

Skiing Focus - Why?

Adults are a very discerning group of diverse individuals who are quite adept at recognizing balderdash. This means that coaches need to be very knowledgeable and confident. The coach must thoroughly understand and be able to communicate the “what”, the “why” and the “how” of skiing.

For our purposes here, these factors are defined as follows:

The “what” are the basic theories, theorems, and concepts of skiing.

The “why” are the physical laws that explain and support the “what”.

The “how” are the various strategies, tactics and techniques; i.e. what we actually coach and instruct others to “do”.

The “WHY”

Many people that I know do not want to have anything to do with either math or physics, however, a bit of understanding at least in practical, applied physics really helps in developing efficient skiing skills. I will attempt to keep the basics here brief, in laymen’s terms and simplify Sir Isaac Newton enough to make his laws actually helpful to us when we ski. (There is an addendum to this article for those inclined to the math and physics.)

Gravitation

Without gravity we couldn’t ski. Gravity is actually the force that pulls us towards the center of the earth, but luckily the earth is solid and we stay on top of it, mostly, except in water and powder, where we get pulled into it.

Friction holds us in place on an inclined plane unless the gravitational force is greater. Our skis have been developed to help minimize the friction so we can indeed slide down the hill. (Years ago, when I first read about Galileo and his frictionless plane, I wondered if he was a skier... dreaming...) So as we slide down the plane, we can call gravity the “engine” that powers us. Learn to embrace this gravity, make it your friend. Go with the force!

Momentum

An effect of gravity, is that we accelerate as we travel down the slope according to our mass, basically our weight ($F=ma$). As we continue down the slope, our velocity increases; i.e. we get going faster and faster. Once we start moving, we have momentum. Momentum is something we have all learned about from experience.

Sir Isaac Newton’s first law is one that we all understand: *“Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it.”*

Sir Isaac Newton’s second law is one that we all intuitively understand and use, even when we don’t want to admit to it: *“Force is equal to the change in momentum (mass times velocity) per change in time. For a constant mass, force equals mass times acceleration.”*

We all know that the longer we go straight down the hill, the faster we will go and that the faster we go, the harder we can fall.... We also understand that as long as we go with the force, down the hill, we will not feel the force on our bodies, yet we know it exists because experience has taught us that it indeed does exist. In addition we know that we have muscles and bones and are able to “act” as another force to manage the natural forces of gravity and momentum and thus, we work with Newton’s laws! Simple, even for those of

you who do not think you can operate in the realm of math and physics!

Feelings and Physics

So, back to what we feel and why we feel it. As long as we go with gravity, with the force, we do not “feel” it. The longer we go with the force, the more momentum we will have. In skiing, we use these forces, they are our “friends”, we work with them and appreciate them. When we go to make a turn, we are redirecting them and hence we feel them. We use the internal forces of our muscles to manage the external forces for the physical world.

Important point number 1 - *Go with the forces and you do not feel them. Go contrary to the forces and you will feel them. Simple.*

For those of you who have trained in the martial arts, you have learned that it takes more force to block an oncoming blow directly. It is much easier; i.e. it hurts less; to redirect it with a block that changes its direction. You block with a moving block.

Likewise in skiing, it is more efficient if you move with the force, feeling it as you work with it and change directions, progressively. Apply this to your skiing and you will become more efficient.

Important Point Number 2 - *Feel the forces, pay attention to them and work with them, directing your bones, in balance, in the “force”.*

All of you understand simple addition, or at least I hope you do. $1+1=2$. Forces are like that too. You take one force and add to it another and you get a greater force. How we move our bones with our muscles can either add to or subtract from a force. In skiing, you are making a nice round turn. Right after the apex, as you start to round out the bottom of the turn, you are changing your direction and hence no longer going with the forces. You feel them more, you need to edge your skis to be able to stand against them and not skid out of the arc. You need to stack your bones to stay in balance to them. One way of making the forces on your body and skis less at that point, is to simply go with them by flexing. Flexing your legs at the bottom of a turn, allows your body to go with the forces and lessens the pressure on your skis. This is a good thing.

Conversely, skating or actively extending at the top arc of a turn will increase the force on your ski bases, much like pushing on the gas pedal in a car. What you feel in skiing is all relative to the changes you are making to your momentum.

Important Point Number 3 - *Forces add up and forces can also be subtracted, you can increase or lessen the forces momentarily by actively moving your body either with the forces or by opposing to the forces.*

Newton has a third law that we are also very familiar with from experience and which we do not need to worry too much about here since his first and second laws pretty much cover skiing, along with gravity. Then Newton’s last law: “*For every action, there is an equal and opposite re-action.*” In skiing we mainly use that intuitively when we use rebound. However, we are not going to go into that here.

Centripetal Force

There is one more basic “force” that should be understood at least a little in skiing. That is centripetal force. Centripetal force is the force that keeps you in a turn. Without using centripetal force, it would be impossible to turn. Centrifugal force is the force that is “throwing” you out of the turn. They exist together. What you need to know about centripetal force is how to create and use it and that is fairly simple. Stack your bones to the turn forces to be able to stand against them. You create angles with your skis and body to balance against the turn forces that are trying to “throw” you out of the turn. You edge your skis and move inside to stay balanced. Simple, intuitive concept.

Important Point Number 4 - *Stack your bones to the turn forces maintaining balance while blending all the skills efficiently with minimal muscular force to accomplish the desired skiing outcome.*

Centripetal Force Diagrams

