

## Snowpack Study in School

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To him who in the love of Nature holds  
Communion with her visible forms, she speaks  
A various language.

William Cullen Bryant

### ABSTRACT

Students at any level can study a snowpack using only simple scientific concepts and mathematics. In my college course in technical writing, I use the study of snowpacks to establish common experiences in science among students with non-scientific backgrounds. During an initial field trip, they examine the layers in a snowpack and observe the various characteristics of snow. Through lecture and reading, students learn basic concepts of snow physics, snowpack stratigraphy, and snow metamorphism. They learn to identify types of snow particles in the field, study local weather history, and collaborate to predict changes that have occurred in the snowpack since the first field trip. During a second field trip, students re-examine the snowpack and compare their predictions with actual conditions they observe. At each stage in the snowpack study unit, students report their findings.

Key words: snowpack study, school science, snow science, snow metamorphism, technical writing.

### A RATIONALE FOR SNOWPACK STUDY

A student of mine told me he had never thought much about snow: "I knew it was white and fluffy and sometimes it was compactible (good for snowball fights, and snowmen)." He thought only "how beautiful it was, how great it was to ski and snowmobile on, how much I enjoyed playing in the snow, and how much of a pain it was to shovel the

driveway." Beauty, play, sport, nuisance—that summarizes the experience of most people with snow. Snow has been all around them, but they have never examined its structure or the agents that change it.

This indifference to snow reflects a general pattern in our schools. While snow science has advanced rapidly since the 1930s, teaching about snow in the schools has been neglected. The usual school science projects have students merely draw and cut out snowflakes or determine the water content of snowflakes by melting a can of snow. Many science textbooks fail to mention snow altogether.

As an antidote to this neglect of snow science, I suggest snowpack study, the systematic study of physical characteristics of snow on flat ground. Snowpack study gets students out into the field to dig a snow pit, examine the layers of a snowpack, study the effects of weather, and report their findings.

Snowpack study is suitable for students at any level because meaningful study of snow on the ground requires little prior scientific knowledge and hardly any mathematics. At an elementary level, the concepts are simple and few, and students can master them in a few hours. Despite its technical simplicity at this level, snowpack study is not merely play or casual observation. Students acquire and apply scientific concepts and procedures, observe a snowpack under guidance, identify particles and classify them into standard categories, try to predict the effect of physical agents on the snowpack, correlate their hypotheses with weather history, and draw conclusions.

Snowpack study is attractive in several other ways. It makes students more aware of their environment. Students who live any place where snow falls can study a snowpack in their own school yard with a minimum of equipment, and they can study it individually or in a group. And because

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snowpack study has not been widely used in our schools, it is a fresh topic. Although snowpack study is presented here as pure science and an end in itself, it also prepares students to understand applications of snow science in glaciology, avalanche studies, ecology, or hydrology, as well as to participate more safely in winter sports. Whether applied or not, snowpack study encourages wider understanding of one of nature's most interesting materials.

## THE SEQUENCE OF SNOWPACK STUDY

In my college course in technical communication, snowpack study provides a common experience in science among students without a technical background. As I organize the unit, students study a snowpack in a sequence from basic principles through field study to reporting.

### The first field trip

Students first develop primary experience with snow during a field trip. They dig a snow pit, measure the layers of the snowpack, test them for hardness and wetness, observe particle type, width, and color, and record their observations. Students report their findings to general audiences. These reports take various forms: visual (photographs, charts, and graphs), written, and oral. Drafts of written reports undergo review and revision.

### Learning about snow science

After the first field trip, students learn about snow science through lectures, visuals, and reading a field guide that I have prepared. They learn basic concepts of snow physics such as temperature gradients, sublimation and condensation, sintering, and latent heat. For many students, these are new concepts, but when presented appropriately, they find most of them easy to learn and apply. This instruction is followed by a brief explanation of snow formation and deposition and the characteristics of newly deposited snow. Students next learn how a snowpack is affected by ten physical agents of metamorphism: gravity, wind, sun radiation, compaction, liquid water, warm air, temperature fluctuation, cold weather, moderate weather, and mild weather. Both the agents and the processes of change are explained in detail and kept in focus throughout the remainder of the study unit.

Armed with knowledge of basic concepts of snow physics and snow metamorphism, and aided by a guide to types of snow particles, students learn how to identify various snow particles such as settled snow, wind crust, sun crust, sintered snow, ice lenses, melt-freeze particles, angulated particles, rounded particles, and firm.

After writing about field trip one and learning about snow metamorphism and its various products, students work in small groups to study local weather

history in detail and to hypothesize how recent weather has affected the snowpack. Their predictions set them up for a second field trip.

### The second field trip

Students then return to the snowpack to make a second set of observations. They again examine and measure the layers and record the physical characteristics of snow. This re-examination of the snowpack reveals how the layers of snow particles have changed during the weeks since the initial field trip. Students now correlate their hypotheses about changes with the actual conditions they observe and explain how these changes correspond to the weather history at the site.

### Contrasting naive and informed observation

With the work entailed by the second field trip now completed, students answer a set of questions about what they learned during the snowpack study unit: What is the difference between (1) naive and unguided observation before taking this course; (2) guided observation during field trip one; and (3) informed and guided observation during field trip two? Students reflect not only on how much they have learned but also on ways that their learning about snow has improved their ability to observe the snowpack, classify types of snow, and interpret changes. Having answered these questions, they are well on their way to thinking scientifically.

### Writing a final report of field observations

The tangible product of snowpack study is a series of write-ups which students eventually meld into a final report. This report includes the following:

- Procedures for studying a snowpack
- Physical characteristics of a snowpack observed in field trip one
- Hypothesizing persistence and change since field trip one
- Observing persistence and change during field trip two
- Accounting for persistence and change by examining weather history
- Reflecting on naive and informed observation
- Assessment of the snowpack study unit

## THE BENEFITS OF SNOWPACK STUDY

In this project, students not only gain knowledge about the physics of snow stratigraphy and metamorphism but develop skills at observing, recording, and interpreting data. Further, they learn to present the information in several forms for lay audiences who are not acquainted with their project. They also learn to work cooperatively in the field, to review each other's papers, to accept criticism from their peers, and to rewrite their reports on the basis of

feedback. Perhaps most importantly, students learn how to learn a new area of knowledge and quickly master its fundamental principles. Development of these related skills make snowpack study an invaluable part of a technical writing course.

Much of the interest of snowpack study derives from the special nature of snow itself. Snow probably changes its structure more than any other inert substance. In studying a snowpack, students can observe the cycle that begins with new snow and after many intermediary stages ends in meltwater. This means that they can observe metamorphic processes over the course of one winter. Other crystal metamorphic processes, such as those that occur in rocks, take hundreds of thousands of years. Although students do not see the processes of metamorphism directly, they come to understand why the changes in the snowpack create crystal structures that vary daily. For promoting the study of science in school, this benefit of snowpack study can hardly be overestimated.

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