STREAMS: Integrated Curriculum

Through hands-on learning, STREAMS students have tackled major environmental problems in their county, have earned numerous awards for their efforts, and have become leaders in community improvement.

by Frederic R. Wilson

Subject Area: science, social studies, language arts, math
Key Concepts: watersheds, wetlands, renewable and non-renewable resources, environmental health, ecosystem interactions, endangered species
Skills: water quality testing, data analysis, inquiry, problem solving, communicating, critical thinking
Location: indoors and outdoors
Time: 75+ hours

In 1995, the Borough of Huntingdon in southcentral Pennsylvania was granted a quarter of a million dollars to correct a sewage leak that was polluting a local stream. The grant was welcome news for the community. But for a certain group of persistent sixth graders, who had uncovered, investigated, and reported the problem, it was more than good news: it was proof that young people can make a tangible difference in the world.

For the past 13 years, students at Huntingdon Area Middle School have been learning about watershed ecology in an integrated interdisciplinary program called Science Teams in Rural Environments for Aquatic Management Studies (STREAMS). They then go a step further and apply their knowledge to resolving local environmental problems.

STREAMS integrates environmental topics into hands-on learning in social studies, science, mathematics, and language arts. Every Grade 6 student participates in the core of the program, which is conducted over 75 hours at the beginning of each school year. Thereafter, any student in Grades 6 through 8 who wants to pursue further voluntary independent study or environmental projects can do so by joining a student-organized environment club.

Since the program’s inception, students have tackled major environmental problems in the county, have earned numerous awards for their efforts, and have become leaders in community improvement.

STREAMS originated with teachers’ observations that the traditional curriculum was disconnected from the real world of the young people in this rural community, and that students are more engaged in activities that take place outdoors, have a direct impact on their families and community, and give them some control of their educational experience. Developed by social studies teacher Frederic Wilson and science teacher Timothy Julian, STREAMS was implemented as a voluntary program during study hall periods but soon became part of the Grade 6 curriculum, fully aligned with state academic standards. Instrumental to its success have been the cooperation of the community and a team teaching approach that maximizes the potential of using the environment as the context for learning. The key factor, however, has been the students themselves, whose enthusiasm has been a catalyst in raising environmental awareness among adults of the community.
STREAMS curriculum

The main topics of the curriculum were developed during the first three years, but modifications are made annually to provide students with new field study experiences and to integrate supplementary content. Through experimentation and fieldwork, STREAMS students study stormwater runoff, erosion, sedimentation, nutrient enrichment, wetlands, groundwater, and the effects on waterways of acidity and household pollutants. One important aspect of the program is the study of a local stream from its headwater to its mouth. Students monitor the quality of the water, conduct limnological tests, and learn about local water treatment facilities. On completing the program, they understand the ecological interactions in a watershed, factors that have a negative impact on it, and how to collect, analyze, and interpret data to formulate solutions to problems.

All four teachers in the Grade 6 teaching team get their hands wet in the outdoor field studies, but each also contributes specialized expertise in a particular subject area.

Language Arts: The language arts teacher prepares students for STREAMS activities by introducing the vocabulary they will need, works with students on STREAMS writing assignments, and assists in grading other subject papers written under STREAMS.

Math: The math instructor gathers and crunches environmental data collected by students in field studies and collaborates with colleagues to teach students how to interpret statistics, construct charts and graphs, and use word processing and database programs for the completion of their projects. He also uses the environmental data in problem-solving activities and in teaching fractions, percentage, median, and mode.

Science: The science teacher integrates the theme “pathways of water,” which is designed to help students understand the properties of water and the physical features of streams (e.g., flood plains, meanders, and levees), groundwater, lakes, and glaciers. Students investigate processes for purifying drinking water and treating wastewater, conduct limnology tests, examine plankton, compare fresh and salt water, and participate in such follow-up activities as constructing a three-dimensional map of a river and using computer programs to chart, graph, and analyze their limnological data.

Social Studies: The social studies teacher guides students to address environmental issues as social issues by evaluating the effects on water resources of such land uses as residential development, agriculture, and mining. Topics include the impact of stormwater runoff and acidity, types of water pollution, the effects of household products on water quality, the functions and benefits of wetlands, and best management practices. Students share their discoveries with appropriate authorities and write letters expressing their concerns. As environment club advisor, the social studies teacher provides students with the opportunity to work year-round in voluntary environmental learning activities and community service projects.

On a typical STREAMS day, all the subject-specific curricula are integrated around the same topic. For example, when students are learning about the water cycle, the social studies instructor teaches what a water cycle is and takes students outdoors for an activity in which they become a water molecule, tracing their way through groundwater, plants, clouds, oceans, animals, etc. In math, students use the data from the water molecule activity to total and graph the number of times they were a molecule in groundwater, seawater, etc. The language arts teacher has the students write a creative story of their journey as a water molecule, undergoing phase changes as a solid, liquid, and gas as they travel through the water cycle. The science teacher has students draw a diagram of the water cycle and then create a model that is placed outdoors for several days so they can observe how water moves in a cycle. On another day, students in science make and introduce food coloring into a groundwater model to...
observe the pathways of pollutants. In social studies, they learn various causes of groundwater contamination and analyze the means and costs of eliminating it.

As with any integrated program that includes field studies, STREAMS requires organization, funding, and careful scheduling. An early challenge was to convince community leaders to involve students in local problems, but students easily earned the cooperation of community members and parent volunteers as they proved themselves capable of designing relevant projects and doing accurate fieldwork. Small grants helped meet initial funding needs, but today the program is completely funded by the school district; the cost of implementing and maintaining it has been minimal because field studies are conducted close to the school and the water-monitoring equipment required is inexpensive. With staff and administrative support, time is provided for extra learning and projects by using study hall periods, altering students’ schedules, and allowing students to continue activities after school. In addition, a block schedule enables team teachers to carry out multiple field studies on a single day. One of the field days, for instance, has students visiting both the local wastewater treatment plant and the water filtration plant, and conducting limnology activities at a river. The students — more than 100 of them — are divided into three groups, and one bus is used to transport them in rotation until all have participated in the three events. On another day, one group of students examines a local stream from the headwater to the mouth, while another group conducts watershed assessment activities.

The ecological knowledge that students gain from the STREAMS program is put to use throughout the year in voluntary studies and community action projects organized through the student-run environment club. A majority of students — approximately 70 percent — elect to participate in these extra activities, which include environmental research, survey analyses, watershed assessments, microbiology studies, presentations at conferences or civic organizations, letter writing, and community service projects. Parent volunteers and educational partners — for example, college and conservation district personnel — assist with extra academic projects off-campus.

**Applying environmental literacy**

The most noticeable environmental impact of students’ work is that, after years of talk, the county is tackling its number one environmental issue: stormwater runoff. The impetus for action came when students’ water-quality tests showed high levels of bacteria in a local stream called Muddy Run. Having learned about pollution associated with stormwater runoff, the students traced the problem to the town’s sewer system, where crumbling pipes overloaded with stormwater were leaking raw sewage into the stream. Mounting a massive three-year letter-writing campaign, the students informed the public, and urged state and local agencies to correct the problem. The state grant of $250,000 to repair the sewer system came as a direct result of this hard work. More than five kilometers (three miles) of broken sewer lines were replaced.

Next, students turned their attention to constructing a wetland on school property that would help reduce stormwater runoff in the upper Muddy Run watershed. They wrote letters, made presentations to authorities, and helped to design, pay for, construct, and landscape the wetland, which was completed in September 1996.

In the past few years, they have tackled another long-standing problem caused by stormwater runoff: the flooding of homes in residential areas. To stop basement flooding and reduce erosion of the Muddy Run stream, the students worked with local partners to construct a swale and stabilize the stream bank. Excavation of the swale channel — 168 meters (550 feet) long, 11 meters (35 feet) wide, and 0.6 meters (2 feet) deep at the center — was completed in 1998. Planting a riparian buffer zone of large trees and understory shrubs to stabilize the swale completed the project. State funding for the project was obtained through a grant proposal co-authored by students. Other student projects have included:

- raising funds to purchase and plant more than 100 municipal street trees that were given free to homeowners
- completing watershed assessments for the Pennsylvania Department of Environmental Protection as part of the department’s goal to assess more than 133,600 kilometers (83,000 miles) of streams by the year 2006
- completing streambank restoration projects
- creating and delivering an informational flyer to 400 residences in the Muddy Run watershed to
educate the public about land management practices that could help prevent stormwater runoff

- creating and disseminating a booklet listing the effects of 30 types of household pollutants and their environmentally safer alternatives
- initiating a school recycling program, which was later expanded to include the high school
- collecting water-quality data for use in a countywide monitoring program
- presenting students’ environmental work and findings to local service clubs, and at state and regional conferences
- raising funds for county projects to eliminate stormwater runoff problems
- educating the public by writing articles and educational advertisements dealing with environmental issues for the local newspaper
- establishing a tree honorarium program to recognize citizens who have made significant contributions to improve the quality of life in Huntingdon

By taking an active role and speaking constructively, students have also served the community in a less tangible but perhaps more important way: they have set examples of environmental stewardship and citizenship to demonstrate that genuine partnerships between youth and adults can bring great benefit to their communities. Student Heather Mentzer summarized the significance of becoming involved in community projects: “I’ve realized that, when students have the courage to speak and act with knowledge, adults will listen, and that not only adults have power to change things but students also have that power.”

**Academic impact**

STREAMS dramatically affects how students learn and how instructors teach. By using the environment as the integrating context for their curricula, the team teachers have been able to provide more differentiated instruction and multiple-intelligence learning opportunities that enable students to understand the interconnections of content, links that are too often missed in traditional subject-specific teaching. Because lessons in one subject area are revisited and reinforced by activities in others, students are better able to comprehend, retain, and assimilate concepts. This combination of relevant hands-on learning and consistency across disciplines creates enthusiastically engaged learners, reduces discipline problems, reaches students with different learning styles, and significantly increases learning.

Two to five months after the STREAMS program, students are given multiple unannounced post-tests that assess their ecological knowledge and ability to interpret and analyze data. Some post-tests are constructed to be similar to national norm tests and the Pennsylvania State System Assessment tests for science, environment, and ecology, emphasizing vocabulary, comprehension, and analysis. Since 1992, students have demonstrated a high level of mastery and the average on these tests has been above 76 percent, whereas pre-test averages were in the 30 percent range. The educational benefit of using an integrated, interdisciplinary methodology is so significant that the program has been expanded to incorporate studies of other ecosystems and biomes, as well as agriculture. The school district now has a K–12 environment and ecology curriculum.

Providing students with a stimulating integrated environmental education that involves community action projects is a challenging but enjoyable reality at Huntingdon Area Middle School. “It is this type of academic endeavor that will help schools meet national standards in math and science,” said school principal Jill Adams. “All it takes is a change in teaching approach, cooperative collaboration, and a willingness to make it happen.”

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