Movement Principles

PSIC's Movement Principles:
Guiding the decision-making process within
The Technical Blueprint

© *Professional Ski Instructors of Canada*

Skiing, from a technical perspective, is about managing external forces and balancing against them. Gravity pulls us down the slope, while skis engage with the snow to generate forces that control speed and direction. Understanding and balancing against these forces is foundational, and understanding these concepts will make you a better skier, teacher, and trainer.

Here we will examine four fundamental Movement Principles designed to provide ski instructors with insights into key movement choices that influence effective ski instruction through the implementation of the technical blueprint – a purpose-based approach. Movement principles help guide our decision making process through a deeper understanding of how the body really works. By understanding Dynamic Balance, Regional Interdependence, Conservation of Energy, and Proximal Stiffness with Distal Athleticism, instructors can make better decisions, offer tailored guidance to their students, and optimize skier performance in the "movement" section of the technical blueprint. These principles allow instructors to assess and develop skiing based on human movement patterns, with each module building a deeper understanding of movement control, stability, energy efficiency, and performance.

1. Dynamic Balance

Dynamic Balance is essential in skiing, it is how we manage the external forces acting on us and it enables control and stability during movement (transformative concepts of force and balance). It is governed by a dynamic relationship between our center of mass (COM) and center of pressure. Within our base of support (BOS), there is a theoretical point where all forces from the snow converge and act on the skier—this is known as the *Center of Pressure* (COP). It serves as the focal point of pressure exerted by the snow. Adjusting the COP changes how the snow pushes back, allowing greater control over the skis' response and performance. For example, shifting pressure toward the front, the tail, or from one ski to the other directly affects how the skis behave on the snow.

Dynamic balance is distinct from static balance, which refers to maintaining equilibrium while stationary. Even trying to stay stationary does not mean there is no movement or sway of the center of mass (COM). In fact, static balance can be compared to how a sheepdog (COP) corrals and guides a herd of sheep (i.e. COM). The sheepdog works hard around all sides to keep the herd together in one spot – but it's an imperfect process (Figure 1). Moreover, dynamic balance involves constant adjustment as skiers move across various terrain and speeds. Skiers must continuously coordinate their body's COM with their COP to stay balanced, comparable to a sheepdog (COP) herding sheep (COM). Now the "herd" is on the move – the sheep dog works even harder to guide the herd in the desired direction by moving where and when necessary. This requires both proactive and reactive movements dependent on the movements of the herd - just as your COP can be proactive and reactive in skiing.

Figure 1: Analogy to static balance – the sheep dog (like the COP) moves around to herd of sheep (COM) keeping them relatively stationary.

In both skiing and walking, dynamic balance relies on controlling the center of mass (COM) through anticipatory movements that optimize its future relationship with the base of support (BOS). Each movement requires specific, reactionary adjustments to maintain control.In walking, the COM shifts forward with each step, creating a controlled "fall" that is quickly stabilized by placing the foot in front of the COM “herding it” and establishing a new COP; balance corrections are minimal, using a rhythmic cycle of weight transfer over a stable base but ever moving base. Skiing, however, demands continuous and multi-directional adjustments of the COP acting to direct the COM due to variable forces from gravity and the snow. A major influence on these external forces are how we manipulate the ski to change direction or speed up or slow down - namely twisting the ski or tipping it on edge. The skier’s COM often moves relative to the COP to initiate turns and manage speed, with adjustments needed to counteract the constant pull downhill and the turning forces acting on the skier’s COM. Unlike the walking cycle’s repetitive stability pattern, skiing requires more precise, varied corrections to sustain balance on a sliding surface, especially as terrain and speed increase complexity.

Mastering the understanding of dynamic balance means harnessing the external forces acting on the skier, manipulating the skis appropriately to influence the force of the snow pushing back on us and dynamically manipulating the COP to direct the COM in the desired direction to achieve balance and control. Recognizing factors like turn size, slope terrain, and speed, as these affect the complexity of balance adjustments required - this is what we refer to as the purpose. Effective dynamic balance skills allow ski instructors not only to demonstrate control but to help students improve their COM and BOS equilibrium in diverse conditions.

2. Regional Interdependence

Regional Interdependence emphasizes the interconnectedness of the body’s joints and muscles in movement, where the action of one joint effects another—a concept known as the “downstream effect.” In other words, the same movement action can have different outcomes at

the ski - this is important to understand. Skiing exemplifies this effect when the position of the hips and knees affects edge control of the ski. For instance, flexed hips and knees aid in tipping the ski for increased edging vs twisting of the ski, while a more upright stance relies on twisting only from the hip perspective, altering the skier's response (figure 2).

Figure 2: Regional Interdependence – notice the 90 degree of hip flexion changes the effect of hip medial (internal) rotation and lateral (external) rotation of the hip joint (femur) on the action of the ski.

Another example is how the body is able to twist the ski in the same two postures from the above example (tall and crouched). In this case the body is still able to perform the function of twisting the ski on the snow but where the action of the twist comes from is very different. If you are sitting reading this document - with your hip, knee and ankle flexed at 90 degrees - turn your foot on the ground like you are trying to twist the ski on the snow. Notice that the thigh (upper leg) doesn't move – now extend the knee joint the leg is straight out in front of you. Notice that you are still able to create axial rotation of your foot (medial and lateral rotation) as if you were twisting your ski on the snow (and the snow pushes back) - but this time the upper leg does the rotating at the hip. This is another example of regional interdependence. Posture matters and it changes how we move to achieve the purpose.

Understanding this relationships helps instructors better diagnose performance elements and provide individualized guidance to students, helping them adjust their body positions and movement patterns to improve performance criterion like - turn sharpness, balance, and edge control to meet the intended outcome of their purpose.

3. Conservation of Energy

The principle of Conservation of Energy in skiing is about managing effort and performance, helping skiers govern energy capacity for sustained enjoyment. Skiers face a trade-off between a low, flexed stance that enables joint movement for early ski edging and powerful turns. In

contrast, to an upright stance, which conserves energy but reduces performance with either a more twisted ski and drifted turn – or a delayed transition with an edge that relies completely on inclination. This trade-off relates to how the body manages the external forces with a proportional internal force to create movement and transmit the forces along the kinetic chain. The extended (long) leg allows the skeletal structure to transmit force and reduces the joint rotation forces (moments) which result in less muscle activation (conservation of energy) to manage the external forces. On the other hand, the lower posture turn transition position (crouched) enables the tipping of the ski (edging) to occur from the hip joint, at will, with movement of the lower body actively moving at the hip joint – instead of waiting for the pull of gravity passively. This provides an opportunity for a higher performance ski turn with earlier edge grip and more speed control options at the top of the arc.

Figure 3: The skier in the left is transitioning in a low position enabling early edge grip, while the skier on the right is in a tall position (legs extended) and therefore axial rotation (medial/internal rotation and lateral/external rotation) create ski twist and reduce grip leading to a skidded or drifted arc on the steering continuum.

Instructors are encouraged to align lesson objectives with each skier's energy capacity, promoting an "Adventure" that suits their abilities and preferences. By teaching skiers to balance high-performance techniques with energy efficiency, instructors can enhance their students' mountain experience, ensuring they can ski longer and more enjoyably.

4. Proximal Stiffness and Distal Athleticism

This principle explains that a stable core (proximal stiffness) enables precise and powerful movements in the limbs (distal athleticism). This is how we move the COM efficiently and effectively by harnessing the external forces acting on us. Just as a backhoe stabilizes itself with support legs before performing tasks, skiers require core stability to control their feet and legs effectively, when the external forces are acting on the COM – it is most effectively harnessed by a stable core - especially on challenging terrains like moguls. Think of another example, like a wide receiver in football, the player makes a cut move to get around the defensive tackle, if the core is solid the player will move quickly and sharply increasing their likelihood for success. If on the other hand, the player's core "breaks away" at the core the player's ground reaction force is dissipated and the player relatively slower – this gives the advantage to the defensive tackle. In either case the play may or may not get hit by the defender – let's assume they do in both

cases. The player with the stiffened core will maximise energy transfer to the defensive player once again increasing their likelihood of bouncing off and running in for the touchdown. On the other hand, the player with the soft core is likely to collapse when met with the impact of the defensive tackle. This highlights the advantages of the strong and stable core – quicker and more precise movements with the legs and skis, while maintaining the ability to maximize energy from the turning force into productively moving your COM across the hill efficiently and effectively. A more stable core is key to maintaining balance and control when we encounter more challenging or less predictable snow conditions.

Core stability aids in leg and ski control and balance, crucial for responsive skiing. By cultivating core stability, instructors can help students achieve optimal precision and agility, enhancing skiing technique and performance.

Conclusion

The PSIC **Movement Principles** provide an evidence-informed approach to ski instruction and directly relate to the teaching and application of the skills within the ***Technical Blueprint.*** Understanding of these principles will inform decision making practices pertaining to movement interactions between the ski and the skills. Recall that the movement decisions are made in a goal-oriented focus known as the purpose-based approach – recall that *purpose provides perspective*.

Through Dynamic Balance, Regional Interdependence, Conservation of Energy, and Proximal Stiffness for Distal Athleticism, knowledgeable instructors can tailor lessons to the diverse needs and capabilities of their students, enhancing control, energy management and stability for more enjoyable and effective skiing experiences. These principles empower instructors to guide students more effectively, promoting long-term skill development and a rewarding skiing adventure.