

TEACHER - STUDENT WATER QUALITY TREND MONITORING: AN INVESTMENT IN SUSTAINING WATER QUALITY IN GEORGIA

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Abstract. This paper describes a program that trains teachers to conduct trend monitoring research projects with their students. This project is important because it provides citizen awareness on the part of both teachers and students and introduces students to a variety of careers in fields related to water resources management. More important yet, it improves both basic science education and the understanding of the relationship and importance of science in resource management and public policy.

INTRODUCTION

Program Benefits

Water quality trend monitoring is important in establishing baseline data. Approximately 40,000 miles of rivers and streams in Georgia receive no professional monitoring. Without it, there is no information available to let communities compare water quality with standards, to provide information about conditions prior to environmental perturbation, or to permit the comparison of background and episodic conditions. Thus, data/information generated by citizen monitoring can be a valuable tool in water resource management.

Trend monitoring involving students and teachers also has significant educational value. In order to conduct a trend monitoring program, a group of students must develop study design skills, organizational skills, good laboratory techniques, and the ability to manage and organize data. There is a reason for their activity and an audience for their results. In addition, because the project is long term, they can develop an appreciation for the fact that all change is not instant, and a snapshot of conditions is not an adequate description. There are good study sites in all communities in all parts of the state. For all of the above reasons, a program to enable teachers to conduct trend monitoring studies with their students seemed to be a worthwhile endeavor in good science and good citizenship.

Program Beginnings and Expansion

In each of the past five summers, five day water quality workshops have been conducted on the North Georgia

College campus. Initially, teams from the Chattahoochee River basin, consisting of a science teacher and two students, were selected from north Georgia schools. These programs, conducted jointly by the authors, were supported by the Eisenhower Act for the Improvement of Science and Mathematics Education. As a result of the success of the initial workshops, support was obtained from the U. S. Environmental Protection Agency through the Georgia Environmental Protection Division to expand the program to Savannah State and Georgia Southwestern Colleges in 1994. Teams from other river basins have been included in the expanded program.

This program was modeled after a similar one coordinated by the University of Tennessee at Chattanooga which targeted the Tennessee River basin. The Tennessee Valley Authority supported the Tennessee project until 1993, and provided technical assistance to North Georgia College in beginning this effort, through its network of environmental education centers.

Program Content

The workshops place a major emphasis on field studies conducted in the surrounding streams and reservoirs. Nonpoint source pollution is the major water quality problem in Georgia, therefore the programs focused on analytical procedures to quantify the five most significant nonpoint source factors that degrade water quality: plant nutrients, siltation, oxygen demanding pollutants, inorganic and organic compounds and disease producing organisms.

Upon returning to their schools, the teachers and students design and conduct a field study on a local stream or lake and prepare a report on that study. The students who attend the workshop serve as a nucleus for involving other students in monitoring programs. Each participating team is loaned a water quality test kit which becomes the property of the school system for those who remain active in the network for three years.

Preliminary results of these studies have been presented to other participants and interested teachers at the annual meetings of the Georgia Science Teachers Association, the Southeastern Lakes Conference of the North American Lake

Management Society, the Georgia Adopt-A-Stream Conference, the Georgia Junior Academy of Science, and the Georgia Water Pollution Control Federation student conference. Telephone support and specialized equipment for research projects are available to participating teams during the academic year from the college based local program coordinators.

Teachers and students also revise and field test instructional materials on water resources. Teachers incorporate these topics into the existing curriculum. The materials revised, developed and field tested are from a publication, "Groundwater, A Vital Resource," which was originally developed at another of the Tennessee Valley Authority's environmental education centers.

Program Operations

When the program was expanded to other sites, additional program coordinators were selected from host university system units. Faculty assist in recruitment, conduct the workshops and serve as resource persons during the following year. Before embarking on a program of their own, they participate in the North Georgia summer workshop in order to gain an understanding of how the program works and a feel for the logistical flow. They also learn about the kind of schedule and activities required to involve such a diverse group of participants who may range in age from 12 to 60.

The staff for each program involves two college faculty and one experienced teacher. A workshop can accommodate eight to ten teams. Local coordinators, teachers and students participate in these intergenerational activities where students and teachers are co-learners. These activities model the behavior which will occur when the teams return to their home campus and, during the course of their monitoring project, interact with adults and agency personnel in their home communities.

Teams may attend the summer program as participants for two years, if they so choose, and students often attend with teacher instructors. Second year teams both refine and expand skills and serve as mentors to the new groups.

METHODS

The program teaches watershed assessment, chemical, physical and biological monitoring techniques. Instructional sites are chosen to illustrate both pristine and impacted streams. Participants are encouraged to attend a program near their home school, both to build a network and to gain an appreciation for normal parameters and problems likely to be encountered in their area.

In watershed assessment, attention is given to topography, land use, map reading skills, stream walks, vegetation, and other characteristics of and impacts on the aquatic community. Chemical testing generally involves the use of Hach or Lamotte test kits, although some bench chemistry is also taught. Kit configurations provided to the schools have

varied from year to year and with the sophistication of the student and teacher and nature of the research monitoring project proposed by the team. They have always included DO, nitrate, phosphate, pH, hardness and/or alkalinity. Depending on needs, teams observe methods for measuring turbidity, settleable solids and suspended solids.

First year teams are not encouraged to begin with bacterial sampling, but teams with established projects are either taught methods or assisted in finding local community partners for such sampling. The Izaak Walton League protocol (macroinvertebrate count) is used for biological monitoring. Physical parameters include measurement of temperature, flow rate, discharge and stream substrate characteristics.

As the state Adopt-A-Stream program has developed, the student-teacher program has both influenced the direction of training for volunteers and been influenced by the selection of parameters, data collection and organizational structure. This is an opportunity for high school students and teachers to participate fully as citizens and as leaders in a significant statewide effort.

During the summer program, students and teachers interact with water quality professionals as they contribute their time in instruction and as students visit their work sites.

DISCUSSION

Water resources education has a role and a function in Georgia schools. It is consistent with many Georgia curriculum goals. However to expect it to be a major focus at the secondary level is unrealistic because of the breadth of curriculum that secondary teachers face. In middle school, less depth of content would be expected, but teachers have more freedom to organize material thematically. There is great potential for water resources education in the schools, but it has to be integrated into existing curriculum or conducted as an extra curricular activity. The "how to" involved in making that happen requires both a depth of knowledge about water resources and a depth of knowledge about curriculum and how schools work--one of the strengths of this program. No amount of printed curricular material will make this happen.

Research about helping teachers implement new material or new strategies into a program suggests that there are two essential elements.

a) Teachers must see and do what you want them to do--it is very difficult to teach someone material about which you are not confident or that you haven't seen work.

b) Long term change requires follow up and support. Approaches to water resources education that will produce long term implementation have to involve more than giving teachers material or conducting one day workshops focused on one or more techniques.

This approach to water resources education is targeted to a particular group of teachers--those who would like to

conduct field based work with students, who want to interact with water resource issues on a local level in their community and who are willing to tackle the logistical challenge of real science outdoors, possibly off site, and the uncertainty of learning with students.

OUTCOMES

Given a teacher-student project of this nature, there were expected measures of success...did teams embark on and complete projects, and did they communicate their results to others? As the program has continued, there have been other, unexpected results also.

To highlight some expected outcomes first: There has been wide variety in participating groups, and thus wide variety in the application of trend monitoring. Projects have been as simple as the study of sedimentation in a school retention pond, which involved almost every eighth grader in a Paulding County middle school. On the other extreme are the projects of two of the teacher-trainers in the project. One involves monthly monitoring of a flood-prone creek in DeKalb County by a 26 member weekend extracurricular group. The other involves the study of a reservoir as it was constructed and filled in Douglas County, from a scientific and cultural perspective. There have been numerous science fair winners and successful applicants for the Governor's Honors Program. All participating teachers have reported both increased awareness of and attention to water issues in their classrooms.

In any program where the goal is to produce an independent, self directed learner (whether student or teacher), you hope for the unintended direction as well. As this program enters its sixth year, some of the first participants are well into their college careers. We have identified two program participants, one now at Georgia Tech and one at Auburn, who are successfully pursuing academic majors selected on the basis of their high school experiences in water resource studies. One team of middle schoolers, during their monitoring rounds, found and reported to the city of Columbus a leak in one of the water mains.

Even more unexpected was the opportunity for one set of summer participants to find themselves taped by CNN for an appearance on Network Earth. Another group was taped for a video distributed by the Georgia Department of Education which described student research needs at the high school level.

Continuation of these community based trend monitoring projects at the school level requires funding. Not only are replacement supplies needed, but projects take on new directions, requiring new equipment and supplies. Students determine what is needed and what resources will be required to meet those needs. They then seek the funding by communicating needs to external audiences. Teams have both written grants and done oral presentations to community

groups to gain support for their ongoing projects. The Pittsburgh Conference, Southwire Corporation, LaMotte Corporation (through a photo contest), the Georgia Science Teachers Association, and many local community groups have supported these teachers and students.

Teachers have won recognition from Business Week, the Izaak Walton League, the Tandy Technology Scholars Program, the Georgia Adopt-A-Stream Program and Georgia Science Teachers Association. The summer program itself was recognized for excellence by the Georgia Economic Development Association.

One of the more unusual and unexpected directions came as the North Georgia College Center, through its TVA connection, assisted in the preparation of a proposal to the United States Information Agency for an international youth exchange and summit. This "Ecobridge" project focused on water issues in the southeastern United States and the Rostov Oblast of the Russian Federation. Twelve Russian students and a teacher spent January 1995 with the Dunwoody High water quality team, and twelve Atlanta students will travel to Russia in March for a month long visit/study. Participation in this program is expected to double next year.

SUMMARY AND RECOMMENDATIONS

Teacher-student trend monitoring programs represent the confluence of two contemporary trends—citizen interest in environmental issues, and education reform efforts to make the curriculum both more rigorous and more relevant. There are benefits to both environmental quality and to the educational system. Opportunities for students to reach out to the community and professionals to reach into the school system become real and not contrived. "Service learning," a term used to describe activities in which students extend their learning beyond the classroom and provide real volunteer service to the community, can take on a new meaning when extended into the scientific sphere.

Water quality professionals can contribute to the success of teacher student monitoring projects by identifying areas suitable for study, by contacting teachers and encouraging involvement, by providing technical expertise, or by making laboratory facilities available for needed tests beyond the scope or expertise of the school project (eg. fecal coliform). They can also serve as student mentors or teacher trainers.

The state Adopt-A-Stream program can provide recognition, reporting structure, and watershed information to teams involved in such projects.