A DETAILED FRAMEWORK OF THE SNOW AND AVALANCHE DYNAMICS CLASS AT THE UNIVERSITY OF UTAH

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ABSTRACT: Traditional certification-based avalanche education is often completed in short, intensive time periods that leaves many students wanting more detailed information. The semester-long Snow and Avalanche Dynamics class at the University of Utah fills the niche between recreational avalanche awareness and graduate level snow science education. The equally balanced classroom and field time allows for instruction in basic snow science and backcountry travel, eventually reaching more complex topics including vapor transport, snowpack mechanics, and the physical/chemical properties of snow and ice. Students use readings and lectures to explore major concepts before engaging with instructors and peers during in-class activities. While in the field, students are able to elaborate on these topics through detailed terrain, snow, and weather observations, which are then shared and discussed. Additionally, students are able to observe the transition from a mid-winter to springtime snowpack regime throughout the semester. Finally, evaluation takes place through traditional testing as well as final projects that incorporate student’s individual interests with concepts or skills learned in class. In the past projects have included snow mechanics testing tools, automated data gathering of snow and weather observations and new instructional tools portrayed through a variety of multimedia platforms. Many students have used this class as a springboard into graduate level studies in snow and avalanche science as well as professional careers in avalanche mitigation. Other institutions wanting to elevate their snow and avalanche education offerings can adopt the framework of this course and ultimately work towards developing a snow, ice, and avalanche studies certificate or minor.

KEYWORDS: education, 5E instructional model, fieldwork, semester

1. INTRODUCTION

Snow and avalanche education courses have traditionally followed a common structure that includes in class and field time for learning, over a relatively short time period of a few days or less. This short and intensive learning period can often leave students with unanswered questions and a desire for more detailed information. The dynamic relationship between weather, terrain, and snowpack can be a complex system of information that is difficult to predict and understand. The semester length Snow and Avalanche Dynamics (5260) class at the University of Utah provides a unique perspective on traditional snow and avalanche education by placing an emphasis on snow, ice, and atmospheric processes. Through in class work and field sessions, students are able to synthesize the dynamic relationship between snow, weather, and terrain.

2. STRUCTURE

2.1 In class work

The classroom portion of the course takes places one night per week and meets for a full two hours. During that time, Students take weekly quizzes, participate in lecture discussions and small group work. Additionally, detailed information about the preceding that weeks field session is also discussed.

Traditionally the first class session is devoted to housekeeping information as well as facilitating the group relationship building process. Every student is required to know every other student’s name in the class and the 1st quiz of the semester is a name quiz. A great emphasis is placed on this because one of the fundamental backcountry safety travel protocols is to know who your group partner’s are. One of the biggest value adding components to the 5260 class is the
diverse backgrounds of the students which take the class. Small groups are encouraged to include students with diverse backgrounds. This allows for more peer-to-peer learning and teaching, which further builds relationship as well as facilitating the see one, do one and, teach one culture.

Developing both a theoretical and practical understanding of how past, present and future weather influences snow and ice processes is heavily emphasized in the course. Throughout the semester, the class shares a weather timeline that a rotating pair of students takes and fills out by hand throughout the semester. Weather information is taken from the Alta Collins and Alta Mt Baldy weather stations accessed via Mesowest. Because precipitation, wind speed, wind direction and, temperature are the foundation for snowpack and avalanche formation, a significant amount of time is spent knowing how to interpolate weather data and the inherent caveats of atmospheric measurements. The assigned pair of students then lead a short discussion about the previous weeks weather and how it will effect the classes field session plans. Finally, pre assigned student groups containing at least one student with an atmospheric science background leads a weather briefing for the upcoming field session. During these briefings, students are encouraged to follow the typical forecasts funnel by starting at the synoptic scale showing a variety of satellite images and upper level weather maps. Secondly, weather models and forecast discussions are critiqued for the upcoming field session and a consensus is made about where that week’s field session will occur.

The bulk of in class time is spent in a lecture format in which instructors and teaching assistants present information covering the week’s topic of discussion. Students complete prerequisite reading before coming to the lecture and come with questions and thoughts for discussion. Certain topics can be spread out between multiple classroom sessions in order to provide sufficient time for questions and comprehension. Weekly assignments are usually begun in small groups during the last half hour and are typically due at the beginning of the following class.

2.2 Fieldwork

The field portion of the course is where students take the concepts that are introduced in the classroom and apply them in a hands on setting. Field sessions take place on Friday afternoons from 1 to 5 pm at rotating locations in Big and Little Cottonwood Canyons. Having a dynamic meeting location allows the class to find the optimal location to apply the concepts from the weeks scheduled topic of study. Early in the semester, when students are able to become immersed in introductory backcountry travel safety, data gathering, and recording techniques. A study plot is set up near the Atwater study plot in Alta, Utah, provides a very approachable setting for students of with a variety of backcountry travel experience. The study plot offers a unique setting to where students are encouraged to ask instructors and fellow students questions pertaining to the present topic and engage in a detailed group discussion. This can be especially helpful when covering the highly detailed topics snow metamorphism and mechanics that require further demonstration. Before field sessions are allowed to go beyond the study plot, each student is required to show proficiency with basic avalanche rescue gear by completing a beacon, probing, and shoveling test.

The semester long class format offers a unique environment where group relationship and dynamics develop very organically. The peer to peer and peer to instructor interactions resemble those of Tuckman’s 5 stages of group development, quickly moving past the forming and storming stages of group development(Tuckman, 1965). The class tends to meander between within the norming and performing stages as new topics are introduced and previously covered topics are re-explored. The ethos of “See one, do one, and teach one” becomes an embedded mindset in all participants of the class. When a student can explain what they have learned to another student or instructor, they are much more likely to retain that information for
later referral. Students can extend the information they have learned throughout the course and apply them to their areas of interest.

3. TOPICS COVERED

Snow and Avalanche studies have a unique nomenclature associated with the topic and it is imperative that students develop a solid base of information that will be utilized by every additional section of the course. Avalanche anatomy, including starting, track and, run out zones, crown, flank and toe of an avalanche are introduced in class and explored during every field session. Snowpack stratigraphy including its properties of cohesion and adhesion within the snowpack are covered and applied within the context of avalanche initiation and common snow stability tests.

Snow metamorphism is first introduced through elaborating on the relationship between the phase changes of water. Developing the conceptual flow of molecular water between those phases can be to insightful process for students. Furthermore, having an understanding of those phase changes helps students understand the nuances between kinetic and equilibrium metamorphism regimes. The snow energy balance is introduced as the relationship between atmospheric and terrestrial radiation and how it governs snowpack metamorphism regimes. Additionally, water is discussed at the molecular level to illustrate its influence on ice crystal formation in the atmosphere and in situ in the snowpack. Finally, wet snow metamorphism regimes are covered as well as how its cyclical patterns influence snow melt and avalanche hazard.

The dynamic stress and strength relationship within the snowpack is a keystone topic covered in the course. Quantifiable test results from shear frame, tensile and ram penetrometer tests are used as initial conditions in calculating the compression, shear, and, tensile strengths within the snowpack. Snow stability tests are broken down into the physical components they are qualitatively attempting to explain. It is a common struggle for students in any snow and avalanche course to draw meaningful conclusions from stability tests. This is why a major focus is placed on facilitating the student’s ability to apply critical thinking strategies and make empirical based decisions.

4. EVALUATION

Evaluation of each student’s comprehension of course materials is completed through weekly quizzes, a comprehensive final exam, and a final project. Each type of assessment is focused around testing a specific skill set. The function of weekly quizzes is to incentivize students to complete required readings as well as test the retention of the prior weeks topic of study.

Though the final exam is a necessary portion of the course, significant effort is made to write a test that provides a meaningful learning opportunity for students. Typical multiple choice and fill in the blank questions are included as well as short answer questions where students must infer information from provided weather data and the weather timeline. Due to the large amount of material that is covered in the course, students are encouraged to apply the group dynamic principles they developed throughout the course to ensure the entire cohort understands the material through forming study groups.

Final projects offer a unique opportunity for students to apply the skills learned during the course and their own areas of interest to a project of their choice. Instructors offer guidance for the student’s ideas and help facilitate access to resources and individuals that will help them create a successful project. Previous projects have included snow stability and structure testing instruments, automated weather timelines, field guides for safety procedures and snow crystal identification tools.
5. CONCLUSION

The semester length Snow and Avalanche course at the University of Utah offers a unique curriculum that covers the physical process of snow and ice in addition to how it translates to avalanche formation. The diverse background of students also allows for students and instructors to learn from each other’s unique perspectives. The semester length course enables students to explore concepts in detail and extend those concepts into their chosen field of study. Institutions looking to develop a more specific snow and ice study area can use this paper as a framework to create their own course and possibly develop a snow, ice and avalanche focus area within their program.

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REFERENCES


