

# Total SKIING

*The proven pyramid approach for improving*

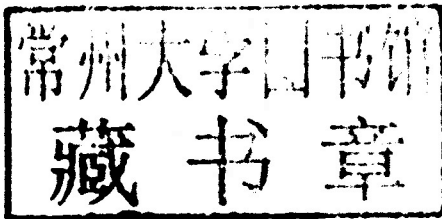
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- *fitness*
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**Chris Fellows**



# Total Skiing

Chris Fellows



Human Kinetics

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*To my wife, Jenny: Thank you for the love, support, and strength that you have given me ever since the day we laid out the first plans for the North American Ski Training Center in 1994. Your sense of humor, consistency, and level-headedness have kept us going strong through both good times and challenging times. Your ability to manage a business while raising our three beautiful children and keeping your outdoor passions alive is truly amazing. Thank you.*

# Preface

In my developmental years as a ski instructor, I often found myself spouting the dogma of adopting an athletic stance, proper leg steering, functional pole use, early edging, and a variety of other “instructor-speak” catchphrases. Using the latest drills and exercise lines, I had worked with my students ad nauseam trying to ingrain the “proper skiing moves.” Eventually the students came to believe that a strict diet of these technique drills would deliver them to greatness. I soon began to question myself, wondering if I was fooling myself and my students by believing their troubles could be cured with technique modification alone. It was hard for me to admit that I might see more success if I approached technique improvement from a different point of view.

Then, in the early 1990s, the legendary ski racing coach Warren Witherell crisscrossed the country introducing ski instructors, ski coaches, ski racing athletes and anyone who desired to ski better to the benefits of balancing boots for optimum ski performance. I remember Witherell swaggering into the Squaw Valley ski school locker room with a roll of duct tape in one hand and an obscure leg-measuring device in the other. He said he could improve our skiing instantly by tipping our boots laterally in the binding, giving us a positive and direct effect on the ski edge. Amazingly, he was right. After measuring, eyeballing, and putting various layers and widths of tape on our ski bindings, he had us ski so we could feel how the edge interacted with the snow. It was unbelievable: the skis actually came around easier and held better on firm snow.

Witherell said he’d done this somewhat crude form of alignment adjustment for World Cup racers with great results. He really knew how to talk to ski instructors.

He also said it might have been the equipment—not the technique or “pilot error”—that had been holding us back. (This gave us another reason to love him.) After much experimentation with different thicknesses and widths of tape on my bindings, I was convinced, and since then I have had my boot soles planed and balanced every season. Witherell’s influence has spread throughout the land, and a cottage industry of custom boot fitting has sprung up due to his book, *The Athletic Skier*, as well as to his persistence in getting the ski industry to adopt his methods. But even though many skiers now realize the tremendous benefits of making equipment adjustments of just a few degrees, there are just as many who still aren’t taking the time to consider the effects of improper alignment. Before my introduction to Witherell’s boot balancing theories, I was one of them.

After I’d been “Witherell-ized,” the experience kept nagging at me as I watched student after student fail when trying to make basic movement changes on the ski slope. They all wanted faster results and I wanted to see faster results. So, à la Witherell, I took his alignment approach one step further and measured and tested my students for weakness and asymmetries in their overall physiology. I started by asking students to perform fundamental movements such as a basic squat, a lateral lunge, and balancing on one leg. As I expected, many of them had great difficulty performing these simple tasks on a flat cafeteria floor. To me it was a relief to see students struggling to perform a basic depth squat, because it revealed a limit to what they could physically do. It was absurd to expect deep flexion movements out on the slope from a student who could not flex properly indoors.

The solution was clear as students became aware of their limitations. This awareness was the foundation on which a total program of improvement was built. The students saw improvement in movement, increased performance, and more enjoyment in their skiing.

# Acknowledgments

This book represents the collaboration and passion of many. It is impossible to list them all, but here is my feeble attempt. The book wouldn't be half the book it is without the expert photography of Jonathan Selkowitz; thank you, Selko. Thanks to my talented and patient editors, Laura Floch and Laurel Plotzke Garcia. You have taught me much and I owe you a big debt of gratitude. A big shout out to expert reviewers Darcy Norman and Per Lundstam, whose insights in the exercise sections were invaluable. Thanks to Kim Mann, our manager at the North American Ski Training Center (NASTC), who helped on this project. Thanks to Jim Schaffner, Greg Hoffman, Jim Lindsay, and Mark Elling for their helpful reviews and casual chats about the equipment sections. Thanks to Michael Silitch for his two-week intensive on-the-fly interview while climbing and skiing. Jeff Hamilton shared his training insights and continues to show me that pain is lessened when shared with someone else on our weekly rides. Perry Norris is saving the Sierra open space so our kids will have the same wilderness we enjoy. Dave Achey, Ted Pitcher, John Nyhan, and Mike Sodergren (posthumously), thank you for your ongoing insights since the first NASTC course in 1994. Marco Sullivan's support means a lot as he continues to inspire skiing athletes young and old (like me). On the note of skiing inspiration, I wish to thank my past and present PSIA Alpine teammates, whose talents and dedication inspire us all to do our best every day with our students. Very big thanks go out to the skiing models: Mike Hafer, Richie Jamieson, Jenny Fellows, Kim Mann, Trevor Tanhoff, and Heidi Ettlinger. Special thanks to Mike and Heidi for modeling for the gym shots as well. Thanks to Truckee's Center for Health and Sports Performance and Dr. Nina Winans for allowing us to use their facility for the indoor photo shoot and a special thanks to the U.S. Forest Service office in Truckee, California. I wish to thank Mike Iman, Mike Porter, and Victor Gerdin, who are true professionals and mentors. Nick Herrin, Rob Sogard, and Michael Rogan are exceptional leaders in our sport and great sounding boards. Mark Palamaras and Charlie Pendrell offered help and vision from the beginning. Thanks to Howard Shao for his inspiration and loyal support over the years. Thanks to Mike Livak and Tom Murphy at Squaw Valley and to Rob Kautz and John Monson at Sugar Bowl; they all supported the project and hosted our photo shoots. Jason Newell and Jeff Sarlo at Rossignol, Bruce Old and Eric Neuron at Patagonia, Dave Goode at Goode, Dino Dardano at Hestra, Keith D'Entremont and Steve Poulin at Uvex, and Jim Marble at Eurosock, all contributed their resources to this book with their top-notch products. There are so many others who supported this book in spirit. Each of our clients at NASTC and all you skiers out there drive projects like this with your passion. Last but most important, I could not have done this without the loving support of my wife, Jenny, whose shared passion for skiing brings us much joy and adventure together.

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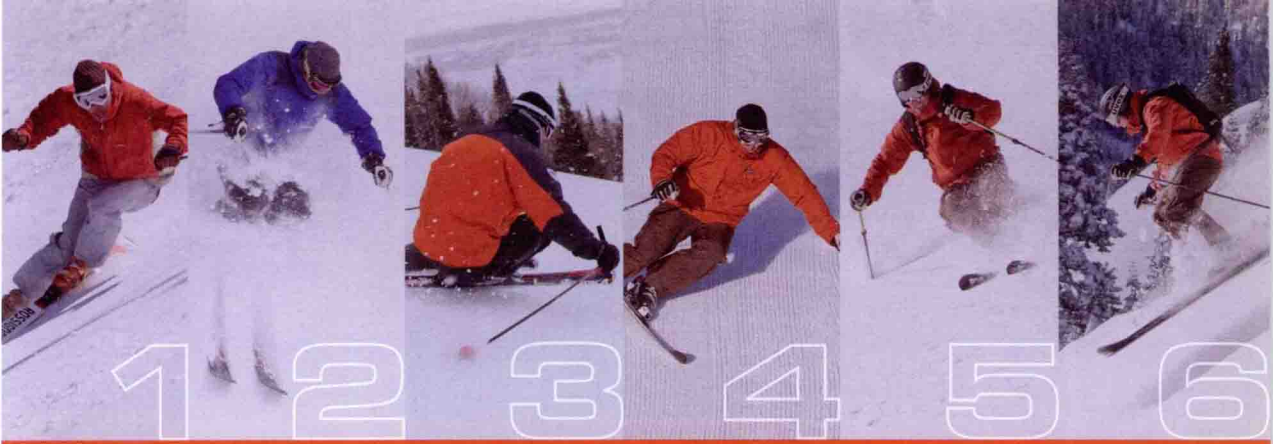
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# PART I

# Ski Performance Components





# The Performance Pyramid

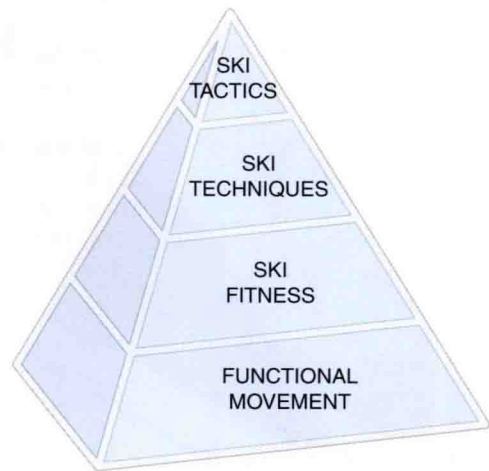
To say that I love to teach people how to ski would be an understatement. I cannot put into words the feelings that come to me when a student looks me in the eyes and says, “Today ranks in the top 10 days of my life.” I have been fortunate to have lived during a time in history in which people have the time and financial resources to come to the mountains in the dead of winter and participate in a sport that stirs the kind of emotions that make even the most stoic and driven folks drop their facades and open themselves to transformation. Learning how to ski requires more than getting

into shape and acquiring the ability to turn and stop. It is about learning the ways of the mountain and how to survive by letting go. It's about sliding down a slope and creating a wonderful journey through mountain meadows, pristine forests, and high, snow-blanketed slopes. Once you allow the deep skiing experience to seep into your being, there is no turning back. The skier's obsession is to climb higher, learn more, and experience greater sensations.

This book describes in detail the basic fundamentals of skiing, physical fitness, and technical and tactical concepts. To help you, this chapter draws the map that will guide you through the concepts needed to progress deeper into a sport that has grabbed many of us and shaken our roots, revealing the true importance of our existence. Quality over quantity is the first lesson. Without quality movements, the rest of your efforts will be wasted on compensation and recovery. To experience quality movements, you must have foundational integrity. This is where the performance pyramid begins.

## The Performance Pyramid

To assess movement quality, the North American Ski Training Center uses the model of a four-level performance pyramid. Here, the balanced skier's performance is displayed in an isosceles triangle, with a base block of functional movement, a center block of fitness, and two upper blocks of ski techniques and tactics (see figure 1.1). The pyramid's four levels represent an important cause-and-effect dynamic in skiing. The block of functional movement serves as the foundation on which the blocks of fitness, technique, and tactics are built. Although all these components are quite different, they are linked by how well the body moves and reacts under the demands of the performance environment, whether in a gym or on a ski slope. Without the integrity of the



**FIGURE 1.1** The performance pyramid.

functional-movement block, the blocks for fitness, techniques, and tactics will soon break down due to fatigue or injury. This pyramid is based on concepts from Gray Cook's *Athletic Body in Balance*, an excellent resource for movement and conditioning.

The bottom level of the pyramid represents patterns of functional movement, or mobility and stability. The next three levels of fitness, technique, and tactics cannot fully develop unless skiers can perform functional movements in a controlled environment. The second level represents fitness, or movement efficiency. These movements enable skiers to produce and absorb power and to generate the endurance and ability to handle challenging snow and terrain. The top two levels represent skiing technique and on-snow tactics. Skiing technique is made up of skill elements that, when solidified, create a launchpad for future maneuvers.

As technique is refined, skiers build confidence and anticipate the approaching terrain and conditions. At that moment, they can visualize tactical solutions to meet the upcoming challenges. As they grow, skiers will revisit the continuum of functional movements, moving through all the blocks and back to functional movement again. The ability to move freely from one block to another shows development. These movements provide the basis of skiing skills.

## Evaluating Skill Level With the Pyramid Blocks

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Often, skiers fail to improve because they focus on their strengths rather than addressing their weaknesses. Coaches and instructors are just as guilty when it comes to identifying the root cause of a fault, flaw, or error. Most identify the symptom and call it a day. As a ski instructor, I was trained to spend most of my time focusing on my students' skills. Most exams for ski instructor certification focus on developing a skill progression that addresses a skier's symptoms. However, in working with a wide range of abilities throughout my career, I have instead come to realize that optimal skiing performance is the result of a stable performance pyramid, or one in which a skier demonstrates strength and consistency at each level.

### Assessing the Pyramid Blocks

In order to identify specific asymmetries or limitations, skiers will be assessed on each block of the performance pyramid in chapters 2 through 5. The assessments essentially provide skiers with a checklist of areas for specific improvement within the parameters of the performance pyramid.

As you age or suffer injury, simple tasks can become difficult, altering your natural movement patterns and causing your body to compensate. Unless you address these compensations before you step on the snow, they will carry over into your skiing, resulting in chronic pain or traumatic injury and affecting your performance. Screening for these asymmetries will give you insight for addressing problematic areas with corrective drills and exercises.

To better understand how the assessments relate to skiing, let's take a look at a specific assessment of functional movement. Begin with the functional movement related to the body mechanics used in everyday tasks, such as squatting down to pick up a heavy object, twisting and turning to open or close a door, running up a flight of stairs, stepping up and over an object in your path, or getting up from the floor after lying on your back. The functional-movement assessments in chapter 2 determine that the most common movement faults in skiing become apparent when performing basic squats, single-leg squats, exercises that demonstrate rotational stability, and lateral lunges.

During these basic exercises, many people struggle to correctly move their hips, legs, core, and upper body because they fail to apply proper compensatory movement to opposing body parts. Instructors see symptoms of these mistakes all the time, particularly with students who can't flex evenly throughout their joints. As a result, they tend to lean forward and flex their ankles or knees too much, causing them to camp out over their skis. Other skiers may not flex the joints enough, causing them to lean backward toward the tails of the skis.

When doing these basic movements, the following tests may identify trouble performing dynamic on-snow tasks. When asked to perform three consecutive squats, do your legs and knees collapse (sharply angle in or out) each time? Do your knees stay aligned while flexing? Do your feet pronate too much, rotating outward? Do you flex your spine? If you have trouble performing a single-leg balance in the lodge, you will have problems with a single-leg drill on the snow.

As Warren Witherell so memorably demonstrated, the center of knee mass must be properly aligned as you flex in your boots so that you can apply direct pressure, transferring energy down to your skis. When isolated from the variables of a ski run, this visual data gleaned from the functional-movement assessment can provide a telling snapshot of your joint movement. If you can perform functional movements smoothly and efficiently, you can incorporate those movements into skiing. On the other hand, if you reveal movement asymmetries in the lodge, you will invariably experience certain limitations on the hill.

## Determining Skier Type

You can combine the results of the pyramid-block assessments to determine your skier type. These categories will be discussed further in chapter 6. Placing skiers into one of four types helps us customize drills and exercises that address total performance rather than particular technique.

Once you have determined your skier type, see part III for the full spectrum of training needs based on your unique profile. These chapters address the needs and compensations identified in the performance assessments of the pyramid blocks and provide clear programs for building up areas of weakness and maintaining strengths. In the end, the groundwork laid in this approach clarifies three important concepts for your development.

First, it identifies your skier type and, therefore, your specific needs. For example, are you inflexible, requiring mobility work, or are you weak in your core, requiring strengthening in that area? Are you a combination of both? Although in good general shape, are you a first-time skier or a seasoned pro who needs to get back into shape since raising kids? Gaps in your pyramid are nothing to be ashamed of, but ignoring problem areas will only keep you stuck where you are.

Second, this approach shows that compensating movements can alter the normal reflexive response of muscles needed for proper skiing. The assessments will identify movement patterns affected by poor posture, muscle imbalance, poor mobility, faulty motor programming, and altered nerve responses due to injury or tightness. Finally, you will become aware of how body parts are associated with one another. You will also learn which joints and muscles are most susceptible to injury by identifying problems in related groups. For example, continually injuring your knee indicates a problem with the surrounding joints of the hip and ankle.

Once you have gone through all the assessments and are armed with this valuable information, it's time to ski. Allow sufficient time to relax and enjoy the mountain, but watch how you adapt your movement when faced with challenging terrain. By attempting terrain appropriate for your ability level, you can apply tactics and make the connections between technical movements, both on and off the snow. At the end of the day, the solution to any weaknesses you've identified—along with the next step in your development—should be very clear.

The system described in this book can help you measure the physical barriers that may be blocking you from achieving your potential. It offers complete and concise information for incorporating the drills, exercises, and equipment adjustments into your own training program. This book will give you the knowledge to completely analyze your overall setup so you don't end up overlooking the most important piece of equipment of all, your body.



# Focusing on Functional Movement

From the time I met Warren Witherell in 1990 to the time I was introduced to Gray Cook's work in 2005, I spent countless hours watching skiers repeat the same patterns of limited movement that failed to advance their proficiency. As a prudent coach, I tried to prescribe exercises that would address their missing skills and to make equipment suggestions that would improve their balance and efficiency, but it was not until I began to include assessments for functional movement and performance solutions that I began to see lasting and dramatic changes.

To assess a skier's ability in functional movement, I use an adaptation of the functional-movement screen (FMS), which is described in [www.functionalmovement.com](http://www.functionalmovement.com), a Web site developed by exercise and movement physiologists Gray Cook and Lee Burton. This adaptation of the FMS consists of tests for the overhead-depth squat, single-leg squat, rotational stability, and lateral lunge. Essentially, this assessment of the functional-movement block of the performance pyramid measures the body's ability to perform basic movement patterns on stable ground without sensory challenges, such as steep slopes, variable snow conditions, and flat light. This assessment determines how well a person moves in a variety of different planes. A parallel can be drawn between any movement problems or left- or right-side asymmetries and difficulties on the ski hill. The invaluable information gained helps establish a baseline for how skiers are set up for the long haul in this dynamic sport. This snapshot of their personal geometry reveals chinks in their physical armor, as well as areas of strength and durability.

This chapter tests your abilities for functional movement in order to determine weaknesses or limitations, to increase your body awareness, and to help you modify your movements in order to eliminate errors and misalignment. As you establish a solid foundation for continuous improvement you will also increase your strength and endurance for skiing.

Injuries can sideline you from skiing and extend into other aspects of your life. Negative side effects include loss of income from missed work, academic challenges for students, emotional depression from this setback in your training and from inactivity, and loss of fitness during the recovery process. Preparative conditioning will not eliminate all risks, but it will help you build strength. It also plays a key role in recovery if you do experience an injury.

## **Concepts of Functional Movement**

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As chapter 1 illustrates, the bottom level of the pyramid is functional movement. Here, the focus is on coordinating muscle groups that create the movement patterns needed for successful skiing. It can be further broken down into the categories of stability and mobility. These elements are often confused with strength and flexibility. Although they are both important, they do not provide the total picture. Dynamic balance plays the role of consolidator in the world of functional movement. Once you begin skiing down a slope, dynamic balance helps you coordinate your movements by making continuous and efficient adjustments and by precisely executing skills.

### **Stability**

Stability is the body's ability to remain unchanged (aligned) in the presence of external changes or outside forces. Remember the last time you skied in uneven terrain or in heavy snow? You probably felt the push and pull of the snow and the bumpy terrain working together to knock you off balance. In extreme cases, you might feel like a dingy caught in a hurricane. A balanced stability component helps you retaliate against the maelstrom.

Stability combines balance, strength, and muscular endurance. In archery, keeping the bow stable as you pull the string back requires the three elements of stability, and the same principle is involved in the mechanics of good skiing. The ability to keep one part of your body secure while stretching and contracting adjacent segments lets you manage your speed and maintain consistent posture throughout skiing turns. This is true body stability!

### **Mobility**

Mobility, on the other hand, combines normal range of motion in the joints and proper muscular flexibility. It is crucial for executing proper mechanics, preventing injury, and skiing well. Mobility lets you move in all planes of motion, thus allowing you to perform any motion without sacrificing stability. It also allows your body to stretch while maintaining enough functional tension to control and guide



your energy in any direction. Mobility is created when muscles, joints, and tendons work together to coordinate your action. As one set of muscles contracts, another extends, and a third supports. Developing mobility engages these complementary groups and alerts your body that it's show time.

Without mobility in your muscles and joints, your range of motion is limited, resulting in movements that are as resilient as a flat basketball. For example, many skiers love to cycle in the off-season. As the first flakes of snow signal the end of biking season, they rush to the gym to power up their underdeveloped upper bodies and to stretch their hamstrings and hip flexors, which are as tight as guitar strings. I speak from experience—it's next to impossible to get me off my mountain bike and into the gym in the summer. Still, I have learned some specific workouts that smooth out imbalances and are necessary for avoiding injury and for skiing athletically in tough terrain. Be aware that your off-season sports could derail your skiing athleticism.

Linking good mobility and core stability is not enough for refining athletic skiing movements. The challenge of a sliding sport like skiing is that you must balance on a slippery surface while simultaneously twisting your legs, planting your poles, and edging your skis. Your dynamic balance depends on your base of support. If you are correctly centered, you will be able to change positions and blend movements at will. For some, this matrix of movement is a bit overwhelming. If you add body imbalances to the mix, you may wonder why you are even trying. It's not that difficult if you make the process a journey instead of a trudge! Shifting your perspective helps you learn quickly and experience the joyful benefits of exploring new territory and expanding awareness in your skiing.

Most of us can remember the learning curve of riding a bicycle. At the beginning, we struggled to balance while barely moving. Once we got up the courage to roll the bike a little faster, it became easier to balance. This is balance in motion, or dynamic balance, in its purest form. This element, also called movement in motion by the Canadian Ski Instructor's Alliance, is the cornerstone to their teaching methodology. The basic premise is that, unlike sports in which speed is generated by internal muscular force, skiing relies on gravity for forward motion that generates speed. Therefore, an expert's success is based on skiing a predetermined track as efficiently as possible. This interplay between external (gravity) and internal (muscular) forces illustrates effective technique (CSIA 2006).

Sensitivity for moving or stabilizing a body part during skiing is the foundation for future skill development, so don't skimp! Skimming over the basic movement patterns inherent in good mechanics and relying on default body compensations weakens your foundation. Very few skiers have faultless technique; nearly everyone compensates with something. However, the more efficient your mechanics are, the more seamless your improvement will be.

## **Functional-Movement Assessments**

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The following assessment sections test your stability and mobility. These dryland tests of functional movement will act as a mirror to help you see weakness and strengths in your skiing technique, providing a clear picture of how you move in relationship to the demands of skiing.

These assessments evaluate strengths and weaknesses for the functional-movement block of the performance pyramid. They are made up of four basic tests: the overhead-depth squat, the single-leg squat, rotational stability, and the lateral lunge. They will rule out any special physical needs, establish a baseline for further evaluations, determine a general level of mobility and stability, and point out asymmetries of the body.

Each assessment should be executed three times. Use your best score of the three. Be honest with your score, since the results will pinpoint the areas of compensation you need to work on. As you accumulate scores, you will begin to see areas of weakness. These will become your main training focus, since it is hard to improve by concentrating on your strengths.