Career of the Month

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Avalanche Researcher

Many of us enjoy snowboarding, snowshoeing, and other winter sports at the season's first sign of snow. But what about when a massive amount of snow crashes down the mountain, gains speed and size with every second, buries everything in its path, and reaches the bottom as compact as cement? Getting caught in an avalanche is extremely dangerous—every year, dozens of people die trapped in a snowy landslide. Most of us are able to enjoy the snow safely because of avalanche researchers such as Karl Birkeland, who studies the science behind avalanches to help us avoid and survive these natural disasters. A lifelong outdoor enthusiast, snow lover (he was on skis by age 2), and innate scientist, Birkeland is in his element.

Recipe for disaster.

At least three characteristics must be in place for an avalanche to occur: snow, a sloped surface, and a trigger. Snow crystal shapes, temperature gradients, atmospheric conditions during snowfall, and melting and refreezing all contribute to the layering typically found in snowpacks. The strength of each layer varies. If a snowpack is on an incline of 30° or more, and a weak layer exists under a stronger layer (or slab), an avalanche is possible. The final factor that triggers an avalanche may be a natural event (e.g., new snowfall, windblown snow, or a falling cornice) or a person.

Career overview.

Avalanche scientists study all different aspects of avalanches. We investigate how layered snow contributes to dangerous avalanche conditions, how avalanches release (including those triggered by skiers, snowboarders, or snowmobilers), the flow patterns of avalanches, and how knowledge of those patterns can be used to increase the chances of avoiding and surviving an avalanche.

I work for the U.S. Department of Agriculture's Forest Service,

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Birkeland celebrates the end of a long day of data collection.

which runs most of the backcountry avalanche centers in the country. The centers provide local backcountry avalanche information (e.g., avalanche conditions and mountain weather forecasts) and education to improve the safety of people who recreate in the backcountry during the winter. I support these centers by carefully following all of the latest avalanche research and emerging technologies and then sharing that information with avalanche forecasters.

I also pursue some of my own studies in practical research applications, which can be used to increase the safety of folks traveling in the backcountry. For instance, I am currently working closely with a Colorado ski patroller on a new snowpack test. The goal is to assess the probability of initiating a fracture and if that fracture is likely to propagate and cause an avalanche. Our initial data suggests that this test gives us a better indication of whether or not a particular slope is dangerous.

Snow safety.

I grew up in Colorado. My parents skied their whole lives, and their passion for skiing, snow, and the outdoors was passed down to me. In the 11th grade, I began working as a ski patroller at a local mountain. The more I learned about snow, the more I became intrigued with its amazing and dynamic properties.

During college, I took time off and patrolled for a Utah ski resort, where I had an eye-opening experience doing avalanche mitigation work. One morning before the resort opened, I was up on the mountain with other patrollers to trigger avalanches with explosives to make sure the slopes were safe for the skiing public. We set off several explosives on one particular slope, but no snow released, and it therefore appeared safe. However, when a final explosive on that slope was detonated, the entire bowl released in an enormous avalanche, which took out all of the spots the previous explosives had not triggered and buried a popular ski run in 3–5 m of avalanche debris. No avalanche research to date could adequately explain why that happened.

It dawned on me that we desperately needed to know more about avalanches to increase the safety of avalanche researchers, ski patrollers, backcountry skiers, and others traveling in the winter mountains. Within a couple years of that experience,

I worked on my master's degree in Earth sciences and investigated how snow varied across slopes, which is critically important for understanding avalanches. This variability probably explains why that morning in Utah many different explosive locations were necessary for the bowl to avalanche. I have continued this line of research for 20 years now, and though we do not have all the answers, we know much more than we did back then.

Advice for students.

To study avalanches, one must have a strong scientific background and backcountry competence. Backcountry skills include the ability to travel in the backcountry (e.g., on skis, snowshoes, a snowboard, or a snowmobile) and avalanche-safety knowledge.

Students interested in avalanches should participate in a local avalanche course, read available literature on avalanches, and seek a mentor at a local ski area. Students should seriously consider working as a ski patroller to develop an intuitive familiarity with avalanches. In the classroom, interested students should take as much science as they can—a well-rounded, solid education in science is essential to becoming a successful avalanche researcher.

BONUS POINTS

Birkeland's education:
BS, biology; MS, Earth sciences; PhD, physical geography

On the web:

American Avalanche Association *(www.americanavalancheassociation.org)*, Forest Service National Avalanche Center *(www.fsavalanche.org)*

Related careers:

Avalanche forecaster, ski patroller, helicopter ski guide, polar scientist, geographer