at a local hospital. All of this leaves me very little time for any sort of structured ski training. In fact, I am lucky if I can squeeze in three to five workouts each week.

I do not plan on completely abandoning the sport that I have spent so many years immersed in. After you spend so much time working towards something you love, it becomes hard to simply quit cold-turkey. I do hope to at least remain competitive on the American Ski Marathon Series next season. But how do I get to a competitive level on such a limited training schedule? What I have decided is that I need to figure out how to maximize my training as a part-time ski racer.

I recently read a short article on the internet about how Thomas Alsgaard is currently training three times per week in his preparation for next year's World Cup circuit. It would be nice if we all had the time (and insane physical capacity) to do this, but for those of us that are part-time racers and weekend warriors that work full-time and/or have families, we simply do not have enough hours in the day to do this. So the question is: What can we do to maximize the training we do have time for? What aspects of a training plan are most important? What can be left out or skipped?

1. Intensity

No matter how little time you are able to devote to training, you should always fit in one intensity workout every week to ten days starting in the summer. Maintaining that ability and feel of going hard throughout the year is important since it can be very difficult to regain once you have lost it. This is especially true the older you get.

Remember that an intensity workout can come in almost any shape or form. It doesn't have to be something done on rollerskis or involve skiwalking or bounding for a specific amount of time with a specific amount of rest. It can be as simple as going hard for twenty minutes in the middle of an hour long run or bike ride or even trying to mow your lawn in world-record time. I personally like doing track workouts because I feel that I am able to get a lot of out of them. I am able to fit a bunch of short intervals into a relatively small amount of time and by the end of the workout I feel pretty tired. It is also a matter of convenience since there is a track right down the street from my house.

The point here is to periodically get your heart and lungs into hammer-mode……how you go about doing this really doesn't matter all that much, especially during the summer. It's not like your cardiovascular system knows what type of training method you are doing, all it knows is that it is working hard.

2. Over-Distance
One good over-distance day is second on my list. It is amazing how well an occasional OD can maintain your endurance. If you average 45 minutes per workout, try to fit in an easy 2 hour over-distance day. If you average 1 to 1.5 hours, try to fit in a nice 3-hour outing. Again, don't forget about the variety of training methods out there. A long kayak can be just as effective as a long mountain run. Also, try combination workouts, where you bike and run or rollerski and run, etc.

3. Skip the Weights
Unless you feel that your upperbody is your weakest link or you need to bulk up those beach muscles for that week on the houseboat in Lake Havasu, skip the trips to weight room during the summer. Some of you may disagree about this, but remember, I am talking about maximizing training on a limited schedule. Of course, if you have a lot of time to devote to ski training, consistent weight workouts can be a valuable supplement to your plan. If you like to rollerski during the off-season, throw in some double-pole only workouts and make those your strength workouts.
Weight training is really only beneficial if you are able to keep up with it on a weekly basis. So, I feel that it is best to start doing some in the fall and try to be consistent with it until you get on snow. I personally hate hanging out in the weight room. I would much rather go for a run than do sets on the bench press any day.
For those of you that really need to improve your upperbody strength I suggest that you make a small investment in turning your garage into a Rocky Balboa old-school training gym. A padded mat, a couple of 25 lbs barbells and wooden box for dips and step-ups is all you need for a basic strength workout that is right there at home. You could even add a punching bag since it just looks cool hanging there and it makes you feel tough.

4. "Everyday" Workouts
For some of you, doing intervals may be unappealing and you really don't have time for OD workouts either, so training only consists of "everyday" workouts. These are simple workouts where you just head out and run or bike or whatever at a comfortable pace for the time available to you. If you are only able to train for 30 minutes three times per week, make sure that you are getting something out of them. Going at a level 1 pace for 30 minutes really doesn't do a whole lot for you, unless you are out of shape and just getting back into training or using it as a recovery workout. If you make some of these short workouts more like semi-pace workouts where you are training in your level 2 to 3 zone then you will get much more out of these days.

The main point I want to get across here is the importance of maintaining a good fitness level throughout the year and it that doesn't necessarily matter how you get it done. If you are able to throw occasional intensity and over-distance workouts into your training throughout the summer and fall, then you are going to be much better off come ski season.

Coaches Note: Much of Scott's advice above could easily apply to a busy HS or college athlete. Note: between ages 15 and 21, strength training provides big benefits – but does not have to be done in a weight room.

Determining Lactate Threshold

Lactate Threshold

Threshold changes day-by-day and, with training, improves week-by-week and month-by-month. The only way to know, and "know" is a bad term to use because it is a changing value, is to take a lab test aimed at finding the threshold.

Athletes have to learn to feel the threshold as they cannot get tested everyday. The test, as well as using a portable lactate tester in training, serves to reinforce or confirm what they feel their threshold is, or what they feel their easy pace is, etc.

Recreational skiers can get tests at university laboratories or better sports centers like the Boulder Center for Sports Medicine for very reasonable prices.

If they aren't interested in this, they will have to use a formula and/or go by feel. It's a comfortably hard pace that can be maintained for upwards of an hour and a half. Formulas are not accurate but may give you a start. A skier's threshold is often between 80 and 90% of max (and even higher). Wear a monitor and, starting slowly, build up your pace gradually paying close attention to your breathing and heart rate. When your breathing is hard but rhythmic and in control and you feel taxed but as though you could go for a good long while then you are probably around threshold. When your breathing becomes a bit ragged and just out of control, and you feel that you could not go for very long then you have crossed over your threshold. Note your heart rate all along the way. The heart rate where you are running a bit ragged is above threshold, so error low. It can be the case that you have predicted your threshold at 175 one day but are running ragged at 173 another day.

What you hope is that you notice the running-ragged-heart rate creeping up. If it is going down, then you know you are training too hard, too much, and/or resting too little. It is a flexible value, so don't think that this can all be boiled down to some numbers. You will have to be involved in deciding for yourself how fast to train regardless what the hr monitor tells you.

Don't make it too complex. Easy feels easy, hard feels hard... tired feels tired. Trust what you feel, and train well. -Andrew Gerlach

Theory and Philosophy of Training

When planning training the emphasis should not be on what you will do, but rather how your body and mind will react to what you do. The goal is not to fulfill training, but to elicit a positive adaptation in your body and mind through training -- to become faster, fitter, healthier, lose weight, etc.

Keep at the fore of your mind the goal of training, be it to get faster or to become fitter. Too often secondary means to the goal become the goal itself. For instance in an effort to become fit one may deem weight loss important. Weight loss can then become the sole concern often at the expense of the true goal, health and fitness. For many athletes attaining a certain number of training hours is important to becoming faster, but when accumulating training hours becomes the goal, it is often at the expense of actually becoming faster. A good motto is: Train, Don't Strain. In other words, do only what it will take to reach your goal - not more, and not less.

Physiological basics

Physiology of Exercise

The study of the responses of the human body to exercise is known as exercise physiology. There are several key principles in exercise physiology that are important to training for endurance performance. To identify factors important to endurance performance, exercise physiologists measure several variables including heart rate, respiration rate, oxygen consumption, and blood lactate. In the past, monitoring these variables was rather difficult and required expensive equipment. Currently, heart rate monitors are widely available and laboratory-based physiological testing has become

more accessible. Combining the scientific measurement of physiological variables with properly planned training efforts often gives the athlete the ability to improve at faster rates.

Energy Systems

Energy enables an athlete to do physical work. Energy is derived from converting carbohydrate and fat at the cellular level into adenosine triphosphate (ATP). Unfortunately only a small amount of ATP can be stored in the muscles and it must therefore be constantly replenished. ATP can be produced in two main ways: aerobically with oxygen; or anaerobically without oxygen.
Anaerobic Metabolism

- Immediate Energy (ATP-CP) - High intensity efforts lasting 3-10 seconds will consume all available ATP and can be immediately replenished using creatine phosphate (CP).
- Anaerobic Metabolism (Fast Glycolosis) - This energy system is the predominant source of energy for efforts lasting 10 seconds through 2 minutes. Anaerobic metabolism breaks glucose down without oxygen yielding ATP and lactic acid. Excessive production of lactic acid will increase the concentration of blood lactate, and will begin to interfere with muscular contraction.
- Aerobic Metabolism (Lypolysis & Slow Glycolosis) - This is the main source of energy for endurance events lasting 2 minutes and longer. Both fat and carbohydrate can be metabolized aerobically. At lower intensities, more fat is broken down producing large amounts of ATP. As the intensity increases, breakdown of carbohydrate is favored since more ATP can be produced per liter of O2 consumed. In extended activities protein can also be broken down aerobically, and can contribute up to 10% of the total energy produced.

Determinants of performance

- 1. Vo2 Max - maximum oxygen uptake (Engine Size - how big is the engine?) This is the ability of the circulatory system to transport oxygen and of the muscular system to extract and use oxygen. Vo2 max is an excellent indicator of aerobic fitness, but a poor predictor of performance within a homogenous group of athletes.
- 2. Lactate Threshold - (RPM's - how high can you race the engine?) Lactate threshold (LT) is the ability to continue using the aerobic system to replenish ATP at high speeds. It is expressed as power output at LT, velocity of LT or percentage of Vo2 max. LT is one of the best predictors of endurance performance.
- 3. Economy - (MPG - how many miles per gallon does your engine get?) Economy can be defined as the amount of oxygen that it takes for an individual athlete to go a given speed. More economical athletes will have a lower oxygen cost at a given pace relative to a less economical athlete. This can explain why an athlete with a lower VO2 max can still outperform an athlete with a higher VO2 max. Economy is one of the best predictors of endurance performance.

- 4. Strength. Strength is defined as the maximum force that can be produced in one all out effort. Muscular endurance is related to being able to maintain a submaximal force repeatedly.

Training Zones

Optimal performance is reached by subjecting the body to specific types of stress in order to elicit specific types of adaptations. Using the Lactate Threshold lactate level or heart-rate, as we have done here, is the most precise way to determine training zones.

Recovery
Intensity: Level 1. Easy, 2-3mmol/L below LT; 30-50 bpm below LT.
Duration: 30 mins. - 1.5 hours.
Objective: This zone is used for warm-up and cool-down periods. Training at this intensity will promote recovery following glycogen-depleting workouts or high intensity intervals and maintain cardiovascular and muscular adaptations. The primary goal of recovery is to deliver O2 and CHO (carbohydrates) back to the muscles.

Endurance
Intensity: Level 2. Moderate, 1-2 mmol/L below LT; 10-30 bpm below LT. Level 1. Easy, 2-3 mmol/L below LT; 25-50 bpm below LT.
Duration: 30 mins. - 3 hours.
Objective: A moderate intensity is the optimum zone for improving endurance adaptations. An easy intensity delivers the same benefits, but more slowly. Unlike many athletes in bipedal and less-weight bearing sports, most skiers do most of their endurance training at the easier of these two intensities (around 35 bpm below LT). Training in both of the endurance zones improves the ability to deliver more oxygen to the muscle cell and process more energy from aerobic sources. Specific training adaptations include an increase in the size and number of mitochondria, an increase in myoglobin, increased capillarization, and an increased number of aerobic enzymes. Skiers tend to lower the intensity the longer the session. Over two hours = level 1. Under an hour = level 2.

Lactate Threshold
Intensity: Level 3. Moderately high, below LT by 5 bpm, or above LT by 5 bpm.
Duration:
• Tempo: 15 to 60 minute continuous effort at 5 bpm below LT.
• Interval: 5 to 15 minutes at LT and up to 5 bpm over LT.
Objective: Training at this intensity will raise LT as a percentage of Vo2 max as well as increase Vo2 max.

VO2 Max
Intensity: Level 4. High, 1-2 mmol/L above LT or at a heart rate associated with 95% of Vo2 max.
Duration: 3-5 minute intervals with half-time to equal recovery.
Objective: This is the optimum zone for improving Vo2 max. Training adaptations

include an increase in stroke volume, an increase in maximal aerobic capacity and improved lactate buffering capacity - go fast, hurt less = go faster.

Intensive Repetitions
Intensity: Level 5. Very high, 2-6 mmol/L above LT.
Duration: Short: 30-60 seconds with complete recovery.
Long: 1-2 minutes with complete recovery.
Objective: Training at this zone generally only occurs for a few weeks prior to a major competitive event and increases anaerobic capacity and buffering ability.

Speed
Intensity: Depends on amount of rest taken between and number of repetitions.
Duration: Short. 10-20 seconds generally with full recovery.
Objective: Develops technique and use of dynamic, powerful motions.

Specific means to improve the major determinants

Ways to improve LT
• Large volume of training at endurance intensity.
Adaptation occurs over months and years.
• Train around the LT. 1 - 3 workouts per week over 4 to 8 weeks. Adaptation occurs over days and weeks.

Ways to improve Vo2 max

- Large volume of training at endurance intensity Adaptation occurs over months and years.
  Please note: Max V02 is built through a large volume of endurance intensity training!
- High intensity intervals (at 95% of max). 1 - 3 workouts per week over a 4 to 8 week period Adaptation occurs over days and weeks

Ways to improve Economy

- Large volume of training at endurance intensity
- Improve technique
- Strength training
- Intervals and speed
- Equipment (less friction on the snow for instance)

Ways to improve strength

- General
  General and maximum strength enables the athlete to build specific strength safely and to maximum effect. General strength covers all major muscle groups, targeting the body's core and important joints.

- Specific
  Specific and endurance strength is of primary importance to cross-country skiers. It uses ski specific motions, intensities and duration.

Why training periods?

A high level of fitness is built systematically with progression and patience. For progress to be consistent there must be a progression in the training load. At the same time, certain types of training cannot be completed without building up to them. Train too much or too hard too soon and your body will not respond optimally to the stress. For instance, if you walk without shoes a little bit everyday and a little bit longer everyday you will develop calluses and eventually be able to walk shoeless for long periods, but, try to walk too far on the first day you will simply get blisters.

Training Schedule Basics

Begin by identifying your goals.
Be realistic about the amount of time and energy you can give your athletic goals, plan accordingly and while you should try to stick to your plan, don't obsess over it. Missing workouts should be expected, and one shouldn't try to make up for missed training.

Plan in reverse from the date of your primary goal.
Mark the date or dates of your season's primary objective on the calendar and plan backwards taking into account the length and focus of each period of training, as well as all personal considerations. Specific means to address your strengths and weaknesses should be incorporated into your training plan.

Training Modes

Skiing and Rollerskiing
Used for: Endurance, intensity, speed, recovery, racing. Strength - no poles skating, double-pole and single pole only sessions.

Running and cycling
Used for: Endurance, intensity, recovery, racing. Bounding: Used for: intensity, speed, strength.
How: Bounding can be done with or without poles. The motion should closely imitate classical skiing. To focus on strength and explosiveness do shorter intervals focusing on getting maximum distance with each bound. For intervals try to use the explosiveness, rythom and intensity that imitates ski racing.

Ski walking
Used for: intensity, endurance, strength.

How: Skiwalking can be done with poles, but is generally done without them. It should closely imitate classical skiing. It can be incorportated into running endurance sessions on steep and/or long uphills and be used for intervals on uphills. Poles should be about 2 inches shorter than poles used for classical skiing on snow.

Spenst (dynamic ski specific plyometric exercises)
Used for: developing explosive power and strength.
How: The focus is on getting maximum distance on each of 10 to 15 hops. Do sets of 10 to 15 hops and take full recovery (2-3 mins) between sets. Skating spenst can be done by hopping from side to side in one place, or jumping sideways up a steep hill. Classical spenst can be done by hopping on one leg at a time up a steep hill, or by bounding with both legs up a steep hill. Be imaginative, and warm up and down very, very well.

Weights
Used for: developing overall maximum-strength and muscular balance. How: Use a wide variety of lifts that cover all major muscle groups.

Circuit
Used for: developing overall strength-endurance and muscular balance.
How: set up a circuit of exercises that alternate stomach, back, legs, arms. Spend half a minute to a minute and a half at each station and move from one station to the next without stopping.

Training Periods for Cross-country Skiers

Transition or Recovery Phase (Spring)
Recover from the physical, mental and emotional stresses of training and racing. Complete rest is fine, but active rest is better.
Preparation: Begin building into your modes of training.

Base (Summer)
Base training is so called because it is the base upon which later phases of training are built.
Endurance:
Aerobic endurance is the number one component of cross-country ski racing, and it is the component of ski racing which takes the most time to develop. It is the primary aim of the base training period. Example: 2hour rollerski or run split between level 1 and 2 or a 3hourr bike on hilly terrain split between level 1 and 2. Please note: about 80% of all training is endurance training. The rest is strength, intervals and races, etc.
Strength:
General: Power and strength-endurance are built on max strength. General strength develops overall tendon and muscle strength necessary to support latter forms of training. General strength is the focus through the spring and summer. Example: after building up to weight training for 5-6 weeks, include some ski specific high weight and low rep work.
Specific: Specific strength becomes more a focus later in the summer and into the fall

once a solid base of general strength has been established. Example: Endurance session using only double pole over gradual terrain.

Intensity:

Most intensity should be below the lactate threshold early in the summer. Anaerobic training such as speed is good, but hard aerobic and anaerobic intervals should be kept to a minimum early on. Example: 2x10 minutes at 5 bpm below LT with 2 minutes rest between intervals. Start with 1-2 sessions a week.

Technique and speed:

Speed training during the base period should not be done at a hard intensity (short bouts of speed with full recovery are recommended) and should be oriented toward using correct movements at race speeds - not at moving at an unrealistic pace. Example: Incorporate 10 20second bursts of speed into your endurance training.

Pre-Competition (FALL)

Training becomes quite specific to the motions and intensity of ski racing. Aerobic endurance is still the primary focus, but the means to develop it have become more specific and more intense.

Endurance:

Training volume levels off or even decreases slightly to allow for the increase in intensity. Most of the training volume is aerobic endurance training - low intensity training of medium to long duration. Example: Rollerski or run almost exclusively in level 1. **Strength:**

General: General strength takes a back seat to specific strength. Max strength is the general strength focus in this period (for only 4 weeks). Strength endurance is the primary concern of a skier, but power and max strength cannot be neglected. Example: circuit using body weight exercises and more ski specific motions. Include some fairly ski specific max-strength exercises as well.

Specific: Rollerski specific strength sessions are the primary forms of strength training and should be predominantly endurance based. Skiers should also incorporate plyometric, explosive jumping exercises into their strength routine during the pre-competition phase. Example: 10x 200meters single pole, 10x200meters double pole. Distance double pole session over all terrain.

Intensity:

During the Pre-comp phase, duration and intensity of "intensity" training should reach levels similar to competition. High intensity (Vo2, above threshold) intervals are used. This type of training must be built up to, to be effective. Example: (LT) 2min, 3min, 5min with equal recovery, times 3 at LT. At the end of each interval you should feel like you could have kept going. At the end of the workout, you should feel like you could have done more. (VO2) 5x5min with half recovery at 95% of max. (target heart-rate will not be meet until the second interval). Each interval should take you the same distance.

Technique and Speed:

All training is technique oriented. Speed training is a great way to train the anaerobic system, but also to learn to ski relaxed and with smooth technique at a challenging pace. Example: 10to20x20seconds incorporated into an endurance session.

Pre-Comp (Early Snow)

The transition onto snow demands a decrease in training intensity because of the increased load of snow skiing. Training volume usually peaks during this phase of training. Example: Endurance sessions strictly at level 1. Intensity can be done on foot rather than skis.

Christmas Stars and Thanksgiving Turkeys: Skiers who do not monitor their training intensity properly during this phase often unwittingly raise the overall training load too quickly. The result is often a short-lived spike in fitness followed by a long-term decrease in race performance. Racers who peak early are known as Christmas Stars or Thanksgiving Turkeys. Example for the early snow period of the pre-comp phase

Race Season
Proper base and pre-competition training leads to a high level of fitness, which leads to consistent races all year long. A properly trained skier should be able to aim at a certain block or a few blocks of races throughout the season and still compete consistently at a high level throughout the season.

Blocks of Normal Races
Endurance: Training volume must rise after a block of key races where the volume will have been lowered. Example: 1.5hour session level mostly in level 1.

Interval: Races and interval sessions must be balanced, but intervals cannot be neglected especially early in the race season. Becareful with intervals between race weekends, especially at altitude, as it can be hard to recover. Example: (LT) 3x7 minutes at 5 bpm over LT with 3 minutes rest. At the end of each interval you should feel like you could have kept going. At the end of the workout, you should feel like you could have done more. (VO2) 3min, 4min, 5min times 2 with equal recovery. Each interval should take you the same distance.

Speed: If not done systematically, must be incorporated into distance or interval work.

Specific Strength: For strength to continue to progress, specific strength must be conducted on snow as it was done on rollerskis early in the competition period.

General Strength: Circuit strength that aims to maintain max strength and power as well as a general muscular balance is important. Rollerboard can be used here and with all circuit strength. Example: Circuit using a wide variety of body weight exercises as well as more dynamic exercises to maintain power.

Race: Results are secondary to continued technical and fitness improvements. Example of an early race season week

Blocks of Key Races

Endurance: Training volume drops. Training frequency (number of training outings) can remain unchanged to avoid feeling stale. Example: (frequency) lower the duration of endurance training but keep the number of sessions the same. (duration) lower the number of sessions but keep the duration the same.

Intensity: Sharpening intervals. Fitness has been gained; intervals now are for feeling sharp and fresh, not improving fitness level. Example: (peaking intervals) 3x3 minutes just below LT w/ equal recovery, followed by 3x2 minute above LT w/ equal recovery, followed by 4x30seconds all out with full recovery.

Speed: Same idea as with intervals.

Strength: Minimal maintenance strength if any at all.

Race: Achieving your racing goals is the focus. Please note: It can be good to bump up to a high(er) volume of training between important races so long as the intensity is kept very low. Sometimes using alternative methods of training, running, cycling, etc is a good way to do this. This helps keep the skier fresh, keep the muscles "clean" and "clear." You have to know yourself to monitor this.

Athlete Self Analysis

Place a check in the box on the right that best agrees with the statement on the left.

	Yes	Sort-Of	Not Really	No
I can ski forever				
I do best in 50km races				
I do well on long gradual hills				
I do best in 30km races				
I do well with an even race pace				
I can only go medium hard/fast				
I do best in 15km races				
I rule!				
I do best in 10km races				
I can go very hard/fast				
I do well with a varying pace				
I do best in 5km races				
I do well on short, steep hills				

I do best in 1-2km sprint races				
I have a great sprint				

Checks moving from upper left to lower right indicate strength in Endurance and a weakness in speed. Checks moving from upper right to lower left indicate strength in speed and a weakness in endurance. Checks pushed right in the middle of the graph indicate a high-end fitness weakness, such as low Vo2, lactate threshold and/or poor economy. Only testing at a qualified lab can determine where your physiological weakness in this zone lies.

You can gain some beneficial information from analyzing your performances in your five best and five worst races. See if you can find trends that might help indicate your strengths, weaknesses (area's of greatest opportunity) with regard to fitness, strategy, diet and your race and pre-race habits. Things to consider are the race distance, technique, individual or mass start, snow and weather conditions (cold/warm, soft/hard tracks), course type (hilly, flat, steep, gradual), strategy (start hard/easy, attack the hills or ski an even tempo), nutrition (general, morning of, day before), other (travel, sleep, emotional state, race size)

Tailoring Training to You and Your life

To make the most of your time and energy it is important to focus your efforts. The best way to do this is by picking a few workouts per week to focus on. If you find that you excel at short events like a 5K, then you probably have good speed but need to improve your endurance (we'll call you a type 1 racer). On the other hand, if you perform well at longer events (marathons) then you may lack speed, and should focus on VO2 max and other speed intervals (you are a type 2 racer).

Use the weekly descriptions and week examples below to plan your own weeks. Focus on the workouts emphasized for the type racer (type 1 or 2) you most resemble. Since time is almost always limited plan to complete the top priority workouts first and fit in the others as best you can.

Training must reflect your life and your life must reflect your training. A hard day a work can postpone a hard day of training. If you train hard then you can't party or study or stay up until late at night.

Further Considerations

Training history
It is very important to consider your training history when planning training. Training adaptations take time - weeks to months to years. The easiest way to monitor and plan training according to ones training history is by tracking volume. Training volume shouldn't increase by more than 15%. Raising your training volume or intensity too rapidly will produce a short positive spike in fitness followed by a long-term decrease in fitness, injury or over-training. If last year you trained 300 hours, aim for at most 345

hours this year. If you trained an average of 10 hours a week during the fall last year, then aim for an average of 11 or 11.5 this fall. If you don't know how many hours you trained in the past, try to recall how many times a week you trained, approximate duration and at what intensity.
Ultimately, through planning as we outline it here, you should be able to get more out of the time and energy you invest in training. Therefore, for most skiers, increasing the quantity of training becomes less important then improving the quality of training.

Terrain: Do your primary workouts on the terrain in which you most struggle. If in races you struggle on short steep hills then incorporate short steep hills into your training and focus on improving your technique in order to maximize your effort on them.

Strategy: Ski races are won on the up hills, but that doesn't mean you don't race the whole race. Experiment with the optimal intensity you can maintain on various types of terrain. For instance, if in training and racing you are so winded at the top of an up hill that you cannot ski well on the down hill following it (and lose all the time you may have gained climbing on the descent), then you need to slow down on the up hill.

Technique: Technique is the primary determinant of economy and economy is a primary determinant of performance. Every ski specific session should focus on some element of technique. Technique, strategy, terrain and fitness strengths/weaknesses are closely tied and to work on one should be to work on the other.

Training Recommendations by period and specific weakness

Base period
General Emphasis: Endurance.
Training modes: less specific, such as running and cycling early in the period and more specific, such as rollerskiing and ski walking, later in the period.

Type 1 racer workout emphasis:
First priority, one endurance session of 2-3 hours per week in level 1.
Second priority, two to four endurance sessions of 1.5-2 hours each per week in level 1 and 2.
Third priority, long LT intervals such as 2x10 minutes under LT with 3 minutes rest between intervals.
Strength priority: circuit strength focusing on strength-endurance (strngth) and back and stomach muscles.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Endurance+ strngth	L1 Endurance	Endurance+ strngth	L1Endurance	Intervals+ strngth	Long endurance

"I only have half an hour to an hour to train most weekdays, can I get anything out of that?"

Yes, but try to fit your priority workout in on the weekend. Endurance sessions of half an hour should be done primarily in level 2 and should include a few bursts of speed. Strength can take as little as 10 minutes a morning if you can wake up just 10 minutes earlier. Warm up for intervals can take as little as10 minutes, the workout 35 minutes and the warm down 15 minutes.

Type 2 racer workout emphasis
First priority, two to four endurance sessions of 1 to 1.5 hours each per week in level 1 and 2 with 5-10 20second speeds (spd) included in half the sessions and spenst and bounding in one session a week.
Second priority, shorter LT intervals such as 7x3 minutes at LT with equal recovery. Strength priority, max-strength weight work (strngth).

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Intervals+ strngth	Endurance+spd/spenst	Endurance+ strngth	Endurance	Intervals+ strngth	Long endurance

"How do I do Intervals or Endurance and strength or speed on the same day if I only have an hour after work most weekdays?"
Incorporate speed and/or spenst into a distance session. Add speed or strength onto the warm up and warm down of an interval session. Cut an endurance session short on one weekday to fit in a more challenging strength or speed session. Add a short strength session in the morning before work or after an endurance or interval session.

Pre-Comp period
General Emphasis:
Intensity Training modes: Specific, such as rollerskiing, ski walking, bounding, spenst.
Type 1 racer workout emphasis:
First priority, one endurance session of 3 hours per week in level 1.
Second priority, long LT intervals such as 5x6 minutes at threshold (rollerskiing or skiwalking).
Third priority, two to four 1.5 to 2 hour endurance sessions at level 1 include speed in one session.
Strength priority, long specific strength intervals and endurance sessions on rollerskis, such as skating w/out poles and double-poling add spenst to a general strength or an endurance workout.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Endurance+ strngth	Endurance+ spenst	Endurance+ strngth	Endurance+ spd	Intervals+ strngth	Long endurance

"I enjoy spending most of my free time with my family, but can dedicate a few hours on two days a week to training, how can I best spend those four hours?"
First of all, try to include your family in some of your training, such as a long hike or

bike ride with your family on the weekend - they can help keep you from going too fast. To make those four hours count to the utmost use them for your priority workouts and be disciplined enough to complete them at the proper pace. Going too fast or too slow in an endurance or interval workout is not a good use of your time.

Type 2 racer workout emphasis
First priority, shorter LT and Vo2 intervals, such as 2min, 3min, 4min x 3 at LT and LT plus 5 bpm, or 5x5min at 95% of max.
Second priority, bounding and spenst training, such as 10x30seconds bounding with poles with 2 min recovery and 3 sets of 3x15 skate and classical specific jumps.
Third priority, two to four endurance sessions at level 1 including speed in half the sessions.
Strength priority, shorter specific strength intervals on rollerskis such as 10x 100meter double and single pole intervals as well as shorter no-poles skate and double pole only endurance sessions.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Intervals + stngth	L1 endurance	Endurance+ speed	Bounding+ spenst	Intervals+ strngth	Long endurance

"I'd like to raise the volume of my training throughout the year (and year to year), but I have max'ed out the amount of time I have to train. How do I make progress in my training?"
All that must increase is the overall training load or stress. If you cannot increase the volume over the year or year by year, then increase the specificity and intensity of training over the year, as well as year-by-year.

Early snow period
General emphasis: Technique and endurance
Training modes: specific and non-specific.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
L1 endurance	L1 +speed	LT intervals, running	L1endurance	L1endurance	L1 +SpecificStrength	Long L1endurance

"How do I really work on technique during an endurance session?"
Focus on one specific element of technique at a time. To make the most of your time, seldom simply ski, but always have one thing in mind that you are specifically working on. Ski without poles or double pole for whole endurance sessions or for a part of nearly every training session. Make sure you stick to the plan and stay in the right training zone even if your training partners are less disciplined.

Competition period
General emphasis: racing
Training modes: specific.

Less important races

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
General Strength	Off	Vo2 Intervals	recovery	Short L1 Endurance + Speed	Race	Long L1 Endurance

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Specificstrength	Vo2 Intervals	recovery	Short L1 Endurance + Speed	Race	Race

"What should I do if I feel too tired to complete a training session?"
Skip it.

More important races

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
General Strength	Off	PeakingIntervals	recovery	Short L1 Endurance	Race	Long L1 Endurance

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Off	Peaking Intervals	recovery	Off	Short L1 Endurance + Speed	*Goal* Race	Recovery

"The big race is coming and I think I can fit in one more tough interval session and maybe another long ski."
Don't. If you are feeling good, you want to stay that way, if you aren't feeling great, at this point you won't get that way by training.

Notes From Trond Nystad

"Planning Training is like a budget. It is alive and changes with the world, even so, you need the plan, so that you no when and how to change and modify your training. Keeping track of what you do and how you respond is simple accounting. You can check on it later and learn from what you have done.

Skiers should make yearly, monthly and weekly plans and then daily plans. Prior to the year you make your yearly plan. Prior to each month you plan that month; before each week you make a plan; and same with each day.

It is not an obsessive process. The most fascinating thing about top athletes is their focus.

They are at all times aware of what it takes to achieve and reach the goals they have set for themselves. Every time they train it is to achieve something. Every workout has a purpose. An easy training session is only successful if the tempo/lactate/heart-rate was kept down. A level 3 interval session is only successful if the heart-rate is kept within the pre determined levels. A hard workout is only successful if it was done at the right level. The athlete always has a certain type of training in mind and does everything to achieve the objectives of the day. Too fast, too long, too short or too long a session means that he/she did not achieve the objective of the day.

It might sound like the athletes are up tight. This is not the case at all. They just know what it takes to become good and what their bodies need and can take. They do not train two sessions every day, they do not train when they are sick, they are not obsessed with training, they have lives outside of training, they take days off, they work or go to school and best of all; they have a healthy perspective on sports." -- Denver University Coach and Subaru Factory Team Alumni, Trond Nystad.

Coaches note: Some of the information above is a bit technical, though this is a good "short" synopsis of training theory. Hopefully you enjoyed reading it, and most importantly came away with a better understanding of why we do what we do. The most important thing is to have some sort of a plan, and stick to it when reasonable – this includes rest. The other important thing is to keep it fun! Plan training that you like to do and plan it with friends when you can – that way you'll do more of it. Keep some variety. There is no one best training plan for everyone.