COLLABORATION IN ENVIRONMENTAL EDUCATION: A TECHNICAL COMMUNICATION INTERNSHIP WITH THE OHIO WYAMI APPALACHIAN TEACHER COHORTS (OWATCH)

by Scott S. Shellabarger

This paper reports on my internship as the Environmental Technical Communicator of OWATCH, an education consortium providing professional development in environmental science to Ohio teachers. Chapter 1 describes the organization of OWATCH including the collaborative atmosphere and the “culture of enthusiasm” fostered there. In Chapter 2, I describe my role as an SME facilitator and outline my mission in relation to the “creation of knowledge.” Chapter 3 showcases the deliverables that I produced. Chapter 4 explains the lessons I learned by delving into the processes involved in completing two information dissemination projects. A detailed analysis of the effect of tone on a document is included. Both Project Management and Anderson’s Problem-Solving Model are used to analyze the accomplishments of the internship, and a proper melding of the two methods is completed with the introduction of my own “Project Solving.”
COLLABORATION IN ENVIRONMENTAL EDUCATION:
A TECHNICAL COMMUNICATION INTERNSHIP
WITH THE OHIO WYAMI APPALACHIAN TEACHER COHORTS (OWATCH)

An Internship Report

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DEDICATION

I dedicate this internship report to the memory of my grandfather, George D. Shellabarger, who passed away on April 24, 2005. He was a hard-working, kindhearted man. He was business-minded and a friend to all he knew. He was generous. Without his support, I could not have completed this document, nor could I have had the tenacity to complete this degree.

I dedicate my graduation with a master’s degree in technical & scientific communication to the memory of my father, Colonel Dan G. Shellabarger.

It was my father’s unexpected death from cancer on Father’s Day in June of 2000 that made me stop and think about the shortness of life. He was only 60, and I had expected to share many life experiences with him as our relationship grew over the years. He passed on while I made my professional way to the top of my game in newspaper advertising and art at the Palm Beach Daily News in Florida. My life was perfect, yet not satisfying. I seemed to have missed something in life’s journey. With my father on my mind, I decided, at the age of 38, to quit my job, career, and life as I knew it. Although changing careers after 15 years and starting all over again at the bottom seemed like a daunting task, time was of the essence. Thanks to the Miami University MTSC program, I was able to take what I knew--writing, editing, photography, and graphic design--and bend it into what I loved and aspired to--teaching about nature--in the form of environmental education.

With a MTSC degree, I believe that I can pursue my professional dream of being an environmental educator--and make a difference in people’s lives. In the meantime, my personal satisfaction lies in knowing that my dad would have been proud to see me go after and accomplish my dreams no matter the costs or risks involved.

I miss you, Dad.

Scott Shellabarger
April 2007
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I would also like to take this opportunity to thank Megan Berkowitz for her personal and educational support during the six years that it has taken me to complete the MTSC program. There have been many personal obstacles and detours, but your day-to-day support has kept me sane and on-course. The pursuit of our matching passions for traveling and for nature photography has been a source of true joy and growth. Thank you, Megan.

I would like to acknowledge the source of my creativity: my connection to the Diehl Family, grandparents Richard & Marilouise Downing. Thank you for your support and kind thoughts.

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Chapter 1 - The Organization

Introduction

In partial fulfillment of the requirements for the degree of Master of Technical and Scientific Communications (MTSC), I completed an internship with OWATCH from January 6, 2003 to April 25, 2003 in the capacity of an environmental technical communicator. The following report will outline the organization for which I worked, the projects I completed, the problems that I solved, and the lessons that I learned.

OWATCH Environment

OWATCH is an acronym for the Ohio Wy-ami Appalachian Teacher Co-Horts, an environmental education consortium devoted to providing professional development in environmental science to public and nonpublic school teachers from Ohio’s thirty-three Appalachian counties. Subjects ranging from Geology to Entomology to Stream Ecology are taught and advocated through the use of Native American stories and “hands-on” training in natural habitats near DuBois, Wyoming and, to a lesser extent, near Utica, Ohio. OWATCH programming is based in scientific research and is expected, per a federal grant administered by the Ohio Department of Education, to improve student academic achievement required by the No Child Left Behind Act of 2001.

I felt a natural affinity toward OWATCH because the organization supports a mission of environmental education--with which I have had previous experience as an Interpretive Park Ranger with the U.S. National Park Service (NPS) at Gulf Islands National Seashore in Ocean Springs, Mississippi. And the experience I gained at OWATCH helped me to become an Outreach Steward with The Nature Conservancy (TNC) of Colorado. All three of these organizations--OWATCH, NPS, and TNC--provide various degrees of environmental education to different elements of the general population with the goal of creating an appreciation and respect for our natural environment.

The National Park Service deals directly with all educational levels of the public, while The Nature Conservancy creates a direct connection for the educated public to the scientific community in support of its conservation advocacy. OWATCH goes one step further by linking scientists to children through their teachers. Teachers are the bridge between the technical community and the non-technical one. As such, teachers are technical communicators in a pure
educational setting whose responsibility is to bring critical information to developing minds, help the information to be understood and grasped, and cultivate a desire for continued learning. OWATCH exists to assist in this process of learning and to channel critical technical communications.

**Collaborative Organization**

OWATCH is essentially a collaboration of educators with a common goal of supporting environmental education for Ohio’s elementary students. Although working at all levels within educational institutions all over Ohio, thirteen core teachers come together to help their peers understand and teach biological and scientific subjects and processes. This team of core teachers possesses a passion for teaching and learning that is the organization’s lifeblood, and the collaborative effort is drawn from this essence. The mission of OWATCH is continuing teacher education, which the organization accomplishes by gathering together the best of various smaller programs while building upon and supplementing others. The strong collaborative spirit of OWATCH’s team focuses the programming on the larger goal of helping Ohio’s children compete on a level playing field in the global scientific arena.

The overall mission of OWATCH matches federally mandated educational guidelines, thus allowing OWATCH to draw financial support from the federal government as well as the state of Ohio and other education-based initiatives and foundations. At the time of my internship, OWATCH was working on acquiring funding from the Ohio legislature in the amount of $5 million and expected to begin full operation in March 2003. While I was lucky enough to be privy to the legislative process during my time with OWATCH, I was disturbed to note the slowness of acquiring money for the educational welfare of Ohio children. OWATCH is accomplishing minimal aspects of its potential educational mission on a shoestring budget comprised of several grants. The Eisenhower Foundation has been OWATCH’s biggest financial supporter, providing funding for the past ten years (to various arms of the organization). The bulk of the funding for 2003, in the amount of $166,437, came, however, from the Ohio Board of Regents for the Improving Teacher Quality Program.

The collaborative atmosphere of OWATCH is strengthened in decentralization. Funding Director Marilyn Parkes is considered the contact coordinator of OWATCH (for general funding purposes) and is based in Lisbon, Ohio (on the far east side of the state, not far from Pittsburgh,
Pennsylvania). Programming has been developed by Dr. Robert McWilliams and Dr. Richard Lee, both of whom are listed as Educational Directors, and Edward Soldo, who is a teacher-facilitator from Sycamore High School in Cincinnati (Ohio). Dr. McWilliams is a former Miami University geology professor with offices in Oxford, Ohio, while Dr. Lee runs the Cryobiology Laboratory at Miami University--also in Oxford (on the far west side of the state, north of Cincinnati). The remaining staff members of OWATCH consist of ten elementary, middle, and high school teachers from across the state who act as facilitator-assistants in the on-site teaching of OWATCH programs. Most staff members are either from the far west or the far east sides of Ohio. The question has been asked of both regional groups: With so many quality educational institutions in Ohio, why not team up with educators who work at a closer location to your own? The answer is clear: shared location does not make a better team; shared passion does. A strong passion to teach and learn brought these groups of educators together, and now they collaborate toward a shared passionate goal.

The collaborative atmosphere at OWATCH is furthered through its unauthoritative governing. There is no central command for the organization. Instead, there are two levels of workers consisting of three directors of equal standing at one level and ten teacher-facilitators of equal standing who report to the directors. At this time there is no support staff. Teacher-facilitators may, however, volunteer for support staff positions as needed. Web site development, for example, is handled by a few different teacher-facilitators who have volunteered time and web space. The environmental technical communicator position that I held at OWATCH is another example of a much-needed member of the support staff who would assist in legislative affairs, promotion, and program development.

The management structure of OWATCH showcases the equi-linear approach whereby Parkes, Lee, and McWilliams all have equal standing, while Soldo and the other teacher-facilitators report to the three directors depending on the context of the duty. On specific projects, the directors defer to each other according to the specialty area. For example, Funding Director Parkes coordinates the lobbying of the state legislature and answers questions from the media. She sets up press conferences and meetings with senators to make sure that OWATCH’s mission statements and importance are realized by potential funding agents. Lee and McWilliams defer to Parkes on these issues, yet provide support in the form of testimony or “hand shaking” and tours with state representatives. And Lee and McWilliams, in their capacity
as directors of programming, supervise the teacher-facilitators and make sure that the subjects and methodologies being taught match up with the goals for OWATCH.

The OWATCH programming team, directed by Lee and McWilliams, includes some of the more seasoned teacher-facilitators as well. The team creates and delivers content in the form of professional development courses. The educators attending these courses are not only taught the subject matter itself, but they are also shown (and taught) techniques for presenting new scientific and technical information to a simpler audience. The subject matter is presented in an accessible format with the educators’ own students in mind as the final destination for the information. A typical example of the type of subject matter would be “Stream Ecology;” the course takes the participants directly into a creek or stream to learn how an inventory of the inhabitants is a gauge of the water quality. Participants learn about insects living in the stream, while being taken on a scavenger hunt to locate these insects.

Stream Ecology needs to be taught in an actual stream in order for the students to truly understand the context of the subject matter. This is the case with many environmental subjects. Understanding this important aspect of learning, the OWATCH programming team delivers coursework in appropriate environments, in many cases teaching classes in locations where scientific research and discovery continue to be performed. Educational programs occur at various public or government facilities and parks throughout Ohio and at the Miami University Geology Field Station near Grand Teton and Yellowstone National Parks outside of DuBois, Wyoming. (See Appendix A for a picture of the MU Geology Field Station/Timberline Ranch and the nearby Grand Teton mountains.) Located at an elevation of 7700 feet in the Wind River Mountains, the Miami University Geology Field Station (also known as the Timberline Ranch) is situated along the banks of the Wind River. The ranch has been the site of field tests and environmental education courses since 1946 when Miami University (MU) entered into a collaborative arrangement with local Wyoming ranch owners. Miami University owns the land while ranch managers John & Barbara Wells live at the ranch and take care of the property. Bunk houses provide living quarters for summer classes, and meals are cooked and served by ranch staff. Classes at the ranch usually serve forty participants who stay for a two-week session. Each summer, two sessions are completed from July to August.

OWATCH facilities and personnel are geographically widespread. Programs are developed in western Ohio, financed in eastern Ohio, taught by teacher-facilitators based across the state,
and held in western Wyoming. The OWATCH educational mission requires a dedicated collaboration built on a solid communication network. Without a multitude of immediate communication channels, OWATCH staffers would waste valuable time simply attempting to meet with one another. The internet greatly reduces the need for face-to-face communication. Directors and staff communicate frequently via the internet through e-mail, website postings, and internet bulletin boards. They use the telephone and video-phone for conferencing. Yet, in spite of the use of these important communication devices, many staff members do still need to travel by motor vehicle to meet in educational settings across Ohio and the nation. Primary and supplemental programming still requires face-to-face communication. The future, however, poses new possibilities for both teaching and working via the internet. Already, many workers in varying professions complete job assignments from home through the practice of telecommuting.

**Telecommuting Standard**

As a technical communicator with OWATCH, I was supervised directly by Programming Director Dr. Richard Lee and given an office within his Cryobiology Lab at Miami University in Oxford, Ohio. But, as I have intimated, funding documents officially list OWATCH as being based in Lisbon, Ohio, under the directorship of Marilyn Parkes. So, for the purposes of the internship, the MU-MTSC department considered my position to be that of a telecommuter. This was not unique for OWATCH staffers. The compartmentalized nature of OWATCH’s organizational structure dictated that all staff members be telecommuters. Telecommuting was considered the standard in this organization.

At the time that I started working for OWATCH, organizers expected that Ohio legislative funding would provide for a more structured support system and the hiring of permanent dedicated staff members working in either Lisbon or Oxford (OH). During the internship period, I was paid through two grant fund sources acquired for continuing research into techniques for the education of environmental science teachers. These grants came from the programming side of OWATCH through Dr. Lee’s efforts. In the absence of centralized funding, each arm of the organization applies for and receives grants pertaining to specific needs within the organizational mission. Without a permanent budget, OWATCH remains committed to a collaborative environment, geographically widespread, and without physical constraints. Technological advances in communication will continue to improve upon the abilities of OWATCH staffers to
complete educational goals--making telecommuting more common in the organization and perhaps allowing for the exploration of distance learning.

**Culture of Enthusiasm**

Despite the aforementioned erratic funding, OWATCH’s core program, known as ESET (Environmental Science for Elementary Teachers), has provided concentrated, short-term professional development for approximately four hundred Ohio teachers over the past ten years. (See Appendix B for a newspaper article that provides an overview of the ESET program.) The OWATCH/ESET program is a two-week, college-accredited, summer environmental science class for elementary school teachers. The course promotes the teaching of botany, geology, and zoology with implications for language arts, mathematics, social studies, technology, and the academic content standards in Ohio. Commonly, elementary school teachers must know many subjects without specializing in any particular one and may lack confidence in environmental subjects. During the OWATCH/ESET class, teacher-participants work on-site in the real-science, biologically-rich landscape of the Wyoming mountains (at the field station/ranch) while facilitator-experts (other K-12 teachers, college professors, and professionals) in environmental science demonstrate “hands-on” methods for teaching nature and science subjects to children of various educational levels. (A course description for Environmental Science for Elementary Teachers is found at: http://www.units.muohio.edu/cryolab/education/index.htm.)

The excitement of both the participants and the facilitators of the ESET program is palpable. Educators who love to teach are instructing teachers who love to learn. As technical communicators, professional educators such as Dr. Lee demonstrate the latest environmental science theories with examples and terms appropriate for elementary teachers. OWATCH/ESET teacher-facilitators inspire participants with an excitement toward the learning--and teaching--of environmental science. The teacher-participants receive methodologies and materials, and they are asked to pass on their newly acquired knowledge to fellow teachers within their schools--as well as to the students in their respective classes. The chain of collaboration continues as the OWATCH educational culture propagates itself by asking participants to inspire others with learned enthusiasm. Thus, OWATCH staffers accomplish their own educational goals through a culture of enthusiasm for learning and teaching.
Chapter 2 - The Mission

SME Facilitator

In my role at OWATCH, I facilitated the flow of information from the scientists to the teachers by enhancing and supporting educational programming tools and devices through my skills as a technical writer, editor, and designer. The starting point was my own office in the Cryobiology Laboratory at Miami University. Here, I was surrounded by the research world of Dr. Lee, a college research lab scientist/professor, his support staff, and his researchers. These people made up my day-to-day office culture as I created a bridge between the research world of the lab and the educational world of OWATCH. I was in the unique position of being in daily contact with subject matter experts (SME)—the tacit knowledge holders—for the educational programming documentation I was to create for OWATCH.

Supportive Mentor

Programming Director Dr. Richard (Rick) Lee was my mentor and supervisor at OWATCH. Dr. Lee’s patient and supportive approach toward his co-workers, staff, and constituents lends itself to the extension of the OWATCH culture of learning and teaching through enthusiasm for the process. While he is a talented writer and teacher, Dr. Lee easily accepts suggestions for improvement—thus generating a pleasant collaborative atmosphere in which to work. For example, in my first week I was able to offer some editing advice on the use of the article “a” or “an” as found in Harbrace1. The word phrase Dr. Lee wrote was “an universal response,” and, while I knew that it did not sound correct, I used Harbrace to support my argument with facts and examples. “An” precedes vowel sounds, not necessarily vowels themselves—thus the difference between “a unicorn” and “an uppity man.” The MTSC program taught me this, and I simply passed on my knowledge. But it really gave me a sense of pride and pleasure to be taken for an authority on the English language; Dr. Lee seemed to appreciate my attention to detail as well.

Dr. Lee is no stranger to collaboration and excels in written technical communication. The Society for Technical Communication gave Dr. Lee an Award of Achievement for a Scholarly/Professional Article in 1993. He has published more than 150 scientific and technical articles

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and invited reviews. He has also edited two entomological/biological books and he currently writes and teaches complex biological and environmental themes and concepts in college classes and through OWATCH programs.

While I was originally scheduled to telecommute my internship from home, Dr. Lee took it upon himself to arrange for me to use an office, equipment, and services in Miami University’s Pearson Building so I could be closer to the scientific information being generated by the Cryobiology Lab. While the equipment and services had not been promised, they were invaluable to the completion of tasks related to my position with OWATCH. Dr. Lee provided a framework within which to complete my internship work by giving me an office to go to daily and a company culture within which to interact.

My Mission

I was hired by OWATCH to use my skills in technical communication to develop promotional and educational materials for use by OWATCH facilitators. The organization needed to increase its outreach to the educational community of Ohio while maintaining connections to the program’s alumni. One way of doing this was to produce a series of journal articles directed at school teachers. These articles were intended to facilitate the introduction to, and/or transfer of, the complex scientific concepts covered in OWATCH educational courses and workshops in Wyoming and Ohio. Both promotional and educational, the articles represented not only OWATCH program concepts but the organization itself in a public forum. OWATCH managers also wanted to enhance the organization’s public presence through the website, so they asked me to do an analysis of this option for them. I analyzed both the existing sites and the options available and produced a report detailing my analysis. The expanding OWATCH organization was able to use my conclusions to support a future internet plan of action.

My mission at OWATCH required many meetings with collaborators as I attempted to integrate my knowledge with that of others toward the end of achieving organizational goals. The journal article took the bulk of my project time (40%), while the website critique and subsequent additional aspects of that project took a close second at 35% of my working time. The press statement and associated legislative aspects of my duties accounted for 15% of my project time. And the final 10% of my time was spent editing grants and other writing projects, including two additional journal articles. As the company technical writer, I was often
approached for my opinion on the techniques for the writing, editing, and presentation design of projects.

The journal article and the website critique were my two largest projects requiring a combined 75% of my time. The work process, however, differed slightly from one project to the other in that the critique required less re-writes. As the focus evolved, the journal article required considerably more changes. Steps 4 and 5 were repeated many times before a final draft was considered. My work process or scheduled workflow included:

1. Research/Gather/Interview
2. Outline Document
3. Write Draft in Microsoft Word
4. Review Draft with SME
5. Incorporate Changes
6. Produce Final Draft and Deliverables

I devoted 35% of my internship project work time to Research/Gather/Interview through both stated and educational means. Step 2, Outline the document, received just 5% of my project work time, while Step 3, initial draft production, required 25% of my time. Review (Step 4) needed 15%. Only 10% each went to the final steps (5 & 6).

Though listed as a minor third project, the press statement was very interesting to be involved with. I had the opportunity to observe the effect of the legislative process on an organization. OWATCH held a press conference to announce legislative connections and needs for the upcoming legislative session. A press statement was read, via video conferencing, by the programming directors in Oxford to an audience of teachers and politicians in Lisbon. While more than 250 miles separated the two groups, MU’s video conferencing unit made us feel as if we were sitting across the table from our partners in Lisbon. In my collaboration on the crafting of this press statement, I was able to provide background knowledge of media relationships and style in order to formulate an effective message (see Appendix C for this press statement).

Both my MTSC education and my professional experience as a newspaper editor enhanced my contribution to the OWATCH press conference. As the media subject matter expert, my input was added to information developed by other SMEs to create the message and image OWATCH wished to convey. This process defines collaboration and the creation of knowledge: SMEs formulating and refining one message from many sources. Collaboration would develop as a theme to describe not only the OWATCH organization itself, but program development and, ultimately, my personal and professional OWATCH experience.
Chapter 3 - The Projects

Introduction

The seventeenth century English author and poet John Donne said that “no man is an island, entire of itself; every man is a piece of the continent, a part of the main.”² I must admit to coming to the MTSC program believing myself to be an island--someone who creates his own path by way of his personal knowledge and who creates a path for others through the teaching of this knowledge. Thus, the concept that knowledge was created by collaboration and that we are all connected through this creation seemed foreign to me; I struggled to give up personal control of a project to allow for a collaborative effort. Since entering the MTSC program at Miami, however, I have found that not only the learning and teaching process, but the process of scientific discovery, is a collaborative process.

I was surprised to find a reference to the collaborative process in the television program “Scrubs” on NBC (March, 2004). The lead doctor character said to the student doctor that (paraphrasing) medicine is not a strict science, but the collaborative effort of doctors deciding what is best for the patient at that particular time, usually through a group decision. This was a very good example of the importance of the collaborative process since most people would place their well-being in the hands of one doctor and expect to be healed by his or her hands alone. The collaborative effort of discovery and healing is not usually acknowledged in a hospital visit. We tend to think only of the one doctor who operated on us, negating the influence of the many other medical professionals, technicians, and specialists. Without the regular monitoring by the nurses, for example, our medical outcome would have been quite different.

Prior to my educational journey with the MTSC program, I would not have noticed the connection to collaboration found in a fictional television show; and my medical judgement would have been limited to the surgeon’s suggestion without regard for the radiologist’s opinion. The MTSC program showed me how to accept and work on a project in the collaborative atmosphere--and how to understand collaboration as a force in the scientific world. This was fortunate preparation since my experience at OWATCH inserted me directly into the collaborative process. From my observations regarding scientific discovery in the cryobiology lab to my contribution to the promotional image of OWATCH, I found collaboration taking place

²Taken from Peter’s Quotations--Ideas for Our Times by Dr. Laurence J. Peter. 1980. Bantam Books, New York.
at all levels of knowledge creation. The introduction of the first project—*revising a journal article and getting it into a mainstream publication for reading by teachers*—was no exception; it would demonstrate the collaborative effort in its classic form and require extensive project management.

**The Journal Article**

Professional journal articles have the effect of forecasting, marketing, and teaching organizational concepts while demonstrating a presence, and maintaining connections, in the educational community. OWATCH also uses journal articles to teach teachers and to promote the organization. As new scientific concepts are discovered by Dr. Richard Lee and his staff in the Cryobiology Lab at Miami University (OH), the researchers are encouraged to publish the results of their findings in professional journals. Dr. Lee would then enlist his staff members to write articles of a more basic understanding to be printed in trade journals for teachers. Thus, OWATCH was able to pass on knowledge from the scientific community to the teaching community in the appropriate forum. Later, programming in the ESET summer classes would delve deeper into the concepts outlined in these journal articles—or perhaps explore ways to teach these concepts to the youthful audience of Ohio school children. Such was the case of the journal article I undertook for my OWATCH internship.

Many years previous to my employment with OWATCH, the original article on which my project was based had been written and submitted for publication by Dr. Jon Costanzo, lead cryobiology researcher for Dr. Lee. The article detailed the use of HOBO™ technology to research cold tolerance and other scientific endeavors. A “HOBO” is a portable electronic data logger (see photo, Appendix D) which can be used in a multitude of situations to record environmental conditions such as temperature and humidity remotely and periodically to highlight patterns for study. Dr. Costanzo had used the devices, created by *Onset Computers* (of Boston, MA), to record the living conditions of the overwintering turtles he was studying. As requested by Dr. Lee, Dr. Costanzo attempted to “translate” his scientific research information into a form more easily understood by a less-educated audience. He then hoped to publish the resulting article pursuant to an OWATCH programming discussion and/or exercise to be conducted later.
Dr. Costanzo’s article advocated the use of the HOBOs in student field research by K-12 teachers. In his original article, he discussed the technology in great detail and the article was rejected for being too technical by the National Science Teachers Association (NSTA) magazine. Dr. Lee recognized the need for intervention by a technical writer. As OWATCH’s technical communicator, I needed to learn the technology, figure out what would make the material more interesting, and rewrite the article so that it would be understandable by NSTA readers—and thus acceptable for publication.

My Approach

I spent the week researching on the web various sources of information about the HOBO data loggers. I found that no one had written anything about them. However, the company that makes HOBOs, Onset Computers, was very helpful in my research and in helping me to understand its product. The marketing coordinator even offered to help me get the article published in various trade journals where he had contacts.

I wrote a sample introduction for the article, but Dr. Lee found the style to be too casual. Perhaps in light of the style, Dr. Lee decided we would change journals and submit to the American Biology Teacher magazine instead. We discussed ways that the introduction should be changed. He talked about how his usual approach was to start from the scientific results and work backwards to the introduction. The content would then dictate the beginning. My own style, on the other hand, was based in my advertising background of fifteen years, that of selling an entertainment value. Thus my idea was to get people interested—to draw them in—by creating a compelling introduction and letting the content then speak for itself.

These two differing approaches would lead to some conflict as I tried to convince the scientist of the need to sell himself, while the scientist argued that there was no need for selling as the data product (or knowledge) sold itself—it simply needed a vehicle through which to be told. Since I was unable to separate the scientist from his data, his created knowledge, I was also unable to sell my theory that teachers, unlike scientists, would need to be drawn into the information we had to offer them. One important element that I had not considered closely enough was the audience. Our readers would be teachers interested in learning, not the general public.
Dr. Lee’s fellow scientists were certainly inclined to use a collaborative atmosphere enhanced through the review of journal articles to create scientific knowledge. The K-12 teacher, while less familiar with this scientific process, would be no less interested in being presented with information helpful in the teaching process. My experience with our teacher audience came from taking teaching classes with them and from interacting with OWATCH team leaders. I learned that while most love learning and teaching, these teachers are not personally active in the scientific community. They spend most of their time interacting in a non-scientific environment, constantly pummeled by advertising and media sources, as they attempt to promote learning through their own exuberance with the topic rather than through simple exposure and absorption. But while the general public must be courted by the media, teachers (and other professionals) seek out information contained in the trade journals; they don’t need to be sold content concepts. Teachers would not be considered “hostile” participants, but rather willing participants in the collaborative teaching and learning process.

Dr. Lee has been teaching teachers for more than ten years. His OWATCH/ESET program has survived many years and educated more than four hundred Ohio elementary school teachers. Thus, he had a very clear assessment and vision of his audience; and my contribution was needed to revise the text for an interested and willing, but less scientifically involved, audience.

Collaborating with the SME

While Dr. Costanzo had begun the process, Dr. Lee was my main SME for the article’s conversion since he had the role of educating the OWATCH teacher constituency. But, like many technical communicators, as a layman, I felt somewhat ill-equipped to understand many of the article’s concepts. Having a college professor as your SME is the best of situations, though--especially one accustomed to teaching an elementary school teacher audience. I had many discussions with Dr. Lee in which he explained to me the technology, concepts, and importance of using the HOBO data loggers starting from my own knowledge base. I attempted to represent my readers as their lowest common denominator in understanding just what HOBOs do. Measuring microclimates turned out to be the most useful aspect of HOBO technology, and Dr. Lee used a simple, but very useful, example to help me to understand. He told me that even though meteorologists report the temperature in absolute values, this measurement is actually an average of various locations. So our idea of climate is really just an average of the millions of
smaller climates within our own. For instance, the temperature of the dirt just below the ground or that of the leaf high in the tree can vary by as much as twenty degrees depending on sun warmth or wind speed. The temperature in each one of these small pocket locations is a specific measure of climates within the larger average climate—or a measure of the microclimate. A HOBO data logger, with its temperature probe, can be positioned to monitor and measure temperature changes in these pocket locations, thus accommodating further study of microclimates.

I incorporated Dr. Lee’s example into the second draft of the introduction. (See Appendix E for the full introduction and the complete version of the second draft of the HOBO article.) I thought that our audience would really benefit from the simplicity, as I had. I converted the content of Dr. Costanzo’s original article from being overly technical to being more comprehensible to me and linked it together with my new introduction (complete with Dr. Lee’s example); I then added a conclusion recommended by Dr. Lee. It was a great first draft collaboration.

I still felt, however, that I was not absorbing the concepts required for understanding the background of my assignments with OWATCH in the cryobiology lab. Being surrounded by multiple SMEs in their scientific environment can be a bit overwhelming, but I decided to spend more time learning and attempting to understand the scientific and technical world around me. For example, in order to understand animal adaptations for cold weather (the essence of cryobiology), I attended Zoology seminars by other scientists in the building. The culture created by my working location in the Zoology Department of Miami University helped me to be constantly primed to absorb more technical and scientific concepts. The more I understood the technical nature of the topics presented, the better I felt able to translate information into knowledge which OWATCH’s teacher audience could understand. Thus, I would be able to represent my audience more reliably.

**OWATCH Passion**

While I am not a teacher, I do have the ability to learn complex subjects quickly and explain them to others in a simpler, process-oriented way. While this is a good trait for technical communicators, a true teacher must have the ability to provide insight and to create an environment for the acquisition of knowledge—not just have the ability to explain things. One of
my observations about teachers is that they create environments for learning while maintaining
an infectious positive attitude ABOUT learning. Teaching as done by the professional teacher is
not simply an ability, but a culture and a way of life.

The OWATCH constituency is no different. During the internship, I had the opportunity to
meet with a group of teacher-facilitators in Lisbon, Ohio. This group consisted of men and
women, old and young, teaching children in elementary school, middle school, and college. I
expected this diverse group of people to have little in common--yet the room was full of energy
and conversations reflected a social gathering of highly intelligent friends. Marilyn is a fourth
grade teacher and the funding director of OWATCH. Chris teaches sixth grade math; and Steve
shows the world of social studies to eighth graders, while John is a sixth grade science teacher.
Dr. Lee, of course, represented the college level, and I, perhaps, represented the student. They
were all fairly well educated themselves, most with advanced graduate degrees--or working
toward such. And they all taught educationally disadvantaged populations in rural, economically
distressed, eastern Ohio counties.

The most challenging aspect of these teachers’ jobs is to balance teaching high academic
standards with very limited resources. These educators substituted personal tenacity for classic
classroom tools such as books and equipment. They talked about their concerns for their
poverty-stricken students. They wanted to do whatever it took to make sure the kids got what
they needed to survive in an educated world. As I observed the OWATCH facilitators meeting
that evening, I saw their passion for teaching. They demonstrated a thirst for learning--an
enthusiasm--that made me want to do whatever I could to further their cause for teaching their
kids. I can imagine that this effect reaches any and all who will listen. It is contagious.

The OWATCH collaboration and educational program seeds--and cultivates--the passion for
learning and teaching that is found in the best teachers. The Wyoming course seems to create a
shared vision of what teachers want to see in their classrooms. The OWATCH facilitators spoke
of a “shared experience” and the desire to pass along the “shared passion” that they felt for
learning and teaching in general. They desired to continue to nurture the passion that they
developed in Wyoming--and to infect other teachers in their schools and districts with the joy and
enthusiasm that they found in teaching.

Teachers are passionate and smart--and quick learners. In classes that I took with them, I
found my teacher-classmates to be full of ideas about how to teach new concepts. They are an
incredibly creative and innovative group. In order to learn more about their students’ level of understanding, I attended “Science Day,” a Miami University-sponsored science fair for all levels of students from grade school through high school. Even the simplest project demonstrated the student’s use of the scientific method and gave a real sense of discovery. They used common household elements to create interesting experiments relating pH and chemistry to water pollution, oil spills, and even the strength of household products such as toothpaste, toothbrushes, soda pop, and antacids. These great ideas had obviously been nurtured and developed by innovative teachers. I saw at this event that behind every great student is a passionate teacher.

The HOBO journal article needed to appeal to our passionate teaching audience. With this goal in mind, I decided to get feedback from two people--the first, an industry source and the second, a member of our target audience. Evan Lubofsky is marketing communications coordinator for Onset Computers, makers of the HOBO. He suggested that we include “hands-on” experiments in the article to give the piece a more “real-world” feel and create a resource utility aspect for the teachers to use. Luke Sandro is a high school science teacher who had submitted other articles for publication in conjunction with Dr. Lee in the past. Because OWATCH had a similar target audience, Dr. Lee and I decided to model our HOBO article after Sandro’s style and submit the piece to a Sandro-recommended publication.

Journal Article Conclusions

The journal article went through fifteen different formats or versions in the four-month period during which it was a project for this internship. Before leaving OWATCH to join The Nature Conservancy, I took great care to complete the best version in a synthesis of everything I had learned during the project collaboration (see Appendix F for the final draft). I created a fourteen-page document filled with illustrations, photographs, and examples. I wrote “bridge” material to draw together and transition between the various points that each collaborating author had contributed. I analyzed my audience and attempted to appeal to their passion. And now my name has been published as a contributor to a journal article which supports the programming of OWATCH.

Working on this project made me aware that I am a technical communicator. My preparation through the MTSC program took me to an environmental education technical and scientific communications job which I found incorporated every process and technique for the
creation of knowledge through collaboration. And being embedded in the scientific culture as a member of OWATCH demonstrated to me the actual collaborative process through which scientific knowledge is created and disseminated. A journal article is one way of information dissemination. A website is another.

**The Power of the Internet**

While the journal article serves to disseminate information and connect a particular audience to an organization or subject, the internet provides the organization with an outlet to anyone who wants to discover it. The implications for web outreach by an organization are huge and incredible in potential scope. A website gives an organization a place to store information for all to read. Like a book on a virtual shelf, the website simply has to be discovered and read by interested parties. The main focus of the organization, then, becomes to simply help in the discovery process by leading people to its website “book” through promotion and advertising. Instead of promoting one idea at a time, the internet gives an organization the opportunity to promote its entire agenda simply by directing an individual to its website. If one journal article is good, then how great would be the impact of a hundred journal articles? The internet has the potential to give an organization’s audience access to thousands of articles and more.

OWATCH organizers recognized the power of the internet; with all the programming and outreach demands of the OWATCH mission, they saw the need to give constituents convenient access to pertinent materials. The OWATCH website could increase its outreach to the educational community of Ohio while maintaining connections to the program’s alumni. The internet could also provide OWATCH with additional means to channel knowledge and critical technical communications to interested readers. *Distance learning* is growing in acceptance and could become an important tool in future OWATCH programming implementation. I was enlisted to analyze the organization’s web presence and to report my findings in written and oral forms to both my supervisor and the other OWATCH directors.

**Search Term: OWATCH**

My first task was to discover just what kind of presence OWATCH had on the web and to what extent they were taking advantage of the opportunities offered by the internet. A Google search for “OWATCH” returned entries for a French video surveillance service whose web
address is owatch.com, but no mention of our organization. To the casual web surfer, OWATCH simply did not exist. But while the casual surfer is not necessarily an OWATCH constituent, ease of locating an organizational website is the ultimate goal. Googling “OWATCH” should be the quickest and most efficient way for alumni and other target audience members to find the information they need. Whether a potential consumer of your product or information is looking for you or not, if they cannot find you, then you have lost their business and any potential they may have offered.

I knew that OWATCH did not have its own website, but I was surprised that there were no references to the organization on any of the websites offered by partner groups. In my continuing search, I broke down and searched for key terms that are found in the OWATCH acronym, such as “teacher co-horts.” I recognized a website devoted to supporting the alumni of the programming efforts of OWATCH. When teachers return from their classes in Wyoming, the Wy-am Project (WP) provides a means to contact others who have attended OWATCH programs and to acquire downloaded lesson plans for use in continuing the education experience. The course taken in Wyoming, called Environmental Science for Elementary Teachers, uses the acronym ESET. While this key word would be useful in my next internet search, the OWATCH acronym should have registered with Google if the Wy-am Project had made reference to the organization it supported. The lack of coverage by the WP site could be attributed to the newness of the official OWATCH organization. The lack of a centralized OWATCH management structure and support may have had some impact as well.

A search for the ESET acronym revealed a well-designed website that showcased the OWATCH programming efforts extremely well with photos, FAQs, and contact information. This site was created by one of the OWATCH master teachers, Bob Flinn. Like the WP, Mr. Flinn volunteered to produce a support system on-line for OWATCH even though the parent organization had no devoted server space. I also explored the website of the Cryobiology Lab at Miami University. The lab’s website showed a branch which mentioned the programming for OWATCH, the ESET course, with a general description and application. But, again, as with the WP site, there was no mention of the OWATCH organization on either of these websites.

Clearly there was no unified web message for OWATCH and nothing for constituents to find. In my analysis of the other websites, I overviewed ways in which these organizations could better align their design and message with OWATCH. Since the OWATCH organization was
working for the benefit of these other groups, I would recommend introductory statements and links to connect all of the groups to one another virtually. After completing this preliminary review, I turned my attention to creating a web presence for OWATCH.

**Site Development**

I had studied techniques for website design and development in the MTSC program. I combined this knowledge with my newspaper design professional background and my graphic design training to put together a plan for an interactive, interesting and useful design. The planned website included four screens of information under the headings of “Course Description,” “Program Materials,” “Links,” and “Photos.” I also recommended an animated logo similar to one I had designed for an Ohio 4-H group. When clicked, this logo would take the user to another page where the animated logo would assemble itself from its other elements to explain the relationship between the OWATCH partners. This idea had played well with users in the 4-H group, and I believed the OWATCH constituency to be of a similar interest and entertainment level.

In order to help Dr. Lee visualize the organizational structure that I proposed for the OWATCH website I used the only software on hand for the task: Microsoft’s Visio—a program designed to produce organization charts. While I was unfamiliar with the program, I was happy to discover that it took just a few minutes to master, and I was able to create a diagrammed flow chart rather quickly. The graphic represented my website structure very well, and it gave the design an added depth.

**Website Analysis Conclusions**

The OWATCH internet presence analysis was a good way for me to further research the culture and history of the organization for which I was working. My ability to pass on information as a technical communicator demanded that I fully understand and be integrated with the culture of teaching and learning as understood by the constituents of OWATCH and its collaborating partners. By studying OWATCH’s internet status, I was able to provide the organization with an important avenue along which programming and administration could be advanced.
My final written report (see Appendix G for deliverable) was welcomed as something a special consultant might be hired to provide. In fact, I was asked to compile yet another version of my report in which I could address the concerns of the partner organizations directly. I then presented this information to a meeting of the individual website developers. The plan was to teach the volunteers some basic website design rather than to criticize their work. Dr. Lee was very conscious of the possibility that the volunteer constituents would be threatened by suggestions that they change website design and content. I agreed that teaching through critique was not the optimum methodology. The environment for learning would need to be set by the tone of both the document and the presentation. The importance of tone will be discussed further in Chapter 4.
Chapter 4 - The Lessons

Two Into One

Two of the many projects I completed with OWATCH have been outlined in this report. The first was a journal article which served to forecast and disseminate important programming topics to the constituent teachers and other interested parties. The second was an internet report which explored the relationships between OWATCH and its partner organizations and made recommendations for a web presence for OWATCH itself. Both projects seemed very different, but upon closer examination I believe that both projects were about exploring mediums for information dissemination. The journal article, in its print form, appeared in a trade magazine using concepts found in OWATCH programming to promote methods for further examination and learning. The website, in virtual form, showcased the organization itself and provided links to concepts and methodologies for further learning. Thus both projects can be seen as parts of a continuous whole.

“Project Solving”

Both projects posed a problem in resolving collaborative issues. And both projects demonstrated the importance of project management and problem solving techniques learned through the MTSC program. The most important of these concepts are those found in Project Management (PM) and the Anderson Problem-Solving Model\(^3\) (APSM). By combining PM and the APSM into a complete, goal-reaching project, it is possible to successfully address a technical communicator’s goals. The term I will use for this experience is “Project Solving.”

*Project Solving* really describes a solution-oriented process of completing project goals. While project management puts goals into a task-oriented process of planning, guiding, monitoring, structuring, motivating, preparing for contingencies, completing, and following-up the project, the addition of the APSM generates a recipe for success. The goal is to turn frustration into solution so that the project never gets bogged down in the bureaucracy of the collaboration.

The Anderson Problem-Solving Model (see Appendix H for a complete overview) consists of five major activity steps to addressing and solving a problem. Responsibilities for the

problem can be found in creating a system, managing a system, or performing an activity within the system. The APSM aims “to solve problems involving the management and communication of specialized information, where that information is to be used for practical purposes,” while “the context for problem solving is the particular situation in which a communicator works.” Context situations include: kind of employer--such as a research center or electronics firm, subject matter, audience, prevailing culture, and even medium of review--be it hard copy or on the web. The activity steps we will use to solve the project problem--or at least resolve the goal process for the project--are as follows: 1) Define the Problem; 2) Design a Solution; 3) Test the Solution; 4) Implement the Solution; and 5) Evaluate the Solution.

**HOBO Methodology**

My initial assessment of the project to rewrite the HOBO journal article was that it was too minor to demand formal project management. After four months, however, I had spent a good bit of my internship time working on the article (this would define a formal project at most companies). The article was written with the input of five collaborators which led to fifteen draft versions. Pictures, charts, exercises, and fourteen pages of copy were produced. I should have addressed this project like any other: the Anderson Problem-Solving Model could have provided the essential road map for successful project completion. Plugging project values into the APSM to accommodate the methodology could have given the project a plan, a value, and a fall-back if bureaucratic roadblocks halted the completion process.

Anderson’s model is a method for starting projects in a logical, scientific, step-by-step, process-oriented fashion in the same vein as a problem would be addressed in the scientific world of the Cryobiology Lab and OWATCH programming. Thus, the Anderson model has the added effect of joining the seemingly nebulous world of technical communications to the more concrete world of scientific discovery. The connection itself may seem tenuous, but the framework is there to give the technical communicator some credibility in the scientific environment.

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APSM Analysis

The APSM analysis starts with a simple definition. What is the problem? As has been mentioned, “rewriting a technical article for a simpler audience” is the problem created by the existence of the original HOBO article. The article as it existed was designed for a scientific journal and covered technical specifications in too much detail (see Appendix I for the original article). In fact, this original article, by Dr. Jon Costanzo, had been rejected for publication by the National Science Teachers of America (NSTA) professional publication. The problem was to revise the article to conform to NSTA standards and levels of comprehension.

Anderson further defines a problem by “specifying a purpose,” “analyzing context,” and “analyzing the audience.” I identify the goal with the purpose of the article. What do we hope to accomplish through the rewriting of this article? And, who is the target for this goal? I expected to address elementary school teachers, and I applied this knowledge to my rewriting the article for the lowest common denominator: myself. Dr. Lee, on the other hand, thought that a more advanced audience of high school or college teachers would benefit from the information. Since a clear and specific goal had not been worked out to guide the project, I chose one interpretation while Dr. Lee chose another, and the project diverged.

If Dr. Lee and I had devised a plan of management for the project and applied the problem-solving model, the project could have progressed, charting problems and successes for future reference. We did not “design a solution.” The drafts that were produced reflected one person or another’s interpretation of the goal or purpose for the project. So, while some aspects of this step existed—“gather information, draft solution, design finished product”—they did not support the project toward an effective solution. In fact, “make preliminary decisions about medium, form, style, production, distribution, etc.” was again assumed since the magazine of choice for submission seemed to dictate these properties as requirements for publication. On the negative side, as the audience changed, the publication standards also changed to accommodate the new audience. This revision affected the design of the final product, as well. For example, my last draft included sample exercises which would give the teacher-readers ideas about how to use the HOBOs in their classrooms. Since these details were not included in the original article, the exercises had to be created.

Anderson’s next step is to “test the solution.” I should have used this step to gain some insight as to the effectiveness of my very simplistic rewrite of the Costanzo original. Dr. Lee’s
assessment was that his audience would reject such a simple interpretation of the HOBO technology. I had no facts to back up my version; the APSM would have created some real data to either support or deny my claims for my version of the article. In any case, the testing phase would have given us some idea of a direction in which to proceed.

Implementation could have been the final result if we had built our plan for completion into a problem-solving model. The HOBO article could now be achieving its goals for the OWATCH organization if we had planned to reach an implementation stage to begin with. And finally, the evaluation stage follows the implementation stage. Evaluation is important to the accomplishment of the goal because it makes sure that just reaching the destination--or making it into the publication--was not all that was accomplished. The process of evaluating the response, analyzing the results, and checking the end result against your goals brings the model full circle. With the APSM, the data exists to prove that a project was attempted and successfully completed, reaching all the goals needed by the organization.

Managing Tone

The website analysis did not need the formal framework of the problem-solving model to be completed since the project started with me. However, certain elements of the APSM, such as audience analysis, added value to the project’s goals and to subsequent spin-offs. I researched the topics and produced my personal analysis of the websites. Some collaboration would come from my sharing my report with Dr. Lee and then with the other directors, teachers, and website developers. I hoped to teach my audience what I understood to be the standard concepts, as learned from the MTSC program, for the optimum way to have a web message seen and acted upon. In the case of the website critique, I was the SME for the organization. In order for my message to be received, understood, and acknowledged, I had to make sure that my audience would not stumble through the reading process. Much of this acceptance of the process of understanding would be controlled by my tone. Depending on my audience, I would have to tailor my report in order to attempt to teach my new collaborators some of the concepts on which the analysis was based as well as the organizational message. A major aspect of this customization would be the tone of the report.

Tone is a grammatical structure which sets the stage for the processing of information. The tone may come through in the “voice” used, whether it be active or passive. The tone can be
seen as reflecting the attitude of the author toward the reader and the subject. If the tone seems critical toward the reader, the reader may become defensive and not want to continue reading or absorbing the information, and the message fails. The tone must not be confrontational. I have found that my style, the journalistic way of simply stating the facts exactly as I see them, can be taken as critical and confrontational. The original web analysis, as presented to Dr. Lee (see Appendix G for this document), has portions that I would consider somewhat critical of the volunteer website designer simply based on the matter-of-fact tone. But a report is generally a cold document which often contains critical information. The audience for the document certainly controls the tone. Dr. Lee, as the audience for the original report, would have demanded a scientific and analytical style—which is characterized as tonally cold, as it would be for analyzing, reporting, or critiquing. This style is common in the scientific arena, but it would not serve its purpose when the subject of the report is also its audience.

Other elements that set a confrontational tone include rhetorical questions, negative wording, and phrases in quotations marks or underlined for unneeded extra emphasis. For example, on page 5 of the web report (see page 64 in Appendix G) under the subtitle of “Giving the Audience What They Need,” at the bottom of the second paragraph, I refer to “the proverbial ‘kiss of death’ to a user’s attention” as being the use of dated material on a website. The phrasing “kiss of death” is extreme in its depiction of the severity of the event. And, with this extreme description, the reader, especially one who is the subject of the text, is being set up in a negative light. The reader may become agitated and simply give up on the message. Any time that the reader is distracted from the message is a time when your information has lost its ability to communicate. Tone is the key to negating at least one element of distraction.

The rhetorical question asks for information which should be obvious to the reader, thus belittling him or her in its inclusion in the text. Often readers are offended when made to look stupid or inept at a task such as that of reading or understanding a message. While this may seem to be common sense (the phrasing “common sense” could also be construed as being of negative tone as it points out something that should be obvious, yet may not be such to the reader), the writer of the message may see the rhetorical question as a device to excite interest in the reader or to create an emotional response. The emotional aspect of the message lends itself to be remembered, so the author must weigh the consequences of his/her writing devices. I used the rhetorical question myself in the internet analysis. For example, at the bottom of page 4 of
the web report (see page 63 in Appendix G), I note that there is no contact name or e-mail address on the “home page” of the WP website. In the report I ask: “What if the user wants more information?” The answer to this question is obvious to the reader and the critic, yet I answer it anyway: “There is no one to ask...”. These devices were meant to inspire interest in my main audience subject, Dr. Lee. I hoped to inflame his emotional response. This may have worked well as this report was my most successful project at OWATCH.

While the writing devices which set the tone for a document can be useful for one audience type, a different reader could be offended by the tone. Thus the writer must constantly reassess the audience and adjust the message accordingly. For example, in the fourth paragraph on page 8 of the web report (see page 67--second paragraph--in Appendix G), I describe the ESET website as having “...an abundance of graphic elements that border on gaudy...” and I further explain that “this could be the product of a creative elementary school teacher;” which almost creates a sort of backhanded compliment. The use of the word “gaudy” sets the tone for the sentence. This is not a positive word and it is obviously meant critically. Most people would not enjoy being described as “gaudy” since the definition includes the word “tasteless.” But the audience for this document was Dr. Lee, and the object of this message was to shock the audience into seeing a problem and understanding a need for change. The need for change was, in fact, realized, so the document accomplished its task. Dr. Lee ordered a new document be presented to the OWATCH-associated web masters in order to fix critical problems.

In the spin-off document, the new audience was the ESET web master, teacher-facilitator Bob Flinn, Marilyn Parkes for the WP, and Dr. Lee, in another role, for the Cryobiology Lab. In my ESET critique, I changed the wording of the “gaudy” description to be less charged so that I would not lose Mr. Flinn as an audience member. For the later document, I completely removed the sentence that contained the reference to “gaudy” graphic elements and simply described the site as “light and bright.” By using positive terminology, I created a proverbial bridge between myself and the audience member over which we could exchange information. Over that bridge I then described the elements of great website design with the intention of allowing Mr. Flinn and the others an opportunity to learn by gathering the new information. Instead of inciting an emotional response and reaction, my goal for the document was an imperceptible assimilation of new ideas.
This is an important aspect of the Anderson Problem-Solving Model. Audience analysis is central to both APSM and the presentation of information in all of its formats and mediums. The audience cannot receive the message unless the writer knows who they are and, accordingly, how to reach them. I studied my audience of teacher-learners and accomplished this task with Dr. Lee’s extensive input. I was thus able to successfully present my ideas to the other staff members and volunteers at OWATCH. The result was a message received and acted upon.

Final Thoughts

In this internship report I have analyzed and reviewed many topics and elements that dominated my learning process during my internship at OWATCH. Number one in my mind is the collaborative process theme which has surfaced within the organization itself in the production of services and continued through to include OWATCH’s organizational makeup as well. Collaboration is not something that I was comfortable with throughout the educational process during the MTSC program, but I learned that even the creation of knowledge--especially scientific knowledge--is a collaborative process.

This realization carried over into my experience with OWATCH, an organization that helps teachers realize professional goals and develop better methods for teaching the sciences to Ohio’s children. In exploring my first assignment, to write an environmental education article about the use of HOBO electronic data loggers in school classrooms, the collaborative process was again something that I had to get used to. On the other hand, the internet analysis project opened new doors in the discovery of partnerships with collaborators and with audiences. Working together eventually produced results in both of these projects that working alone could not.

For example, both projects held traps for me in the audience analysis section of the APSM. My tone, which I must constantly monitor, was wrong in the beginning of both projects. Without the collaboration of Dr. Lee, my message would have been lost to my target audience. I was too critical in the website report, and I was too simplistic in the journal article. In both cases, Dr. Lee helped me define my audience and redirect the tone and content of my message. The collaborative effort produced a more productive and effective message.

In regards to project management, I could have benefited from techniques advocated by technical communication experts which are used to collaborate with the goals of superiors, while
educating them in new ways of thinking about projects and focusing the goals of the project for completion. Although I tried to build a consensus for change, I had nothing to back up my claims. I needed to get the power brokers positively invested in the change toward a concrete goal. I needed to prove that there was a need for change; and I needed to provide a rational plan to implement the changes. All of this could have been accomplished through appropriate project management and problem-solving methodologies.

On the positive side, I learned about the consequences of tone in the conveyance of a message. Audience Analysis techniques from APSM and from other communication sources are useful tools in understanding the tone and its implications for the reception of a message. When a writer, or even a speaker, complains that “no one understands me,” perhaps one factor is the tone of the communication since that influences the receipt of the message. Studies in tone, through the MTSC program and through this internship, have shown me that the delivery system for the message and the crafting of the message can be as important as the message itself.

The technical communicator is not simply a tool to be used and/or directed by others. The Technical Communicator is an entity who represents the reader and who crafts a message to accomplish the goals of the project. The Technical Communicator must have the ability to understand a wide range of topics and be able to acquire new information quickly. With these abilities and these tools, the Technical Communicator can shape the way we learn and what we learn. The MTSC program helps the Technical Communicator to discover, learn, and build for the future.
Bibliography


Appendix A
The Miami University Geology Field Station

The following photographs show the Timberline Ranch in Wyoming, the location of the MU Geology Field Station. The ranch is seventy miles southeast of Yellowstone National Park and Grand Tetons National Park. OWATCH environmental education programs like ESET (Environmental Science for Elementary Teachers) take place here every July.
Timberline Ranch/MU Geology Field Station in Wyoming

The Grand Tetons
Appendix B

OWATCH/ESET Newspaper Article

The following newspaper article is reprinted from *The Delaware Gazette* (Delaware, OH). The article showcases OWATCH’s central educational program, Environmental Science for Elementary Teachers (ESET), which is held each summer at Miami University’s Geology Field Station in Wyoming.
Teachers spend summer back at the ranch

By MARGO BARTLETT
Features Editor

Two Big Walnut Elementary School teachers completed a two-week environmental science class for elementary teachers in the Yellowstone/Grand Teton National Parks area recently.

Pam Smith, a special education teacher at Big Walnut Elementary School, and Mary Price, a first-grade teacher, were among 40 teachers selected to participate from a highly competitive pool of applicants.

Teachers lived on a ranch at 7,700 feet elevation. The class was taught outdoors, with plenty of hiking in the Wyoming mountains as participants used the terrain and environment to gain hands-on experience in geology, botany and zoology. Environmental science teaching units were developed around Native American stories.

Each participant came home with books and other materials to use in the classroom and to train other staff members.

Funding for the graduate class offered by Miami University was provided by the Ohio Board of Regents, Robert McWilliams and Richard Lee of MU and Edward Soldier of Sycamore High School near Cincinnati were the creators and instructors for the experience.

Lee Smith mentioned, he a former Delaware resident and a graduate of Hayes High School.

Smith said he and Price heard about the program a year ago at Ohio State University's Children's Literature Conference.

"We both thought, boy, that sounds pretty neat," Smith said. Not only was Wyoming "a wonderful area of the country to go to," the program itself offered great ways to combine science concepts with literature and other subjects.

"It doesn't have to be just science," the said.

At the ranch, which has a 50-year association with Miami, the teachers lived in bunkhouses "with showers down the hill," Smith said.

The course involved strenuous hiking, Smith said, "but they were patient with us. They realized we weren't all athletic creatures.

Price said she was "kind of worried" about the physical demands of the program.

"It wasn't anything easy," she said, "but everyone was pretty much able to do it."

To be in Wyoming with knowledgeable instructors sharing their expertise on-site was exciting, Smith said.

"Being actually where you're learning things... It's like a dream come true to me," she said.

Price said the hands-on aspect of the program, which included studies of trees, flowers, rocks and a variety of creatures, was valuable.

"I'm excited to get back into it and share everything," she said.

She and Smith will be sharing with other teachers as well as students.

Program participants are required to teach the concepts to other teachers.

Price said. Materials for doing so, including a book of Native American stories, Keepers of the Earth, will be sent to them.

Guesting at the night sky from a ridge was one of the most memorable experiences, Smith said. Soldier took the group to the vantage point.

"He gave a wonderful astronomy lesson," Smith said. "I didn't remember there were that many stars. It was fabulous."

The program concluded with a test and a lab practical. It wasn't a vacation, Smith said — it was too demanding to be called a holiday — but it was an enriching experience.

"I think there'll be a lot of kids who really benefit from this," she said.

Pam Smith, left, a special education teacher at Big Walnut Elementary School, and Mary Price, a first-grade teacher at the school, stand in front of the Grand Teton in Northwest Wyoming.
Appendix C
OWATCH Press Statement

The following two pages contain a document that was a third project during my internship with OWATCH. This press statement was read aloud to an audience of teachers and politicians via real-time video conferencing. The speaker, Director Robert McWilliams, was in Oxford, Ohio, while the audience and other participants were seated 250 miles away in Lisbon, Ohio. The document was originally designed to be a press release, but was later modified to be used as a speech. Notice the format of this press statement uses a larger font and wider spaces to give the speaker an easier visual cue. Another example of designing a document for a listening audience rather than a reading one is the use of the personal pronouns “we,” “our,” and “us.”

The press statement also provides an overview of OWATCH, its partners, and its relationships.
Miami University is delighted to become partners with the Columbiana County Educational Service Center and OWATCH in providing high-quality environmental science training for Ohio elementary school teachers.

Co-directors Dr. Robert McWilliams and Dr. Richard Lee of Miami’s Geology and Zoology departments have collaborated with Ohio’s elementary school teachers and school administrators through the Ohio Board of Regents Eisenhower Program for the past ten years and the Columbiana County Educational Service Center’s Wyami Teachers Network for the last five years.

Since its inception in 1993, 833 Ohio elementary school teachers have participated in our *Environmental Science for Elementary School Teachers* program. Teachers engaged in this program master, in detail, the same environmental science principles that their students are mandated to know and understand by Ohio’s Elementary School Science Standards. In addition, participating teachers learn and develop hands-on, inquiry-based activities that they can apply in their classrooms, their playgrounds and on field trips to teach their students. These hands-on activities use Native American stories as themes to illustrate environmental science concepts and concerns. Teachers participating in the *Environmental Science for Elementary School Teachers* are immersed in the study of environmental science while the two-week course is taught at the Miami University Geology Field Station.
in remote northwestern Wyoming. This course provides four-semester hours of graduate credit.

Our partnership with OWATCH will allow us to continue training Ohio elementary school teachers using methods we have proven to be effective in teaching environmental science. It will allow us to expand our influence on the teaching and learning of environmental science in Ohio’s elementary schools. Our collaboration with the Columbiana County Educational Service Center and Appalachian school districts will allow us to expand our program to include follow-up workshops and mentoring for participating teachers throughout the school year. In addition, we will now be able implement some of the latest computer-driven technology in elementary school classrooms. Lastly, we will be able to measure and evaluate the effectiveness of this program using measures of student performance on Ohio Proficiency Tests over several consecutive years.

In support of this partnership, Miami University pledges more than one million dollars in tuition fee waivers.

OWATCH is the culmination of 18 years of continuous collaboration between dedicated Ohio classroom teachers, school administrators, Miami University scientists, educators, administrators and the Columbiana County Educational Service Center’s Wyami Teachers Network and support from the Ohio Board of Regents Eisenhower Program.
Appendix D
HOBO™ Portable Electronic Data Loggers

The Miami University Cryobiology Laboratory uses three different models of the Onset Computers HOBO™ portable electronic data logger (see photo next page). Depending on the need, these units can be buried in mud or dirt, placed in a snow bank, sunk under water, or even attached to the back of a wandering turtle. The units will then monitor and record temperature, humidity, and other environmental conditions at periodic intervals. This allows the researcher to chart living conditions for an organism over a period of days, months, or even years without having to be physically present to take the measurements. Specifically, this technology has been used to record freezing temperatures inside the burrow of the Painted Turtle for studies in cold tolerance.
Three types of HOBO™ electronic data loggers from Onset Computers
Appendix E
OWATCH HOBO Article—Second Draft

The following document is the second draft of the HOBO journal article. It contains a very simplistic introduction to microclimates as compared to the original document (found in Appendix I). Compare this with the final draft as well (found in Appendix F).
HOBOs Are Changing the Way We Look at Micro-Climates

On the evening television news the weatherman says your town will get an overnight freeze. Regional temperatures, measured at the local airport, will drop into the high twenties. “Cover your plants,” says the official face on your TV screen, “and bring your pets inside.” In other words, organisms susceptible to temperature changes will likely suffer. Unfortunately, most don’t have the option of being offered a spot by your fireplace.

What about the turtles, frogs, beetles, and such that rely on warm temperatures to stay active and alive? Thankfully for them, the temperature at the local airport, or even in your yard, is not necessarily the temperature of their environment. In fact, environmental temperatures actually consist of ranges—varying by anything from a few degrees to much wider values. High in the trees bordering your yard, for example, affected by wind chill, the temperature might be 15°F or 20°F, while in the back yard itself, sheltered by your hedge, the temperature is 25°F. The ground, though, still warm from the heat of the day is 30°F, and the dirt next to your house is a balmy 35°F. Each of these environments exists within your weatherman’s predicted climate change. For this reason, they are called micro-climates.

Working to Understand Micro-Climates

The micro-climate is the entire world to the organism that lives there. The warm soil near the house insulates a population of sow bugs (or roly-polys). A beetle nestles in the grass of the yard, and a moth caterpillar pupates in a curled leaf of a tree. Each is affected by changes in its micro-climate, and each has selected its micro-climate—biologically and evolutionarily—to exploit optimal conditions for propagation of the species.

Studying organisms in micro-climates suffers from many problems, not the least of which is the precision of the instruments. Recording temperature changes in the sow bugs’ environment, for example, might require sticking a thermometer in the ground every ten minutes, all night long. The sow bug environment is probably disrupted, thus adding to the variables, and the
researcher has to stand all night in the cold. But this example does not begin to approach the difficulties that arctic researchers have had to overcome. Imagine attempting to monitor night temperatures in a subzero environment as researcher Valerie Bennett has endured (Bennett, 1998).

A Little Help from the HOBOs

New technology developed by Onset Computer Corporation is changing the way microclimates are studied—and increasing the precision of the measurements taken for those studies. The HOBO® data logger is just one of a line of data collection products currently being tested, used, and modified for use in a variety of microclimates—including the shell underside of box turtles, the stomachs of crocodiles, the inside of insect galls, and the nests of sea turtles, to name a few.

While automated sensor devices are not new to the field of research, hazards in data transfer, coding, collecting, and cost often prohibit all but the most well-funded educational facilities from using them. Recent advances in miniaturization and computer chip technology helped Onset® to design data logging equipment that is versatile, user friendly, and economical. Costs per unit are as low as $60 each, and Onset offers a program through a sponsored website (iscienceproject.com) which lends loggers to K-12 educational institutions for free.

Each logger is fully self-contained in a plastic case only slightly larger than a matchbox. Information is gathered through an attached probe that records such things as temperature, relative humidity, air pressure, light intensity, and voltage at timed intervals that are preset by the user. Battery operation may last from 2-10 years—allowing the logger to continuously sample and record information for extended deployments. Even if the power or system fails, the data is retained in memory until downloaded by the researcher.

HOBOs: Not just Cheap, But Also Easy

Ease of use is one of the best features of Onset’s data loggers. Each device connects to your computer via a cable and the software starts automatically when it senses the connection. The control software can run on an Apple Computer (Mac) or a PC with minimal memory and speed requirements. Programming options include choice of sampling duration and interval, unit of measurement, high/low-temperature alarm settings, and memory overwrite. A special multiple-
sampling option instructs the logger to continue sampling during the measurement interval and to store the maximum, minimum, or average value. The logging function can be activated immediately, triggered subsequently by the push of a button, or programmed to turn itself on at a specified time up to 3 months later. The delayed start feature is very useful for synchronizing the recording of multiple loggers. A blinking LED visible through the front cover of the case confirms that the logger is operating properly.

Downloading data from a logger with full memory to a Macintosh IIx computer is completed in several seconds. Graphs of the data appear automatically and, although they are not of publication quality, the simple X-Y plots are suitable for cursory analytical and educational purposes. Portions of the graph can be enlarged and automatically rescaled simply by selecting the region with the cursor, as is demonstrated in Figure 1 (see next page). The data may be exported in various formats using the supplied software and saved as ASCII files which can then be opened in virtually any spreadsheet or graphics program. Operation of these data loggers is sufficiently simple that, after a brief instruction, students can readily launch and download data on their own.

**Giving the HOBOs a Mission: Some Tips**

While the standard temperature loggers are extremely versatile and may be used in many different laboratory and field environments, precautions should be taken to protect the circuitry from moisture. Some of the newer loggers are specifically designed for fluid conditions such as underwater measurements. Researchers have always been creative in keeping their data safe. Some have successfully sealed the logger’s case with cloth tape and/or silicone caulking (Mueller & Rakestraw, 1995).

The Miami University (OH) Cryobiology Laboratory, a pioneer in the use of HOBO temperature loggers, places the device in a small plastic container (similar to a Tupperware® tub) with tight-fitting lid. To accommodate the external probe, a small hole is drilled in the bowl’s side through which the sensor and cord are passed; the joint is then sealed on the inner and outer surfaces with hot-melt glue. After launching, the logger is put in a heavy plastic bag, placed in the container, and buried under desiccant (silica gel or CaCl₂). Packaged in this manner, researchers at Miami University can place their HOBOs in practically any indoor or outdoor environment. A laptop computer can be used to collect data from field loggers with minimal
disturbance to the unit or probe placement. Temperature loggers may be used in mud or water if they are safely enclosed in Onset’s submersible polycarbonate case or a suitable facsimile. Additionally, Onset now offers two new lines of watertight temperature loggers that are specifically designed for deployment in damp environments.

Figure 1.

**Keeping the HOBOs Healthy**

The HOBO’s manufacturer provides good product support services and technical consultation. Onset’s stated policy is to repair or replace without charge any product found to be defective within one year of delivery. Also, the manufacturer offers a program for user-damaged
units in which technicians can recover data and fully repair or replace data loggers. This service has been used to recover valuable data stored in the nonvolatile EEPROM memory on a temperature logger that inadvertently became waterlogged.

The manufacturer is interested in accommodating the special needs of users, such as specific sampling ranges or other custom requirements. In a recent study proposed to improve glove design, NASA used HOBOs to measure temperatures experienced by astronauts aboard the space shuttle *Discovery*. Special power and program-launching mechanisms were developed by Onset specifically in support of this project (Davis, 1995).

**Science Education: Learning with HOBOs**

The portability, versatility, and ease of use of HOBOs are of obvious benefit for student use. They may be used in various laboratory explorations in disciplines including physics, chemistry, and biology. In the contemporary research laboratory, data are transferred from various sensors to spreadsheet applications for computer analysis and storage. For example, oscilloscopes used to study the electrical activity of nerves and muscles are rapidly being replaced by computerized data acquisition systems. HOBOs are available to provide students with practical experience not only in collecting data, but also in using computers to analyze, organize, present, and archive data.

Another educational benefit of using the temperature logger is that data may be collected over extended periods of time without user attention. In the classroom, this feature equates to permitting experiments to continue beyond the typical 1-3 hour laboratory instructional period. HOBOs are particularly useful in field studies lasting for weeks or months where frequent site visits may not be practical—or for the long-term monitoring of terrestrial and aquatic conditions. These units may be particularly useful for environmental monitoring at land labs, nature centers, and outdoor education centers.

**HOBOs Help Teach About Micro-Climates**

One field application for which these loggers are particularly well-suited is to compare environmental conditions among different microhabitats—for example, shaded woods versus open fields, beneath versus above snow cover, short grass versus forest canopy. Each of these microhabitats can be investigated using HOBO technology. The micro-climate of these
microhabitats can be assessed by setting the HOBO to record data for a time period and then analyzing the information recorded. Figure 2 (below) shows a series of graphs generated by the HOBO software after data loggers were deployed to record the temperature changes in three types of microhabitats.

*Figure 2.*
The loggers were in the field for eight days and recorded temperatures ranging from five to forty-five degrees (C). The short grass graph shows especially wide fluctuation so the organisms living in short grass would have to be hardy—that is, able to withstand wide ranges in temperature. The forest canopy graph, on the other hand, shows a pretty stable fluctuation. Each day the temperatures vary by only about ten degrees. What does that say about the organisms that live in the forest canopy? Tree dwellers might die if the temperatures fluctuated too wildly—since the data show that they don’t have to have a hardy response to temperature in their microhabitat.

Temperature measurement is a fairly simple way to pose questions about organisms and the environment in which they live. If organisms can survive certain temperature conditions, what factors might need to be studied in controlling them. For instance, we know that the first freeze kills fleas living outside the home, so can we devise a method that manipulates the temperature to kill fleas living within the home?

**Riding the Research Rails with HOBOs**

There are many questions and hypotheses to pose, and tracks and avenues through which to investigate, thanks to the HOBO technology. Miniature data loggers are versatile, user friendly, and economical tools that may be effectively used to enhance efforts ranging from inquiry-based science education to advanced research. They may be particularly useful in small group studies or science fair projects. Educators and researchers interested in this novel technology should contact Onset Computer Corporation’s biology/education representative (or see onsetcomp.com) for more information on using these devices in educational and research settings. And don’t forget to check out iscienceproject.com for more ideas on how HOBOs can deliver inexpensive, fun lessons in K-12 science. In spite of the train theme, you won’t get railroaded at Onset.
Appendix F
OWATCH HOBO Journal Article--Final Draft

The following document is the final draft of the HOBO journal article as it was submitted as a completed project for this OWATCH internship.
Tools for Teachers:
Using Computerized Temperature Loggers
in Inquiry-based Science Education

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The National Science Education “Content Standards 9-12” directs us to note that students will best learn scientific concepts by participating in investigations that cause them to use cognitive and manipulative skills as they create scientific explanations. In response, we move to more hands-on and inquiry-based science teaching that will challenge our students to design and conduct meaningful experiments. To that end, this “Tools for Teachers” report describes a comparatively versatile, user-friendly, and economical tool for making automated recordings of temperature and other environmental parameters that can be used in a wide variety of laboratory and field applications to enhance active experimentation in the classroom.

Use of Computerized Data Acquisition Systems in Research

The rigors of making accurate, repeated environmental measurements have long challenged scientists and educators in fields as diverse as aviation, meteorology, environmental biology, ecology, and ecological physiology. In research, manual sampling techniques are potentially limiting as they can be time intensive, logistically unfeasible, and subject to investigator bias.

The relatively recent development of microcomputer-based environmental sampling technology has permitted automated, continuous sampling of a host of environmental parameters, such as ambient temperature, humidity, pH, wind speed and direction, solar radiation, and soil water potential. The advent of such systems has largely circumvented problems associated with manual sampling programs, although they are not without disadvantages concerning versatility, ease of use, and cost (Peterson & Dorcas 1994).

Data Loggers are Ideal for Student Use

Fortunately for educators and researchers alike, miniaturized data loggers that are highly versatile, user friendly, and economical are now commercially available. Onset Computer Corporation (P.O. Box 3450, Pocasset, MA 02559)—whose primary business since 1981 is the design, manufacture, and distribution of precision computers for data logging and instrument control applications—offers a recently-developed family of miniature data loggers for single-
and multi-channel monitoring of temperature, relative humidity, air pressure, light intensity, and voltage. Each logger is fully self-contained in a plastic case only slightly larger than a matchbox. Although we have used several of these products, we have extensively used the temperature loggers—the least expensive and perhaps most versatile of Onset’s data logging devices.

As cryobiology researchers, we use the data loggers to measure conditions in the microhabitats of overwintering insects and reptiles. Sea turtle protection agencies use these loggers to study nesting conditions for endangered sea turtles. And in a recent study purposed to improve glove design, NASA used these temperature loggers to measure temperatures experienced by astronauts aboard the space shuttle *Discovery*. Special power and program-launching mechanisms were developed by Onset specifically in support of this project (Davis 1995).

The basic temperature logger features a microprocessor and on-board memory that stores both the operating program and acquired data. Depending on the unit’s memory, automated sampling deployments lasting from 15 min to several years are possible. The standard loggers are equipped with a lithium battery that may last from 2-10 years. Even if the power or system fails, the data is retained in memory until downloaded by the researcher.

Costs per unit are as low as $60 each, and Onset offers a program through a sponsored website (iscienceproject.com) which lends loggers to K-12 educational institutions for free.

**Operation of Temperature Loggers is Simple**

Ease of use is one of the best features of Onset’s data loggers. Each device connects to your computer via included cable; the software starts automatically when it senses the connection. The control software can run on an Apple Computer (Mac) or a PC with minimal memory and speed requirements. Programming options include choice of sampling duration and interval, unit of measurement, high/low-temperature alarm settings, and memory overwrite. A special multiple-sampling option instructs the logger to continue sampling during the measurement interval and to store the maximum, minimum, or average value. The logging function can be
activated immediately, triggered subsequently by the push of a button, or programmed to turn itself on at a specified time up to 3 months later. The delayed start feature is very useful for synchronizing the recording of multiple loggers. A blinking LED visible through the front cover of the case confirms that the logger is operating properly.

Downloading data from a logger with full memory to a computer is completed in several seconds. Graphs of the data appear automatically in simple X-Y plots. Portions of the graph can be enlarged and automatically rescaled simply by selecting the region with the cursor. The data may be exported in various formats using the supplied software, and then opened in any spreadsheet or graphics program. Operation of these data loggers is sufficiently simple that, after brief instruction, students can readily launch and download data on their own.

Data Loggers in Use

The gall fly, *Eurosta solidaginis*, is one of the most versatile and well-adapted organisms known to man. We know this because we used Onset’s data loggers to record the temperature of the gall fly larva’s microhabitat, its overwintering gall chamber, over the course of its one-year life cycle. Figure 1 shows one of these galls still on the plant with the temperature logger probe inserted. The logger itself is placed securely on the ground.

The process is fairly simple. *Eurosta solidaginis* lays an egg in the stem of the Goldenrod flower. The plant reacts to the intrusion by creating a protective gall around the egg and subsequent larva. This gall forms the overwintering environment for the young gall fly. Encased in a seeming tomb of dead plant tissue, the gall fly larva survives recorded winter temperatures of up to $-40^\circ$C, at times experiencing the physical freezing of its tissues, and becoming one of only three organisms known to be able to survive the freezing and thawing process (Lee & Hankison 2003).

Our investigation of this insect’s ability to survive freezing has led us to a critical factor in the process: the water present in the gall affects the insect’s survival. The influence of “inoculative freezing” (for more information, see Davidson & Lee and Sandro & Lee)
demonstrates a classic relationship between the organism and its environment—and a lesson for us and our students: you cannot ignore habitat in your study of biology. The bigger picture, of course, shows us a relationship between life and earth—and our own relationship to the environment.

The freezing process of the gall fly, *Eurosta solidaginis*, is marked by what is known as an “exothermic event.” The exothermic event is the point in a freezing process when physical freezing begins and heat is released through the chemical process of ice formation. An exothermic event is recorded in Figure 2 using temperature data logger data. As shown, the temperature drops until ice forms at –3.8°C. The temperature spikes back up with the heat of the reaction and drops away again to continue the freezing process. Could this exothermic event be a trigger of some kind that tells the organism’s cells to prepare for freeze damage?

Another application for which these loggers are particularly well-suited is to compare environmental conditions among different microhabitats—for example, shaded woods versus open fields, beneath versus above snow cover, under a log versus forest edge. The climate of these microhabitats can be analyzed by setting the data logger to record information like temperature and humidity for a time period, and then reviewing the data recorded. Figure 3 shows four graphs generated by the software after data loggers were deployed to record the temperature changes in four types of microhabitats.

The data loggers were left in their environments for approximately five days and recorded temperatures ranging from 10 to 40°C. The “open grassland” graph shows regular, somewhat peaked fluctuation while the “deep woods” graph is more rounded and less pronounced. The “under log, in woods” graph shows even less fluctuation. Each day the temperatures vary by only about ten degrees. Conversely, the last graph, “woods edge,” shows huge fluctuations with ranges from 10 to 40°C. Organisms living on the woods edge would have to be able to withstand wide ranges in temperature on a daily basis. What does this data say about the organisms that live in the woods? In a comparison between woods edge dwellers and those under logs, we can hypothesize that if the “under log” organisms’ environmental temperatures fluctuated too wildly,
the organisms may have to accommodate negative effects on their lives—since the data show that they live in a stable temperature microhabitat.

Temperature measurement is a fairly simple way to pose questions about organisms and the environment in which they live. If organisms can survive certain temperature conditions, what factors might need to be studied in controlling them? This actually raises a number of questions that can relate temperature data to other behaviors and physiological states. For example, would you expect woodland invertebrates to be more or less resistant to desiccation in light of their temperature conditions? And what about the relationship between temperature and metabolic rate?

We are still searching for answers to many questions. Computerized data loggers are making the process of gathering data a little simpler in our study of cold environments. We believe that students can benefit from data logger use in the investigation of exothermic reactions and events ranging from pond, puddle, and lake freezing to the laboratory freezing of solutions of various osmolality. In addition, the relationship of an organism with its environment is a topic that is readily explored thanks to data loggers. A simple exercise in measuring the temperature of various microhabitats evokes new questions and topics for further study and exploration.

**Tips for Deploying the Temperature Loggers**

In our experience, standard temperature loggers are extremely versatile and may be used in essentially any laboratory or field environment so long as precautions are taken to protect the circuitry from moisture. Our procedure is to contain the logger in a small plastic bowl with tight-fitting lid, such as any name-brand variety of single-meal storage container. To accommodate an external probe, a small hole is drilled in the bowl’s side through which the sensor and cable are passed; the joint is then sealed on the inner and outer surfaces with hot-melt glue. After launching (through the computer software), the logger is enveloped in a heavy plastic bag, placed in the bowl, and buried under desiccant (silica gel or CaCl₂). Packaged in this manner, these
In the contemporary research laboratory, data are transferred from various sensors to spreadsheet applications for computer analysis and storage. Use of computerized data loggers provides students with practical experience not only in collecting data, but also in using computers to analyze, organize, present, and archive data.

Another educational benefit of using these data loggers is that data may be collected over extended periods without user attention. In the classroom this permits experiments to continue beyond the typical 1-3 hour laboratory instructional period. This feature is particularly useful in field studies lasting for weeks or months where frequent site visits may not be practical.

In summary, there are many questions and hypotheses to pose, and tracks and avenues through which to investigate. Miniature data loggers are portable, versatile, user friendly, and economical tools that may be used to enhance efforts ranging from inquiry-based science education to advanced research in various laboratory explorations of disciplines ranging from and including physics, chemistry, and biology. They are of obvious benefit in student use and may be particularly useful in small group studies or science fair projects. Educators and researchers interested in exploring this novel technology should contact Onset Computer Corporation’s biology/education representative (or see onsetcomp.com) for more information on using these devices in educational and research settings. And see the Onset-sponsored website icscienceproject.com for more ideas on how data loggers can deliver effective, classically simple, inexpensive—and even fun—lessons in K-12 science.
Acknowledgments

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References


Figures

Figure 1. Goldenrod plant gall with the temperature logger probe inserted.

Figure 2. The exothermic reaction is characterized by a jump in temperature as ice forms, giving off heat.
Figure 3. Data logger graphing results show that a wide range of temperatures are encountered in various microhabitats.
Figure 4. The computerized data logger easily connects to a laptop computer for portable data downloading.
Appendix G

OWATCH on the Internet Report

The following contains the original version of the “website review” report as it was submitted as a completed project for this OWATCH internship. This draft was modified for tonal issues and presented to various volunteer web designers collaborating on the OWATCH internet presence.

(Editor’s note: The assembly of the appendices for this internship report required complete reformatting that may have resulted in inaccurate references to page numbers—due to copy movement—or incomplete graphics. The essence of the material, however, remains unchanged and should be accurate in content.)
OWATCH on the Internet:
Results of a Web Search for OWATCH

including
Recommendations for Improvement
to Associated Sites
And
Suggestions for Development
of an OWATCH Website

by Scott Shellabarger
Technical Writing Specialist
For OWATCH

February 11, 2003
Exploiting the Search for Knowledge

The internet or world wide web is an incredible resource for locating information on a myriad of topics. The web of data storage devices that make up the internet can be compared to a massive library that globally warehouses information relating to every subject imaginable. As such, the internet can be used to research a topic or simply to discover more about a subject.

Enterprising companies and organizations can exploit the internet’s similarity to a global Yellow Pages by making company or organizational background information available on the web for the edification of potential customers, investors, or patrons. In other words, organizational success is based on people finding your organization, appreciating it, and supporting it—thanks to the dispersing of valuable organizational information in as many ways as possible. The internet accomplishes this task more fully than any other medium before.

But simply making organizational information accessible to the general public, or “putting your book in the library,” does not guarantee that your “book” will be picked up off of the internet shelf and read. Many internet resources become lost in a sea of information—never being consumed or even found. Understanding the workings of the internet is an essential factor in the organizational development and exploitation of a web presence.

Searching for OWATCH

Internet or web browser programs like MS Explorer, Netscape Navigator, and even America On-Line provide a window through which the user can view chunks of information stored on the web. These programs use a limited search of “key words” to locate information on the internet. Generally, browsers use a “smart programming” which allows them to learn and grow with advances in internet development and organization. “Key words” are invisible phrases that are embedded in web site documents. While key words are designed to gain the attention of the “search engines” employed by the browser, advanced search engines, such as Google, can also search the words found in the text of the web page itself using “spider” or “crawler” technology (programs that read, record, and classify every word on the internet). Advanced search engines compile information choices based on the frequency that a subject or word is mentioned in a web document. For this reason, a reliable search of internet resources is usually conducted from the site of an advanced search engine itself, such as google.com.

Although the internet holds a wealth of resource material, the person trying to locate information (the user) does not usually have a wealth of time to spend wading through all the possible “hits” (or key word connections) he or she may get in response to a “query.” When searching for a subject on the internet, the first thing to think about is how can the search be narrowed to the absolute limit of the range of knowledge to be discovered. In thinking about the subject matter to be searched, consider the most unique aspect, and run the search for that key aspect.

OWATCH is a good example. How would this organization be found on the web? Entering OWATCH itself, in Google, brings up a French, live, on-line video surveillance service whose
web address is owatch.com. Google gave the most precise response to our search for OWATCH. It will be easy to discern our organization from the competition as owatch.com does not delve into environmental education at all—and the entire website, including the Google description, is in French.

Let’s investigate this further from the point-of-view of a potential OWATCH patron or participant. The user may know that OWATCH is an acronym that stands for Ohio Wy-ami Appalachian Teacher’s CoHorts (with a nod to English teachers for allowing “cohorts” to be spelled uniquely in order to accommodate a more accurate acronym). The unique, search-narrowing terms here are “Wy-ami” and “CoHorts.” It should be noted that while the general public would look at “cohort,” as defined in Webster’s New World Dictionary, as “a band of soldiers, a group, an associate,” the term is a common one used to describe teaching relationships and so might be searched for under those stipulations. A general Google search for the word “CoHort,” however, reveals previously copyrighted terminology in a computer company called CoHort Software that produces graphics and statistics software programs allowing scientists and engineers to manipulate data and run statistical analyses. Although teacher cohorts may not overlap in their technologies with CoHort Software, this search has provided possible legal implications to the use of the word CoHort in OWATCH’s documentation.

Continuing our investigation of the internet paths to OWATCH, Google’s search for the term “wy-ami” brings up many entries for the Wyoming Alliance for the Mentally Ill, whose acronym is WYAMI. Jokes aside, I believe that OWATCH can discern itself from its neighbors in this list as well due to the difference in the missions of the two agencies—although WY-AMI does employ teachers, and the search pattern overlaps here as well.

Analyzing OWATCH Associates

The fifth entry Google presents in a search under the term “wy-ami” is that of the Columbiana County Educational Service Center—the client of OWATCH director Marilyn Parkes. Ms. Parkes coined the phrase “wy-ami” by combining Miami (from Miami University) with the location of the concentrated programs of OWATCH: Wyoming. The term has the added benefit of sounding like a Native American word—thus also providing a link to OWATCH programming.

Located in Lisbon, Ohio, the Columbiana County Educational Service Center (CCESC) is an organization which supports and supplements local educational efforts. CCESC supports the “Wy-ami Project” by providing a web presence, among other things, at their website www.ccesc.k12.oh.us. The relationship between CCESC and OWATCH or the “Wy-ami Project” is not clear to those entering the website or searching for OWATCH. A drop-down menu at the CCESC site reveals a link to the “Wy-ami Project,” but once on the site, the proliferation of OWATCH logos is the only clear sign that one has reached a destination—and that sign is obscure at best.
An in-depth analysis of the CCESC Wy-ami website finally reveals that the organization being supported here is the *Columbiana County Wy-ami Teacher’s Network*, an alumni-type organization which provides support and assistance to those teachers who have completed OWATCH program training. Much of the documentation found on the site provides useful reference to the programs offered through OWATCH. There are, however, many elements that are cumbersome. With a few modifications, CCESC’s Wy-ami Project website could be a much-improved and easier-to-use resource and supplementary device for OWATCH alums.

**Recommending Improved Usability**

The primary concern of any website is that the site be accessible and readable by all who enter it. The goal is the dissemination of information, but information does not just get picked up and read, as we have already noted here. Design, layout, and language all contribute to the accessibility of the information on a website. We can learn the *do’s and don’t’s* of website presentation by looking critically at similar sites. In this case, I have a few recommendations which will improve the usability of the OWATCH alumni website operated by CCESC and the *Columbiana County Wy-ami Teacher’s Network* (CCWTN). These recommendations are summarized in Figure 1 and explained in detail in the following paragraphs.

Upon entering the Wy-ami Project (WP) website, the user is presented with two frames of information, one to the right and one to the left. The left frame contains the menu, and the right showcases the information associated with the appropriate menu selection. This is a standard format for most basic websites. The user would then expect to click on phrases and graphic elements in the menu frame that would be links to other pages of information. In this case, each phrasal entry is situated next to a logo graphic of the “brand” (as in the logo tattooed on livestock) associated with the OWATCH programming in Wyoming—the image of two mountains with a tree centered between them. These logos are expected to be button-like in that they would access more information pages, but they do not, and the user is left to wonder if the site is ready to provide information or not—among other things.

**Looking for HOME**

The lead screen, or HOME page, is the place where the user starts. This page should have all the basic information necessary to help the user to know exactly where he or she is. The WP site starts with a photo album. There is nothing to indicate what this site or this group is about. There is no contact name or e-mail. What if the user wants more information? There is no one to ask—and the casual web surfer won’t go far before he/she loses interest and leaves the site—thus defeating the goal of the organization in having a website.

**Giving the Audience What They Need**

Roaming through the various information pages reveals much that is probably clear to the teachers who would be directed to the site. But, who is the audience that the site is really trying to address? Is it exclusively concerned with teachers—or will supporters and non-teachers be
looking for information here as well? Information pages should be written with the lowest common denominator in the audience in mind so as not to exclude the uninitiated with jargon terms.

Dates are another no-no in websites—unless the calendar is important to the presentation of the information. Most websites are not updated monthly or even yearly. Some sites actually talk about issues that occurred a few years ago as “coming up”—like the “new” millennium. If the date is not extremely important to the information, don’t include it. Using a date can make your site information look old and unimportant—the proverbial kiss of death to a user’s attention.

Clarifying the Design

Clarity in design and purpose is also of the strictest importance in website development. WP’s “Links” takes the user to “Lessons.” Users understand “links” to be to other websites concerning a similar subject. “Lessons” is a valuable topic of its own and should be designed as such. The lessons themselves are PDFs that automatically download to the user’s computer without warning. One of the files is a 12MB PowerPoint presentation that highlights the achievements of the organization very well. Why is it included with “lessons?” A lighter version of this PowerPoint presentation would be a great downloadable property to be found on the HOME page as it provides a complete overview of the issues and achievements OWATCH is involved with.

A standard practice in website design has become a staple of navigation on the web. Instead of using the “back” button in the browser, a website should provide a link to the HOME page on each and every screen the user links to. In the case of the WP website, these links either do not exist or they take the user back to the CCESC home page—which is long way from Wy-ami.

Saying a Simple “No” to Jargon

As was touched on in the Giving the Audience What They Need subsection, the use of jargon is another area that is easily overlooked in the design of the website. Many sponsor organizations simply see their own customers and constituents as users without considering the openness of the internet. The world wide web has the potential to provide a myriad of information types to anyone who searches it. Organizations cannot narrow their focus in website design or presentation. Some potential customers or patrons are an unrealized resource accessible only through the internet.

Simplifying the Headings

On the WP website, headings such as “Best Practices” and “Synopsis of Practice” may be clear to teachers, but are much too technical for the general public. The phrases really don’t mean anything, and potential patrons might be put off just enough to leave the site without the sense of good will that every organization seeks to instill in the public. While headings should be concise and obvious, if the website needs to continue to use jargon terms, a translation should be included as well to make choices obvious to the layman as well as the teacher. “Best Practices,”
for instance, sounds a lot like a “Director’s Vision” in the presentation of the information—and *Director’s Vision* is more clear in the included information simply by its heading. “Synopsis of Practice” explains the organization very well and should be summarized on the HOME page as an overview of the views and aspirations of the organization.

The body copy of the “Synopsis of Practice” contains underlined phrases as if for emphasis. On the internet, an underlined phrase is standard to mean a link—the user expects to encounter more information when clicking on underlined text. The “Synopsis of Practice” does not appear to contain links. Converting this text to web standard **bold** for emphasis would greatly improve website usability.

“Ohio Learner Outcomes” should include “Proficiency” in the label or heading to improve clarity. Additionally, explanations should be available to the reader as they enter a page. The “Content Standards Chart” could use an explanation for the layman.

*Figure 1—Recommendations for Improvement to the Wy-ami Project Website (CCESC)*

<table>
<thead>
<tr>
<th>Website Improvement Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change brand logos to actual rollover button links.</td>
</tr>
<tr>
<td>Create home page with basic organizational information and contacts.</td>
</tr>
<tr>
<td>Re-write information pages for general public understanding.</td>
</tr>
<tr>
<td>Remove all mention of dates—unless it is critical to content (like a calendar).</td>
</tr>
<tr>
<td>Change “links” from lesson plan downloads to associated websites.</td>
</tr>
<tr>
<td>Make “lessons” a page of its own with some explanation.</td>
</tr>
<tr>
<td>Have smaller version of PowerPoint presentation on Home Page as downloadable general info.</td>
</tr>
<tr>
<td>Put Home links on all pages--taking visitor back to first WP page.</td>
</tr>
<tr>
<td>Change “Best Practices” to “Director’s Vision” to avoid teacher jargon--or have both.</td>
</tr>
<tr>
<td>Put “Synopsis of Practice” in summary on Home page to explain the organization.</td>
</tr>
<tr>
<td>Don’t underline for emphasis. Underlines mean “links” on the web. <strong>Bold</strong> for emphasis.</td>
</tr>
<tr>
<td>Clarify “Content Standard Chart” with an explanation.</td>
</tr>
<tr>
<td>Give “Ohio Learner Outcomes” a “proficiency” label.</td>
</tr>
<tr>
<td>List people’s names with links to e-mail for contact efficiency.</td>
</tr>
<tr>
<td>Explain the meaning of the logo on the introductory page.</td>
</tr>
<tr>
<td>Animate the creation of the brand logo: “M” mountains join the “tree stick.”</td>
</tr>
</tbody>
</table>

**Enhancing the Experience with Graphics**

Nothing on the internet is there just to be there. Like the newspaper, information on a web page is designed in a certain way to be absorbed and used. Graphics such as pictures and logos are placed to enhance that experience. Newspaper pages are designed with a large “question mark” in mind on the page; photos are placed at the center top of the page to capture the reader’s attention and information is placed in order of importance following this question mark (?) pattern down the page. This design method has been tested and proven to follow the reader’s attention as a page is first picked up and scanned by the reader. Thus, the newspaper is designed
to grab the reader’s attention along the path that the reader reviews. Pictures especially are positioned to draw the reader’s eye along a specific path to a specific end—whether that is to the next page or to an advertisement placed at the end of the path.

The web page, as another medium of information distribution with a purpose, must follow proven design standards in order to stay competitive with other information sources. Everything on a web page should work to increase good will toward an organization by passing on critical information which the user desires and which the organization wishes to promote. When listing the names of people associated with the organization, for instance, standard practice and design dictates that this list of names be linked to e-mail addresses so that the user can notify an individual for more information or to answer questions. Simple lists of people are meaningless to the uninitiated and thus have no true purpose on the internet—unless providing some source of vanity for those listed. Again, the internet does not exist for the people who put up a website—it exists for the user, and the organization exploits this use.

**Branding a Good Graphic**

This critique started with the discussion of the “brand” logo appearing on the HOME page; it will end there as well. As I mentioned on page 4, the WP site opens to a series of graphics that are the “brand” (as in the logo tattooed on livestock) associated with OWATCH programming in Wyoming—the image of two mountains with a tree centered between them. This logo is a great symbol for the OWATCH program and has meaning in the mountains that come from the “M” in Miami and the pine tree that comes from the Wyoming ranch (program location) brand logo itself. To the layman, the image even carries an association with Native American symbols—which is important to OWATCH as well.

The Wyami Project is missing an important opportunity by not explaining its logo on the opening page. Knowledge is an important element of association that fosters good will toward an organization. The logo explanation should be linked via a large logo that sits in the upper left corner of the HOME page next to the title of the organization. Using multiple logos for buttons could be considered “overkill.” Perhaps the logo information page could contain an animation of just how the logo was formed. This animation would provide a great illustration, and it would be fun for the user to observe. The animation itself would be relatively simple to produce as the logo is made up of a series of stick figures easily separated and put back together.

**Discovering OWATCH Supporters**

OWATCH is a collaborative effort. There are three main websites that exist to support and promote the organization. A general search, however, reveals only one of them. As has been analyzed already, the *Columbiana County Wy-ami Teacher’s Network* employs the *Wy-ami Project* website in support of OWATCH. CCWTN is the only organization that uses terminology that would direct an internet browser to take the web surfer to an OWATCH-sponsored site as they use the unique word *wyami* in their name as well. Other organizations that support OWATCH include the Cryobiology Lab at Miami University and Bob Flinn’s ESET.
Bob Flinn is a “master teacher” employed as a volunteer within OWATCH programming efforts. During the school year, Bob works as an elementary school teacher at Winton Woods Elementary School just outside of Cincinnati, Ohio. During the summer, however, Bob participates in OWATCH programs in Wyoming, working to help advance learning opportunities for his fellow Ohio elementary school teachers. Back in Ohio, Bob maintains a website that provides information relating to OWATCH with FAQs (Frequently Asked Questions), application information, pictures of past events, relevant links, and contacts—all under the banner ESET, which stands for Environmental Science for Elementary Teachers. The words OWATCH or wyami or cohorts is not found here—and so ESET is not revealed in a search for such.

The ESET website, found at www.home.earthlink.net/~b_flinn/b_flinn.htm, is well-designed and informational. There is an abundance of graphic elements that border on gaudy, but the creativeness of an elementary school teacher would allow for such design expression. Colors are light and bright; buttons are large and expressive; links take the user to obvious locations. Bob Flinn could make ESET easier to find in association with OWATCH by adding these search terms to his keywords list: OWATCH, wyami, and cohorts—along with science education and science teacher.

The term “science teacher” is important to OWATCH because it describes a constituent of the organization’s programming. Science teachers would be the ones interested in participating in OWATCH. But a search of the first 50 entries of Google’s listing for “science teacher” reveals no reference to any OWATCH-related websites or organizations at all. The same holds true for the term “science education” which elicited 4,150,000 entries from Google—and nothing within the first 150 entries that would take the user to an OWATCH-associated site. This is especially disappointing as our last OWATCH-affiliated website is managed by educational mecca Miami University.

The Cryobiology Lab at Miami University is run by OWATCH programming director Dr. Rick Lee. As such, Dr. Lee has provided a location on his lab’s website with Miami University for an informational link to OWATCH—although he, like Bob Flinn, neither mentions OWATCH by name nor refers to the term wy-ami. In fact, the Miami University Cryobiology Laboratory’s science education section simply provides a description of the Wyoming course for prospective participants, along with contact information. For what it provides, the design is simple and appropriate. But the site, found at http://zoology.muohio.edu/cryolab/ScienceEd/ScienceEducation.html, could use more information and actual references to the sponsor organization (OWATCH), its programs (ESET), and its alumni support groups (The Wy-ami Project).

**Building the Perfect Beast**

If OWATCH is to maintain a presence in the field of elementary science education, then it must build a web presence to support information gatherers, users, and constituents. And the collaborative organizers must come together to agree on a system of support. Currently, the system is flawed in its ability to be discovered. Multiple platforms of information presentation
can exist as long as they do not obscure knowledge from the web searcher. We do not want to defeat the purpose of the internet. Simple links to the other sites would help to solve some of the problems. Also, an investigation of the keyword source of the existing sites would be beneficial. WP, ESET, and the CryoLab sites all seem to be buried in the information of the internet—hardly accessible at all to the web researcher.

**Designing a Useful Information Source**

The OWATCH website should start with a useful HOME page which explains the organization and its mission. It should also have a list of the directors and e-mail contacts—and the date when the site was put into action. The logo should be prominent, but not overbearing and not in multiple places. The animation and logo explanation could be linked from this page.

From the HOME page, four screens of information (in addition to the LOGO page) should be linked:

1. *Course Description* explains the programming themes of OWATCH, with links to application information.
2. *Program Materials* lists downloadable PDFs of actual handouts and teaching materials.
3. *Links* to related teaching and alumni sites and helpful science background materials.
4. *Photos* and/or video of the people, environments, and programming in action.

For a graphic representation of the connection between the various elements or pages of this website design, see figure 2.

*Figure 2—Charting OWATCH website design*

OWATCH Website Organization
OWATCH-ing the Internet

Organizational success is based on people finding your organization, appreciating it, and supporting it. The internet accomplishes this task more fully than any other medium before. Enterprising organizations can exploit the internet’s similarity to a global Yellow Pages by making organizational background information available on the web for the edification of potential customers, investors, or patrons. These facts are not lost on a few of OWATCH’s contributors who have developed their own websites to answer various questions about the organization or program they support. The Wy-ami Project, ESET, and the MU Cryo Lab all have a vested interest in the success of OWATCH programming.

The Wy-ami Project, an alumni support website, provides teachers with an outlet to contact others who have gone through the OWATCH program and to acquire and apply skills through sample downloadable lesson plans. ESET describes the event that OWATCH produces in Wyoming with photos, FAQs, and contact information. And the Cryo Lab’s educational branch provides descriptions of the courses offered and contact and application information.

OWATCH could use the comprehensive website outlined in this report to touch on all of these important areas—and provide constituents, and those who seek information, with the answers they need. An open policy of providing information will lead to public goodwill and a continuation of important programming efforts for elementary teachers seeking assistance in teaching environmental and scientific topics and concepts.
Appendix H
*The Anderson Problem-Solving Model (APSM)*

The following table summarizes the Anderson Problem-Solving Model for Technical Communicators as developed in 1983 by Paul V. Anderson.
# Anderson Problem-Solving Model

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsibility</th>
<th>Create System</th>
<th>Manage System</th>
<th>Perform Activity Within System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define Problem</td>
<td>Specify Purpose (organizational function, reader's use, writer's intention, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze Context (constraints, conventions, etc.)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze Audience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Solution</td>
<td>Make Preliminary Decisions about Medium, Form, Style, Production, Distribution, etc.</td>
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<td></td>
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<tr>
<td></td>
<td>Gather Information (interview, use printed and computerized sources, etc.)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draft Solution (for example, in print: write rough draft and sketch figures)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design Finished Product (for example, in print: choose typefaces; design layout, etc.)</td>
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<td></td>
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<tr>
<td></td>
<td>Produce Pilot Version or Review Copy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Solution</td>
<td>Design Procedures for Testing or Review</td>
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<tr>
<td></td>
<td>Present Pilot Version or Review Copy to Sample of the Audience or to Reviewers</td>
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<tr>
<td></td>
<td>Gather Responses</td>
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<tr>
<td></td>
<td>Analyze Them</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recommend Improvements in the Solution</td>
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<td></td>
</tr>
<tr>
<td>Implement Solution</td>
<td>Revise the Solution</td>
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</tr>
<tr>
<td></td>
<td>Produce it (print it, tape it, film it, etc.)</td>
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<tr>
<td></td>
<td>Package it</td>
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<tr>
<td></td>
<td>Deliver it</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate Solution</td>
<td>Design an Evaluation Method</td>
<td></td>
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<tr>
<td></td>
<td>Use the Method</td>
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<tr>
<td></td>
<td>Analyze Results</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Formulate Recommendations</td>
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<td></td>
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<tr>
<td></td>
<td>Make Changes</td>
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</tbody>
</table>

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Appendix I

OWATCH HOBO Article--Original Draft

The following pages contain the original unedited draft of the journal article as it was given to me to become my main internship project. This draft was deemed too complex for an audience of high school teachers by the professional teachers group NSTA in 1996.

(Editor's note: The assembly of the appendices for this internship report required complete reformatting that may have resulted in inaccurate references to page numbers--due to copy movement--or incomplete graphics. The essence of the material, however, remains unchanged and should be accurate in content.)
Using Computerized Temperature Loggers in Inquiry-based Science Education

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As we move to a more hands-on and inquiry-based mode of science instruction, we need to challenge our students to design and conduct meaningful experiments that are neither contrived nor overly redundant. The expense and technical complexity of most computerized data acquisition systems limits their utility in educational settings. This report describes a comparatively versatile, user-friendly, and economical tool for making automated recordings of temperature and other environmental parameters that have significantly enhanced our research. Our experience suggests that this computerized data acquisition system can be used in a wide variety of laboratory and field applications to effectively enhance active experimentation in science education.

Use of Computerized Data Acquisition Systems in Research

The rigors of making accurate, repeated environmental measurements have long challenged scientists and educators in fields as diverse as aviation, meteorology, environmental biology, ecology, and ecological physiology. In research, manual sampling techniques are potentially limiting since they can be time intensive, logistically unfeasible, and subject to investigator bias. Depending on the project’s time scale, a program of manual sampling may necessarily involve a discontinuous sampling design that yields incomplete information. Furthermore, the timing of crucial measurements is not always opportune: events most fascinating to us, cryobiologists interested in natural systems, often occur during early morning hours in the dead of winter.

The relatively recent development of microcomputer-based environmental sampling technology has permitted automated, continuous sampling of a host of environmental parameters, such as ambient temperature, humidity, pH, wind speed and direction, solar radiation, and soil water potential. The advent of such systems has largely circumvented problems associated with manual sampling programs, although they are not without disadvantages concerning versatility, ease of use, and cost (Peterson & Dorcas 1994).

One drawback of modern data acquisition equipment is the high cost. A basic system we purchased in mid-1995, with capabilities to measure several environmental parameters, cost
nearly $4,500. The purchase price, coupled with substantial maintenance and sensor replacement costs, would be prohibitive for many potential users, particularly those at educational institutions.

Another drawback is that various data acquisition systems require the investigator to use computer code and algorithms for operating the sensors, transmitting data to the CPU, and downloading the data to final memory. Data transfer to a personal computer may require special cables, software, and modems. Furthermore, even some of the state-of-the-art systems still require users to write their own operating programs using a specialized language. Often, the supplied system control software typically is rudimentary and available only in PC format.

Many computerized data acquisition systems are at best semi-portable. In the field, components and sensors typically are mounted on a large tower or other structural support. The equipment is conspicuous, perhaps creating security concerns, and relatively difficult to relocate. Providing an appropriate power supply can be problematic. Rechargeable batteries require either periodic replacement or continuous charging via solar-generates current. Although a remote-sensing system of this kind is useful in some applications, for example in establishing a permanent weather station, this system’s lack of versatility and portability greatly limits its utility in educational programs.

**Novel Data Loggers are Ideal for Student Use**

Fortunately for educators and researchers alike, miniaturized data loggers that are highly versatile, user friendly, and economical are now commercially available. Onset Computer Corporation (P.O. Box 3450, Pocasset, MA 02559), whose primary business since 1981 is the design, manufacture, and distribution of precision computers for data logging and instrument control applications, offers a recently-developed family of miniature data loggers for single-channel monitoring of temperature, relative humidity, air pressure, light intensity and voltage (Table 1). Each logger is fully self-contained in a plastic case only slightly larger than a matchbox. Although we have had reasonably good success with several of these products we
have extensively used their temperature loggers, the least expensive and perhaps most versatile of Onset’s data logging devices.

The basic temperature logger features a CMOS microprocessor, an 8-bit A-D converter, and on-board memory that stores both the operating program and acquired data. Environmental temperatures are measured with an integral or external thermistor sensor and stored in non-volatile EEPROM memory available in 2, 8, or 32 K configurations. Remarkably, the data in memory are retained even if the power is lost or the logger otherwise fails. Depending on the unit’s memory, automated sampling deployments lasting from 15 min to several years are possible (Table 2). The standard loggers are equipped with a lithium battery that draws 13 μA and lasts an average of 2 years (Table 2). Replacement batteries are available inexpensively from Onset and are simple to install. Recent innovations include temperature loggers powered by batteries that may last 4-10 yr. The accuracy of the data loggers reportedly is within the manufacturer’s specifications (Table 2; Mueller & Rakestraw 1995).

**Operation of Temperature Loggers is Simple**

One of the best features of Onset’s data loggers is their ease of use. The logger is connected to a personal computer via the supplied serial interface cable and 2400 baud communications and quickly programmed using menu-driven software (available in both DOS/Windows and Macintosh formats). The unpretentious control software requires at least a Macintosh Plus, with 1 MB free RAM, running system 6.0.8 or later (recommended: 68020 processor or better, system 7, and 2 MB free RAM). In PC format, a 386 (or better) processor with a minimum of 2 MB RAM running Windows 3.1 or later is required. Programming options include choice of sampling duration and interval, unit of measurement, high/low-temperature alarm settings, and memory overwrite. A special multiple-sampling option instructs the logger to continue sampling during the measurement interval and to store the maximum, minimum, or average value. The logging function can be activated immediately, triggered subsequently by the push of a button, or programmed to turn itself on at a specified time up to 3 months later. We have found the
delayed start very useful for synchronizing the recording of multiple loggers. A blinking LED visible through the front cover of the case confirms that the logger is operating properly.

Downloading data from a logger with full memory to our Macintosh IIsi computer is completed in several seconds. Graphs of the data appear automatically and, although they are not of publication quality, the simple X-Y plots are suitable for cursory analytical and educational purposes. Portions of the graph can be enlarged and automatically rescaled simply by selecting the region with the cursor (Figure 1). The data may be exported in various formats using the supplied software and saved as ASCII files, which can then be opened in virtually any spreadsheet or graphics program. Operation of these data loggers is sufficiently simple that following brief instruction students can readily launch and download data from them.

**Tips for Deploying the Temperature Loggers**

In our experience the standard temperature loggers are extremely versatile and may be used in essentially any laboratory or field environment so long as precautions are taken to protect the circuitry from moisture. Some investigators have successfully sealed the logger’s case with cloth tape and/or silicone caulking (Mueller & Rakestraw 1995). Our procedure is to contain the logger in a small plastic vessel with tight-fitting lid, such as any name-brand variety of single-meal storage container. To accommodate an external probe, a small hole is drilled in the bowl’s side through which the sensor and cable are passed; the joint is then sealed on the inner and outer surfaces with hot-melt glue. After launching, the logger is enveloped in a heavy plastic bag, placed in the bowl, and buried under desiccant (silica gel or CaCl2). Packaged in this manner, these units may be used in virtually any indoor or outdoor environment that does not subject them to inundation. A portable computer (laptop or equivalent) may be used to collect data from loggers with minimal disturbance to the unit or probe placement. Temperature loggers may be used in mud or water if they are safely enclosed in Onset’s submersible polycarbonate case or a suitable facsimile. Alternatively, Onset now offers two new lines of watertight temperature loggers that were specifically designed for deployment in damp environments.
Product Support

Our experience has shown that the manufacturer provides adequate product support services and technical consultation. Onset’s stated policy is to repair or replace without charge any product found to be defective within one year of delivery. Also, the manufacturer offers a program for user-damaged units in which technicians can recover data and fully repair or replace data loggers. We used this service to recover valuable data stored in the nonvolatile EEPROM memory on a temperature logger that inadvertently became waterlogged.

The manufacturer is interested in accommodating the special needs of users, such as specific sampling ranges or other custom requirements. In a recent study purposed to improve glove design, NASA used these temperature loggers to measure temperatures experienced by astronauts aboard the space shuttle *Discovery*. Special power and program-launching mechanisms were developed by Onset specifically in support of this project (Davis 1995).

Using Computerized Data Loggers in Science Education

In the contemporary research laboratory, data are transferred from various sensors to spreadsheet applications for computer analysis and storage. For example, oscilloscopes used to study the electrical activity of nerves and muscles are rapidly being replaced by computerized data acquisition systems. Use of computerized temperature loggers would provide students with practical experience not only in collecting data, but also in using computers to analyze, organize, present, and archive data.

Another educational benefit of using these temperature loggers is that data may be collected over extended periods without user attention. In the classroom this permits experiments to continue beyond the typical 1-3 hour laboratory instructional period. This feature is particularly useful in field studies lasting for weeks or months where frequent site visits may not be practical.

The portability, versatility, and ease of use of these units is of obvious benefit for student use. They may be used in various laboratory explorations in disciplines including physics, chemistry, and biology. One field application for which these loggers are particularly well suited
is to compare environmental conditions among different microhabitats (e.g., shaded woods versus open fields, beneath versus above snow cover, etc.). They are also ideal for long-term monitoring of terrestrial and aquatic conditions. These units may be particularly useful for environmental monitoring at land labs, nature and outdoor education centers.

In summary, these miniature data loggers are versatile, user friendly, and economical tools that may be effectively used to enhance inquiry-based science education. They may be particularly useful in small group studies or science fair projects. Educators interested in this novel technology may contact Onset’s biology/education representative for more information on using these devices in educational settings.

Acknowledgments

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References


Figure legend

Figure 1. Temperatures encountered by an eastern box turtle (*Terrapene carolina*) in an outdoor enclosure during autumn, 1995. The turtle was outfitted with a user-modified logger (8K memory) programmed to sample temperature hourly. Shown are plots created by product-supplied software illustrating (A) \( n = 2015 \) data points collected over the entire experiment; (B) subset of the record focusing on diurnal temperature fluctuations; and (C) individual sample points recorded over a select 28-hour period.

Table 1. Miniature data loggers manufactured by Onset Computer Corp.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sampling range(^a)</th>
<th>Unit cost(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>temperature</td>
<td>-39° to 75°C</td>
<td>99-172</td>
</tr>
<tr>
<td>relative humidity</td>
<td>5 to 95%, non-condensing</td>
<td>149-266</td>
</tr>
<tr>
<td>air pressure</td>
<td>0 to 15 PSI(^c)</td>
<td>249</td>
</tr>
<tr>
<td>light intensity</td>
<td>&lt;0.001 to &gt;10,000 lumens/ft(^2)</td>
<td>149-266</td>
</tr>
<tr>
<td>voltage</td>
<td>0 to 2.5 V</td>
<td>129-246</td>
</tr>
</tbody>
</table>

\(^a\) pertains to standard models; many custom configurations possible

\(^b\) Price in U.S. dollars, effective January 1996, depends on memory configuration (2, 8, and 32 K available). Starter kit including software for DOS/Windows or Macintosh, interface cable, and manual also required ($59). Quantity and/or educational discounts (50% for K-12) may apply.

\(^c\) data displayed in PSI, mBar, mmHg, or altitude (ft or m)
Table 2. Features and specifications of Hobo® Temp, Hobo® XT, and StowAway™ XTI models of miniature temperature loggers manufactured by Onset Computer Corporation.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case construction</td>
<td>Polycarbonate; 4.6 ¥ 4.8 ¥ 1.5 cm</td>
</tr>
<tr>
<td>Mass</td>
<td>26 g</td>
</tr>
<tr>
<td>Power source</td>
<td>One 3.6-V wafer lithium cell; life, ± 2 years</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-39° to 75°C, non-condensing</td>
</tr>
<tr>
<td>Sensor and sampling range</td>
<td>Internal/external thermistor; -39° to 123°C</td>
</tr>
<tr>
<td>Measurement units</td>
<td>°C, °F, A-D</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.2° to 0.6°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2° to 0.4°C</td>
</tr>
<tr>
<td>Response time (in water)</td>
<td>Internal sensor, 15 min</td>
</tr>
<tr>
<td></td>
<td>External sensor, 3 min</td>
</tr>
<tr>
<td>Memory</td>
<td>Non-volatile EEPROM (2, 8, or 32 K)</td>
</tr>
<tr>
<td>Data storage capacity</td>
<td>1,800 to 32,520 data points</td>
</tr>
<tr>
<td>Deployment duration</td>
<td>15 min to 360 da</td>
</tr>
<tr>
<td>Measurement interval</td>
<td>0.5 sec to 4.8 h</td>
</tr>
</tbody>
</table>

\(^a\) Values given pertain to 2K units