

Observing Snow and Wind: Using the Environment to Engage Students in Science and Engineering

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BACKGROUND

- Undergraduate students experience weather every day
- Atmospheric science faculty at colleges and universities around the nation routinely build on and incorporate those experiences into undergraduate courses
- The local weather in the vicinity of the University of Utah provides opportunities in our department to apply fundamental science concepts in ways that students can recognize as being relevant to them:
 - health effects of episodes of very poor air quality in the Salt Lake Valley
 - major snowstorms that affect arriving or leaving campus
 - upcoming weekend weather in the nearby Wasatch Mountains affecting outdoor recreational interests

UNDERGRAD COURSE REVISIONS

- The Atmospheric Sciences undergraduate curriculum has been extensively revised beginning this year to develop an undergraduate program that engages and excites all students, including underrepresented groups, about science
- The department has developed an instrumentation laboratory with equipment donated by Campbell Scientific, Inc., Logan UT
- A critical component of this effort has been to increase hands on learning opportunities in the ATMOS 1010 course, Severe and Unusual Weather
- Students' awareness regarding how weather observations are made is enhanced by having them take weather observations routinely
- One of the most popular assignments is to measure the type and quantity of snow received on campus
- A goal of this project is to assess quantitatively and qualitatively the impact of these changes in the ATMOS 1010 course
- The specific educational goals of this project are to:
 - increase student proficiency related to the underlying principles and sources of uncertainty associated with environmental instrumentation
 - enhance student confidence to use technologies to observe the environment and solve real-world problems



The Department of Atmospheric Sciences has a newly remodeled environmental instrumentation laboratory (703 WBB) that is used extensively for hands on instruction

EVALUATING THE IMPACT OF COURSE CHANGES

- This research study is investigating the effectiveness of the new curriculum coupled with the integration of the environmental instrumentation experiential laboratory experience on student learning
- This study is examining the following:
 - The quality and effectiveness of instrumentation skills training for faculty and teaching assistants
 - The extent to which the new curriculum and revised laboratory experiences enhances student instrumentation skills
 - The degree to which student confidence levels were increased when using instrumentation
 - The growth and degree of change of departmental educational practices and curriculum
 - The change in numbers of atmospheric science majors
 - The change in enrollment in the non-major departmental courses
 - The attitudes and scientific literacy of non-science majors for science
- One of the first steps was to develop an anonymous survey for students to complete at the outset of the semester to be followed by focus group discussions to obtain additional student feedback
- The survey is online at <http://www.zoomerang.com/Survey/WEB22BR99YRMD9/>
- Representative survey questions:
 - What, in your view, is atmospheric science? What makes any science different from other disciplines of inquiry
 - Is there a difference between a conceptual model and a scientific law? Give an example to illustrate your answer.



Students calculate the snow water content by working together to gather measurements. The snow water content determines the quality of the snow.

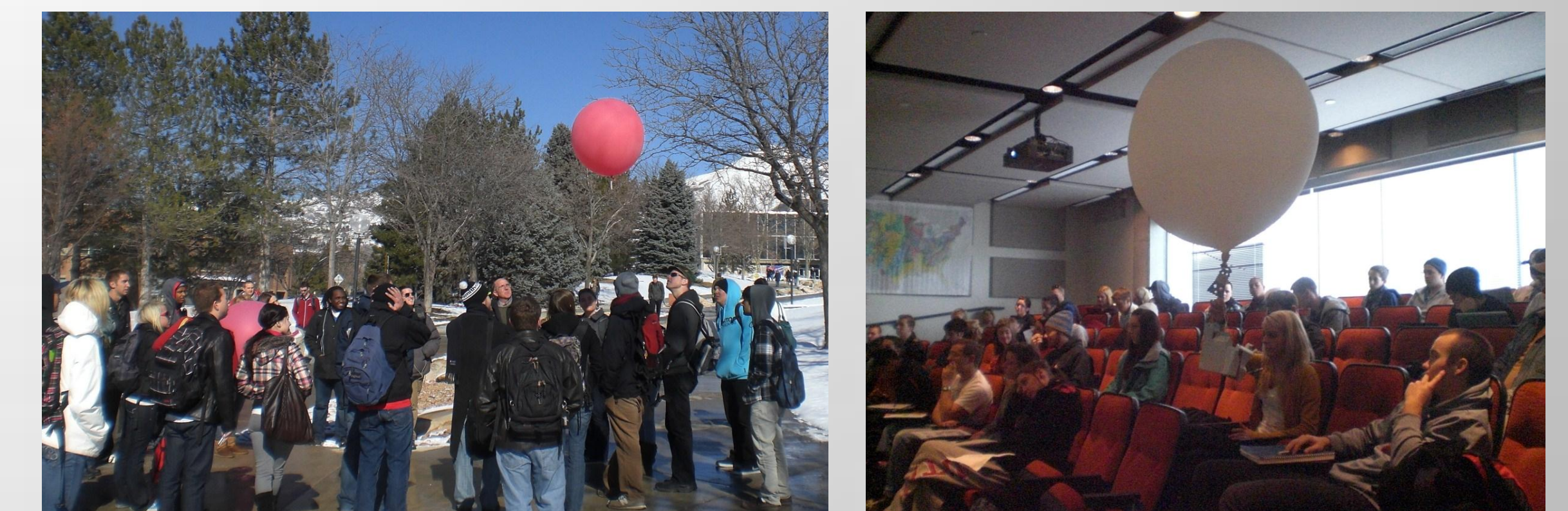
MEASURING SNOW: ATMOS 1010 ASSIGNMENT

- Some of the information collected by students in ATMOS 1010.
- Use the snow crystal classification if the snow is recently fallen to define the crystal type
 - Measure the inside diameter and cross-sectional area of the tube
 - Push the tube down onto the board. Record the depth of the snow outside of the tube
 - Lift the tube off the board and push the snow into the glass container. Use the hot plate to melt the snow. Pour the water into the graduated cylinder. Record the volume of the liquid water in milliliters
 - Determine the snow water content in percent by dividing the volume of the water by the volume of the snow
 - What errors might there be in your measurements? Explain briefly.
 - So, is the snow you measured the greatest snow on earth? Why or why not? Summarize your results and how they compare to those reported in the reading.

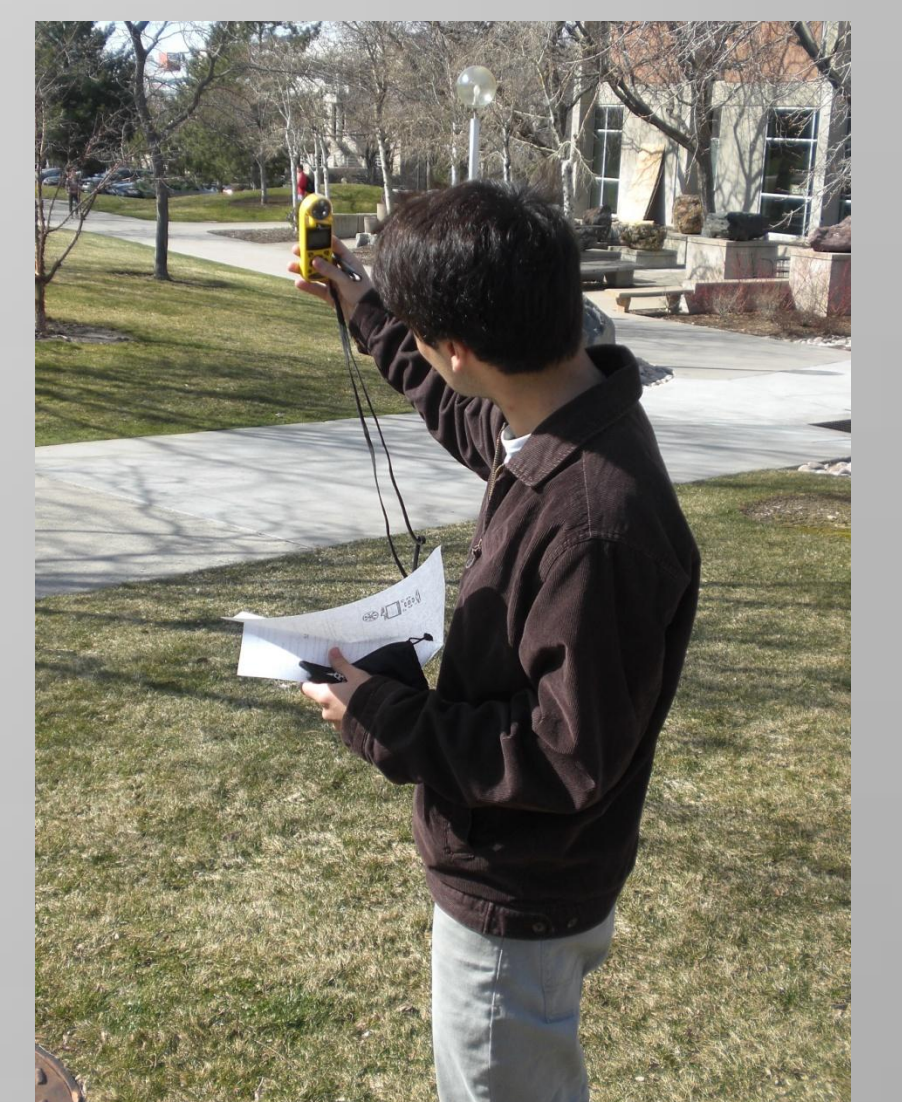
STUDENT FEEDBACK

Student feedback is garnered from individual module feedback surveys and end of semester evaluations:

- "I have used Mesowest on my phone to get proper weather readings. I have also explained what an inversion is to my friends and family."
- "This past summer I went camping with my family. My parents checked the weather forecast on the Farmer's Almanac. The forecast turned out to be wrong. From this module I have learned which weather forecast services provide the most accurate forecasts."



"There are many times in which you will look at some sort of app, or browse the web to get an idea of the temperature. It has been interesting to use one of the very instruments used to produce those numbers that we look at that has made its way to those places telling us the temperature."
-Student Weather Journal Response



"I went skiing and I was able to tell the other person on the lift what kind of snowflakes were falling. They were graupel, not that interesting and pretty crappy snow."
-Student Weather Journal Response



Launching weather balloons, using the Kestrel 4500, and observing the environment were some of the hands-on activities used.

CONCLUSION

Formal evaluation is still underway. We will be ending the semester with the post survey similar to the pre-survey that was issued at the beginning of the semester. Focus groups among the students will also be held to discuss the out product of what the students have learned.

ACKNOWLEDGEMENTS & REFERENCES

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