P1.23 METEOROLOGY AND WEATHER MONITORING DISPLAY FOR NATURE CENTERS

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1. INTRODUCTION

Nature centers are an informal educational opportunity often frequented by school groups and the public. They reach a wide audience with an age range varying from preschoolers through adults. Such informal means of education are sometimes very effective since the students can become immersed in applications of the science. When people learn about physical science and mathematics in an informal setting, they often see the relevance and applicability of what they learn.

Nature centers typically present information about environmental topics and natural science. Many of these centers do a wonderful job of educating in such areas as biology, geology, and environmental science; however, it is seldom that one sees a nature center exhibit or program that emphasizes physical science, technology, or mathematics. In this project we sought to provide this missing element by developing displays and programs that use meteorology to exemplify physical science and mathematics in the natural world with an emphasis on the technology of monitoring. This paper reports on a state funded project to site a display on meteorology and instrumentation to monitor weather variables at Stokes Nature Center in Logan Canyon.

The displays and programs use the natural themes observable in the surrounding environment. The centerpiece of the education programs is a weather station sited near the Nature Center. This station presents a display within the Nature Center and includes interpretative plots of the data. Data are integrated with other data from nearby stations. Displays are included to explain the weather and climate of the region as well as instrumentation. In addition, children's programs have been developed for visiting school groups and for teachers who wish to develop classroom meteorology units. Specifically, physical science and mathematics State Core Curriculum objectives are integrated into the presentation and study of meteorology through hands-on displays and experiments. The programs include using the data from the weather station, outside environmental observation, and using simple instruments to measure meteorological variables. Students use this integrated picture to predict the next day's weather. Teachers may then follow-up in the classroom to assess the children's predictions. In this way, school children learn about meteorology in the natural environment plus use mathematical skills to put their newfound knowledge to work.

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2. STOKES NATURE CENTER

Stokes Nature Center is an example of how many informal education opportunities work. They include both formal activities for school classes to use as field trips as well as including displays that anyone can view upon visiting. It is situated at the mouth of Logan Canyon (Fig 1) and served as the pilot site for this project. The center is a non-profit nature education facility (see http://www.logannature.org/). It provides field-based science education programs for all ages, including:

- Field programs designed for school field trips, correlated to the Utah State Core Curriculum, including pre- and post-visit lesson plans.
- Saturday family programs: one week per month of nature programs for all ages and another week emphasizes activities for children ages 6-8.

- Winter safety and winter survival programs, designed as special programs for one day or one evening plus one full day in the snowy outdoors on a snowshoe trip. This program is popular with Boy and Girl Scout troops.
- Summer Dipper Day Camp, which is a chance for elementary students to spend a week of summer days exploring Cache County's diverse habitats and wildlife.
- Displays within the Nature Center building, accessible to drop-in visitors during the hours of operation.

Topics for the programs include exploring river water quality by collecting and identifying invertebrates, hands-on ecology, plant and animal seasonal preparations, soil science, tree ecology, geology, and the inner workings and transport of seeds.

FIGURE 1. Stokes Nature Center in Logan Canyon

Various local schools use Stokes Nature Center to facilitate their teaching of science. The Nature Center receives excellent feedback from excited children, teachers, and parents on their presentation techniques and their methods of integrating the surroundings into their lessons. Programs such as the one presented here are examples of opportunities for the public to learn about science in an informal setting. It reaches people from all walks of life. The informal nature of the Center allows children to learn without the usual pressures of schoolwork, thus being accessible to students who may not be traditional learners. Similar opportunities abound at other informal education venues.

3. COOPERATIVE PARTNERS

While there is much that is positive about the efforts of the Stokes Nature Center and other centers like it, we believe a weakness is that there is a general lack of emphasis devoted to physical science and mathematics. Of course, physical science and mathematics are also intrinsic parts of the natural world. One example of a physical science that is quite amenable to the type of learning that goes on in a nature center is meteorology. The instrumentation involved in measuring meteorological variables is an opportunity to demonstrate technology. In addition, the science of meteorology is also an excellent example of a science that deals with data in a very mathematical way, thus being a wonderful opportunity to present mathematics as part of nature.

This project provided a paradigm of cooperation between an informal education center, formal K-12 education, higher education, industry, and government entities to enhance opportunities for learning science and mathematics.

To meet the goals of providing enhanced mathematical and physical science curriculum, this project concentrated on working with real-time weather data. The project goes beyond the typical cloud and sky observation to teach students to evaluate data to determine the "why's" of how the weather works. Thus, the first step of the project was to obtain equipment to measure meteorological variables. A weather station was sited at the nature center (see Figure 2). Campbell Scientific, based in Logan, is one of the primary sources of weather stations in the United States. They donated equipment for a fully functional weather station to Stokes Nature Center and provided manpower to set the equipment up within usual specifications. Variables measured include air temperature, relative humidity, wind speed and direction, barometric pressure, precipitation, and solar radiation. Additionally, Campbell Scientific has four other weather stations sited in Cache Valley with data accessible online. Siting the weather station required the co-ordination of the university investigators, Campbell Scientific personnel, nature center staff, and the US Forest Service who owns the land on which it is sited. A proposal was written to justify a categorical exclusion and a public comment period was held. The comments were all positive and the Forest Service granted the exclusion.

FIGURE 2. Weather station and rain gage at Stokes

Telephone lines provide communication between the weather instruments mounted on the roof (Figure 2) and a data logger that includes software programs to retrieve the data and graphically display it on a computer sited inside the Nature Center. The computer displays are programmed to specifically show the variables of interest at the current time as well as to allow viewing historical data.

A second type of data acquisition is via hand-held monitors that groups visiting the nature center can take into the field. These devices include thermometers, hygrometers, and manometers. These are hardy in nature so that they can be used by many groups over a long period of time.

The weather data is an important part of providing Nature Center patrons with opportunities to assess the physical and mathematical basis of meteorology. The project provides educational opportunities centered around the way people typically visit the nature center.

4. DISPLAY FOR NATURE CENTER

A display centered around meteorology was prepared for Stokes Nature Center. The centerpoint of the display is the computer that records and displays the data from the weather station. The computer display is interactive, giving the visitor various options for viewing data. Displays of current data are presented in terms of histograms, dials, and data thermometers. The user may switch the view to plot time series of historical data over a variety of time frames. Plots are of various types, ranging from a simple time series that shows hourly changes to very long-term displays, such as histogram plots of a variable, such as temperature, which help interpret the climate of the region. Also, the visitor is invited to compare the local data with the other stations throughout Cache Valley.

In addition, the changes in weather monitoring through the years is displayed to the left in a tri-panel display. Past instruments, such as a working Galileo manometer are displayed in a plexiglass case. Question boards allow the visitor to guess answers to questions about the workings of such instruments. They are encouraged to further understand the physical principles through inquiry. The middle display is sited over the computer and emphasizes modern instrumentation techniques. On the right panel, a photo of the weather station is included as well as an explanation of how the various variables are measured. Overtop it all is a cloud mural that paints the differing types of clouds at the appropriate level in the atmosphere (see Figure 3). A key below helps children to identify the various clouds. The displays can be viewed either by school groups or informal visitors.

FIGURE 3. Cloud mural that is a focus of the meteorology display at Stokes Nature Center.

5. CONCLUSIONS

By observing meteorological data and conditions, visitors to Stokes Nature Center can integrate the physics and mathematics of the natural surroundings and use the tools available to interpret and predict future

conditions. In addition, learning modules were developed for visiting school groups and which may be used by teachers who wish to develop classroom meteorology units (Haupt and Barta 2003). These programs have been piloted and assessed as being useful for the teachers involved. In addition, a weather station and a display have been sited at Stokes Nature Center that allow the visiting public to view real time meteorology data and describes the tools to interpret it.

This project was designed as a model that can be expanded to other nature centers throughout the state and region. The project required close collaboration between K-12 and university educators, engineers, industry, the US Forest Service, and nature center personnel. Our hope is that by collaborating with informal education environments, a new paradigm for educating the public in science and mathematics can be developed. Achieving these goals will help increase the public's (and particularly school children's) abilities in science-related areas.

Real mathematics and scientific inquiry is important to help students develop productive views of the nature of mathematics and science. When students understand mathematics and science as dynamic processes, rather than static sets of facts to be learned, they are more successful at inquiry and continued learning.

REFERENCES

Haupt, S.E. and J.J. Barta, 2003: Integrative Meteorology Opportunities at Community Nature Centers, Proceedings of the 12th Education Symposium, American Meteorological Society, Long Beach, CA, P1.28.

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