

Rural Schools in a Global Economy

by Hobart Harmon, AEL Staff

More than 45 percent of the nation's schools and half the local school districts are located in rural areas and small towns. Administrators in rural districts with small schools face many challenges—among them, how to provide the curriculum and extracurricular opportunities that will prepare all students for success in a global economy. Equally difficult is the dilemma surrounding the pursuit of state, federal, or global education goals. Parents and the community often question the relationship of such goals to the locally identified needs of *their students* and *their community*.

In a rural area, effective management practices and a keen sense of place are the cornerstones that enable a district administrator to think globally and act locally—all the time keeping hold of his or her leadership position. What are some of these practices? And can we still create and nurture community schools in a society captivated by a global economy?

The superintendent of a rural district in Virginia recently sought help from AEL in develop-

ing his ideas for improving educational opportunities at a small K-12 school—fewer than 100 students—located on a mountain top. An AEL colleague and I conducted a telephone conference call with several rural superintendents across the nation to discuss key issues and practices for meeting the needs of such a school. We used results of the conversation to develop a questionnaire and conduct a national study of superintendents to find out how they coped with similar problems (rural area, small school, limited budget). The practices identified were grouped into three categories: fiscal practices, staffing issues, and extracurricular activities. Within each category, the practices are listed in order of frequency, beginning with the most-often mentioned.

Fiscal Practices

- **Seek bids and compare pricing for all purchases.** Not generally sought by large suppliers, small school systems tend to remain loyal to their current suppliers. Using a bidding process, districts can generate substantial savings, especially when all schools in the district consoli-

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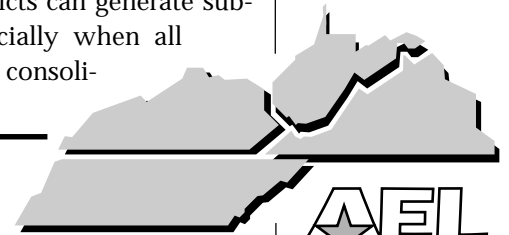
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date their bid requests. Even greater savings may be realized when several districts unite in such a process. Many regional education service agencies and some state departments of education provide this service. Suppliers are also very sensitive to comparison pricing.

- **Pay all bills promptly where discounts are available.** Some vendors provide a discount for prompt payment. The district's

finance office may have to obtain special permission from the governing board to allow timely payments where discounts apply.

- **Be aggressive in energy conservation measures.** Utilities are typically a high-cost area for smaller districts, particularly those with older facilities, which are often energy wasters. Start by asking school personnel and students to help save energy. Placing timers on heating and cooling systems can save energy when buildings are not in use. Consider requiring after-hours users of facilities to pay for actual energy costs. Conduct an energy audit and develop a plan for becoming energy efficient.
- **Join a regional education service agency or a consortium that provides special services and programs.** Such agencies may provide many cost-effective services, such as sharing specialized personnel—speech therapists, psychologists, technology staff, and purchasing agents—that often are required but not easily affordable by small districts. Forming consortia to provide programs or purchase needed goods and services makes education and budgetary sense.
- **Increase the student count.** Since most states allocate funding on a per-pupil basis, increasing attendance generates more funds, and therefore more personnel. This might be accomplished by implementing all-day kindergarten or incentives to increase attendance at all levels. One teacher can be a significant addition in a small school, especially when assigning bus, lunchroom, playground, extra-curricular, and other personnel duties.

Checklist Helps in Planning Rural Schools

“Planning Schools to Serve Rural Communities,” a new resource from The Rural Center at AEL, discusses the character of a good rural community school and briefly considers the relationships among learning, community, and facility construction in rural areas. The document also contains a checklist for the leadership of rural school districts to use in developing a community school. Listed here are items from the checklist that relate to a rural school district involved in a facility renovation or building project.

- Educators, community members, and students work together to identify needs for any new construction or renovation.
- Plans include a provision for skilled community volunteers to help construct new facilities.
- “Ownership” by the community is secured before the local board of education approves new construction.
- The school helps provide the community with access to communications technology.
- The school helps meet the leisure recreational and wellness needs of the community.
- The facility fits into the landscape. It looks like it belongs where it is located and not like it is a visitor from some other land or culture.
- The school actively seeks opportunities to use the community as part of its curriculum.
- The architect being considered by the school board has designed facilities previously that fostered healthy relationships between a school and its rural community.
- The school is or will be small enough to serve its students and community well.
- Transportation arrangements allow all students to participate in extracurricular activities, and the school is located within convenient driving distance of those it serves.

Readers may request a single copy of “Planning Schools to Serve Rural Communities” from AEL’s Distribution Center at no charge. (See the order form that accompanies this issue.)

Staffing Issues

- **Consider obtaining waivers from state certification requirements.** Teacher certifications are becoming more and more specialized, especially at the secondary level. The cost of staffing a variety of specialty areas could prohibit small, rural schools from offering some courses. Some states are allowing waivers from certification if schools can provide evidence that they can offer a course that meets state criteria. For example, in the absence of a certified physics teacher, a school might offer the course from its science teacher, who may very well be qualified, but not certified, to teach physics.

- **Obtain federal or state grants to fund key personnel.** Small, rural schools may be eligible for grants if they are in an area classified as high poverty. Grant writing may be a laborious process, but creativity and resourcefulness is synonymous with rural folks. Grants for special-needs students and for enhancing the school's curriculum enrich the entire school.
- **Redirect district funds to the school's priorities.** The value of planning and prioritizing is well known to small school systems. Limited resources require directing funds toward the schools' major objectives. Involving school staff in developing such goals and objectives can put schoolwide support behind the allocation of limited funds.
- **Increase use of community volunteers for nonteaching duties.** Rural schools are also community schools. Getting help from volunteers to perform nonteaching duties frees up time for staffs who probably are already overburdened and saves money for the district in some areas.

Extracurricular Activities

- **Pay teachers a supplemental salary to perform extracurricular duties.** Supplemental pay rarely equals the teacher's regular

rate, but the additional money is appreciated, and it conveys value for the teacher's time. Students benefit greatly from the extracurricular activities in a small rural school.

- **Provide students with transportation to participate in after-school activities.** Rural districts often have students who must travel long distances to get to the school. An activity bus that runs on a scheduled route after school throughout the district enables many students to participate without placing a hardship on their families.
- **Allow students to participate at other schools in the district.** Small rural schools find it difficult to offer a wide range of sports for boys and girls, and some schools may not have enough students to even support a sports program. Combining sports programs allows for expansion of offerings, enhances the quality of the teams, and provides opportunities that may not otherwise be possible.
- **Use community volunteers to conduct activities.** Community members sometimes are willing to support their school's activities. Small rural schools rarely have the personnel to support all the activities needed to meet student interests. Community members can fill this void to enrich the curricular and extracurricular experiences of students in accordance with state and county guidelines.

"Redesign" of Urban School Districts Calls for State Policies That Encourage Local Efforts

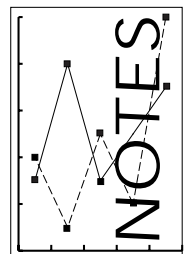
Without abandoning the popular "local control" aspect of education decision making, state-level policy makers have an important role to play in addressing the chronic poor performance of urban school systems.

"The urgency of the matter and the complexity of the issues require new kinds of collaboration between city and state, coupled with new kinds of policy," write researchers at the Education Commission of the States. A publication from ECS outlines several key policy initiatives state policy makers can invoke

to help educators redesign urban districts.

The researchers consider initiatives that pertain to four categories: governance, funding, school choice, and accountability. In describing various options, the researchers emphasize how policy makers can encourage and empower the efforts of those more closely involved—teachers, parents, and students—rather than supplanting or overlooking "local" input and responsibility.

The authors acknowledge that "no state has yet undertaken a full partnership with an



urban district to bring about systemic changes” to drastically improve learning opportunities for students.

However, they continue, the large-scale restructuring efforts currently underway in three urban school districts—Baltimore, Chicago, and Minneapolis—offer both state and city leaders opportunities to investigate, monitor, and become aware of successful strategies that can help them pursue “the next crucial

stage of urban school improvement.” In-depth profiles of the three districts are included in the publication.

To Order: *Redesigning the Urban School District* is available from the Education Commission of the States, 707 17th St., Suite 2700, Denver, CO 80202-3427; (303)299-3692 (cite order no. UE-97-4, 16 pages, \$6.50 plus postage and handling, prepaid).

Time and Money Lacking for Teachers to Use Performance Assessments Effectively

Based on interviews with teachers, reading specialists, and supervisors in one state that administers performance assessments to students, researchers Peter P. Afflerbach, Janice F. Almasi, John T. Guthrie, and William D. Schafer conclude that several barriers are making it difficult to implement the changes in instruction and curriculum that are needed to make the most of performance assessments.

Foremost among them is a lack of time and money. Teachers were especially concerned about not having enough time to plan with their colleagues or to discuss their experiences with each other. They also claimed they don’t get enough inservice training to help them learn how to make the changes.

Performance assessments in reading—those that require students to demonstrate reading comprehension by writing essays and completing other open-ended tasks—are heralded by many states as a way to drive changes in reading instruction and curriculum. But even as more and more states require schools to administer performance assessments, their failure to provide financial and other types of support threatens successful implementation of curricular improvements.

“The participants in this study made clear the fact that change takes time, and change as massive as redesigning curriculum in accordance with a performance program requires considerable efforts and expenditures,” summarize the researchers.

Some of the teachers added that their state’s education department never explained the purpose or nature of the assessment. Nor did it explain how teachers and schools were to move students toward performance assessment goals. The researchers note that, although this may be because the state wanted to encourage local control over the change, their study “did not detect a communication system that could support such an arrangement.”

To Order: *Barriers to the Implementation of a Statewide Performance Program: School Personnel Perspectives* was produced by the National Reading Research Center, University of Georgia, Athens, GA 30602-7125. The document is available from ERIC Document Reproduction Service, 7420 Fullerton Rd., Suite 110, Springfield, VA 22153; 800/443-3742; document no. ED392020; \$8.16 plus \$3.75 shipping prepaid.

To Prepare High School Students for Work, Target Services to Students' Total Needs

Despite the roles that apprenticeships, school-to-work partnerships, and career education play in preparing students for work, let's not forget about the most basic factor: keeping students in school. Increasingly, this may translate into providing child care, transportation, and other general services in addition to more specific career and job-related programs.

A new publication by the National Center for Research in Vocational Education describes a complete model of school services that helps students stay enrolled and succeed in school. The research-based model, created by Carolyn Maddy-Bernstein and Esmeralda S. Cunanan, responds to the range of students' needs before, during, and after high school.

Basic services included in the model are: (1) counseling to target student achievement, self-esteem, and other factors that affect post-graduation plans; (2) psychological services that enable school staff to place students in appropriate programs; (3) social work services that may offer students help with personal problems; (4) school-based health services that treat students and provide preventive health information; (5) child care assistance to enable student-parents to finish high school; (6) transpor-

tation to and from school; (7) community-based services; and (8) food to ensure a constant source of nutrition.

Before students enroll in high school, the researchers recommend that junior high staff make students and parents aware of educational opportunities and programs; assess students' learning styles, career interests, and aptitude; and help students become aware of careers and initially explore them.

These kinds of services can function as a prelude to more traditional academic advising, skills evaluation, career education and planning, mentoring, and job placement assistance. Further, schools can opt to continue job placement and follow-up on careers of former students to "gain valuable information that may be used in evaluating program effectiveness and for program improvement," say the authors.

To Order: *Student Services: Achieving Success for All Secondary Students* is available from the National Center for Research in Vocational Education, Materials Distribution Service, Western Illinois University, 46 Horrabin Hall, Macomb, IL 61455; 800/637-7652 (cite order no. MDS-1007, 58 pages, \$6.50 prepaid).

Funding, Personnel Constraints Limit Reform Program Dissemination

The "key limitation" in implementing schoolwide reforms is "the limited national capacity to provide schools with well-researched models backed by networks of trainers, demonstration schools, materials and other requirements," the Center for Research on the Education of Students Placed at Risk concludes.

Researchers Robert E. Slavin and Nancy A. Madden discuss efforts to disseminate the center's "Success for All" model of schoolwide reform. Designed for schools educating many at-risk children, Success for All combines an innovative reading curriculum for early grades with family support teams and extensive professional development. The researchers are the architects of the program. The program is now

in about 450 elementary schools nationwide.

Success for All, like many schoolwide reforms, requires a solid commitment to professional development and significant financial support. Districts usually start their efforts in high-poverty schools that have substantial Title I funding.

The authors describe how their experience in disseminating the program offers some widely applicable lessons about professional development and school reform. Their experience suggests that the two crucial components of a successful dissemination effort are a corps of "talented, dedicated trainers" and local and national networks of schools that can provide

“technical and emotional support” to each other.

According to the report, the center has found it difficult to recruit enough trainers to meet demand, even with the addition of trainers working in other parts of the country and at three regional training centers. The authors discuss the difficulties and successes they encountered in recruiting regional laboratories, universities, and other education institutions as partners.

They call for greater federal support for re-

search, dissemination, and professional development, and giving school-level staff control over some professional development funds.

To Order: *Scaling Up: Lessons Learned in the Dissemination of Success for All* is available from the Center for Research on the Education of Students Placed at Risk, Johns Hopkins and Howard Universities, 3003 N. Charles Street, Suite 200, Baltimore, MD 21218; 410/516-8808 (33 pages, \$6.50 prepaid).

Performance Assessments Highlight Student Reasoning and Thinking in Science

Beyond evaluating students’ mastery of desired knowledge and skills, performance assessments reveal students’ reasoning and thinking processes, giving teachers valuable feedback that can inform their instruction, says a publication by the National Center for Research on Evaluation, Standards, and Student Testing.

Researchers Gail P. Baxter, Anastasia D. Elder, and Robert Glaser observed fifth-graders taking a science performance assessment. The assessment required students to identify which components of electrical circuits were inside several “mystery” boxes. Students did so by connecting each box to batteries, light bulbs, and/or wires and watching for expected results.

Students who performed well on the assessments scientifically tested their hypotheses and demonstrated their understanding of electrical circuits. For example, Carlos connected each box with a battery and a bulb and, based on the outcome, knew which components to test next. Because he knew that the boxes could contain either one or two batteries—and that two batteries would make the test circuit’s light bulb glow more brightly—Carlos created an external

circuit to compare the relative brightness of all the bulbs.

In contrast, students with a more limited understanding of circuits engaged in trial and error, randomly hooking components up to each box. Raymond, for example, only connected a bulb in the circuit to each box but “did not appear to recognize the limitations of his approach,” the researchers observed. His actions tell the teacher that Raymond didn’t understand how to test the boxes in a scientific manner.

Performance assessments “highlight opportunities for instruction to foster reasoning and thinking with acquired knowledge Activities that differentiate more from less proficient performance can support the development of thinking and reasoning in the elementary science classroom,” the researchers assert.

To Order: *Assessment and Instruction in the Science Classroom* is available from the National Center for Research on Evaluation, Standards, and Student Testing, 10920 Wilshire Blvd. #900, University of California, Los Angeles, CA 90024 (cite report no. TR-418, 17 pages, \$2.50 plus shipping and applicable sales tax; call Kim Hurst at 310/206-1532 for information).

Early Childhood Institute Releases *Including Your Child* Booklet and Developmental Progress Chart

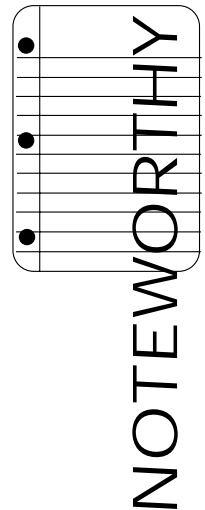
Families of children with special needs often have questions about how to help their children and may not always know where to go for answers. A new publication from the U.S. Department of Education's National Institute on Early Childhood Development and Education can lead families to people and places that can help. The easy-to-read book, *Including Your Child*, covers the first eight years of a child's life and contains:

- hints to help in the search to meet a child's special needs;
- a developmental progress chart that gives general milestones in a child's development between one month and five years of age;
- an extensive resources section that includes associations and organizations, hotlines, In-

ternet sites, parent training and information centers, federal agencies, and state government information; and

- information about laws that have been passed to help get the supports and services a child may need.

Single copies of the book and poster are available free on a first-come, first-served basis from the National Library of Education, 800/424-1616; fax 202/219-1696. Additional copies of the book and paper are available from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (stock number 065-000-00993-5, \$10; 25% discount for orders of 100 or more); credit card orders by fax: 202/512-2250. The booklet is also available at <http://www.ed.gov>.



Exemplary Professional Development Programs Sought

The nation's Regional Educational Laboratories are providing assistance to two efforts to identify exemplary professional development programs—one by the U.S. Department of Education, and the other by the National Staff Development Council.

U.S. Department of Education

U.S. Secretary of Education Richard Riley announced November 6 that the department is seeking applications for its National Awards Program for Model Professional Development. Part of an ongoing effort to identify and honor excellence in education, the program recognizes schools and school districts that provide exemplary professional development opportunities for teachers and other educators.

The department is seeking exemplary models of professional development based on identified needs of a school or district as described in its goals and objectives. Applicants must demonstrate a link between their goals, professional development activities, changes in instruction, and improved student learning. The experiences of the recognized programs will be disseminated nationally to assist others.

Principles of Professional Development*

- Focuses on teachers as central to student learning, yet includes all other members of the school.
- Focuses on individual collegial, and organizational improvement.
- Respects and nurtures the intellectual and leadership capacity of teachers, principals, and others in the school community.
- Enables teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards.
- Promotes continuous inquiry and improvement embedded in the daily life of schools.
- Is planned collaboratively by those who will participate in and facilitate that development.
- Requires substantial time and other resources.
- Is driven by a coherent long-term plan.
- Is evaluated ultimately on the basis of its impact on teacher effectiveness and student learning, and this assessment guides subsequent professional development efforts.

*The Principles of Professional Development were developed through a public process to ensure that the Department of Education's efforts in professional development reflect the best available research and exemplary practice.

Applicants will be expected to address the Principles of Professional Development (see box), which were developed through a public process to ensure that the department's efforts in professional development reflect the best available research and exemplary practice.

Eligibility is open to public and private schools and school districts where professional growth is an integral part of school culture and where the needs of all students are addressed. Up to ten winners will receive cash awards and be recognized at a ceremony in Washington, D.C. Applications can be obtained by contacting the department: Fax 202/219-2198; e-mail Sharon_Horn@ed.gov; or by downloading the application from the department's or (www.ed.gov) or AEL's Web site. **Completed applications must be received by January 15, 1998.**

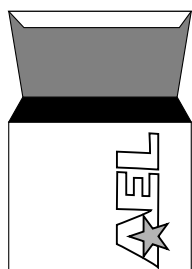
National Staff Development Council

The National Staff Development Council's (NSDC) Results-Based Staff Development for the Middle Grades Project is seeking exemplary staff development programs. NSDC will publish a resource publication that recognizes programs that have resulted in increased student learning. Content-based, middle-level (grades

5-8) staff development programs in language arts, mathematics, science, and social studies will be considered. Complete descriptions of programs and results for students may be submitted by schools, school districts, universities or colleges, states, or other agencies for consideration by the National Advisory Panel. Exemplary programs meeting the established criteria will be included in a guide to be released in 1999 that will help others replicate or adapt the successful ideas in their settings.

NSDC is working in partnership with the National Association of Secondary School Principals, the National Council for the Social Studies, the National Council of Teachers of English, the National Council of Teachers of Mathematics, the National Middle School Association, the National Science Teachers Association, the Regional Educational Laboratories, and ERIC.

For more information, contact Joellen Killion, Project Director, Results-Based Staff Development for the Middle Grades, 10931 W. 71st Place, Arvada, CO 80004-1337; 303/432-0958; Fax 303/432-0959; killionj@aol.com. The Program Nomination Form can be found on AEL's Web site at: <http://www.ael.org/rel/schlserv/modpgms.htm>. **Descriptions are being accepted through December 1998.**



INSIDE

Meaningful School-to-Work Experiences for Youth in Small, Rural Communities? YES, it can be done!

A new publication from the ERIC Clearinghouse on Rural Education and Small Schools (ERIC/CRESS) at AEL documents education practices that hold promise for rural communities struggling to survive in economically and socially difficult times. *Finding Their Own Place: Youth in Three Small Rural Communities Take Part in Instructive School-to-Work Experiences* was developed by ERIC/CRESS, in collaboration with the Education and Work and the Rural Education programs at Northwest Regional Educational Laboratory.

Citing the successful experiences of the three communities, authors Bruce A. Miller and Karen Hahn challenge common beliefs about the lack of opportunity for rural youth to participate in meaningful and instructive

school-to-work experiences in their own communities. But to create such opportunities, they emphasize that schools, community members, and policy makers must work together. Miller and Hahn describe how the three programs succeeded and offer timely advice to other small, rural communities considering similar endeavors.

The publication is divided into three sections: Chapter 1 briefly reviews the research on school-to-work issues, focusing on how the unique qualities of rural communities create special challenges for the development and implementation of school-to-work programs.

Chapters 2 through 4 present portraits of three rural schools that have worked closely

with their communities to engage youth in experiences that benefit their communities and prepare youth to be productive members of a democratic society.

- Liberty Bell High School is located between two small towns in the state of Washington, with a combined population of less than 1,000. Yet, every year for the past six years, the community has offered more than 200 courses for youth, ranging from investment banking to wildlife biology to ski patrol.
- Students in Saco, Montana, teach evening computer courses to members of their small, remote community of less than 250 people. Additionally, although only 64 junior- and senior-high students are enrolled at the school in Saco, they learn about other parts of the country by participating in more than 50 field trips every year, including state and national conventions, music festivals, academic competitions, and training programs.
- In Broadus, Montana, students participate in a rural development course in their county high school (total enrollment 180), which helps them assume active roles in community council meetings and task forces that have resulted in successful development projects.

The conclusion of each portrait includes a discussion of how lessons learned in these communities can be applied in other locations.

Chapter 5 addresses the importance of policy development as a tool for garnering support for school-to-work program development and for helping sustain innovative changes.

This resource can help rural schools and communities—especially those that are remote and small—think about new ways of collaborating.

- Educators will learn about promising practices for school-to-work programs and how schools and communities can work together to better meet the needs of youth. They will also discover strategies for linking and integrating community-based learning opportunities with academic subjects.
- Administrators will learn the importance of building a strong support base for bringing about school reform. They will also find suc-

cessful strategies for sustaining the changes over time.

- Community development practitioners will learn to see the school as an important player in addressing community needs.
- Community members—parents, students, and other residents—will gain a greater appreciation and understanding of what it means to live in a rural setting. They will learn how academic goals can be achieved through community-based learning experiences and expanded through distance technology.

Ordering information: *Finding Their Own Place: Youth in Three Small Rural Communities Take Part in Instructive School-to-Work Experiences*, by Bruce A. Miller and Karen Hahn, is available from the ERIC Clearinghouse on Rural Education and Small Schools (ISBN 1-880785-18-8, 114 pages, 1997, \$12.00). (See the order form that accompanies this issue.)

AEL Establishes Outreach Locations In Virginia and Tennessee

In an effort to further develop and strengthen linkages between educators and AEL's resources, two outreach locations have been established in the Region. An AEL satellite office in northern Virginia opened in September; the first AEL resident director position was created in Tennessee at about the same time.

The decision to open a satellite office in northern Virginia was motivated by a desire to enhance AEL's offerings to the more urban areas of the Region. The close proximity to metropolitan areas opens opportunities for building alliances with universities, associations, and individuals expert in serving the needs of nonrural schools. The location also puts AEL in a position to compete for resources dedicated for urban areas, enhancing the capacity to serve all clients in the Region.

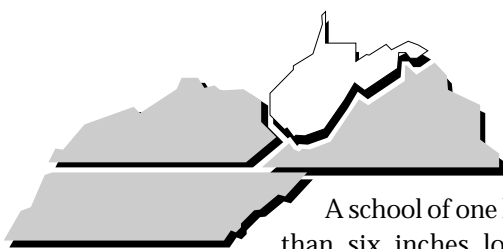
The new office—AEL • Arlington—is located in the Rosslyn Metro Center, 1700 North Moore Street, Suite 1275, and can be reached by calling 703/276-0200 or 800/624-9120. Pamela K. Buckley is director of the Arlington office. Both the Eisenhower Regional Consortium for Mathematics and Science Education and the Region IV Comprehensive Technical Assistance Center operate from the new northern Virginia location.

Peggy F. Harris fills the newly created position of Resident Director for Tennessee. Harris is a former member of AEL's Board of Directors, serving a term as AEL president, and most

(continued on page 12)

Fish Gotta Swim in Model Agricultural Science Program

By Topper Sherwood



FOCUS ON INSTRUCTION

Featuring articles about teachers in the four AEL states—this issue, West Virginia

A school of one hundred trout, none more than six inches long, snaps at the flakes dropped into their tank by teacher Tracy Stutler. It's a rarity that Stutler is feeding the fish today. His students carry the keys to Charles Town Junior High School's new aquacultural laboratory, and they maintain their own schedule for year-round feedings and water-quality readings. In return, the fish—swimming in a complex bio-system supported by pumps, air filters and electronic monitors—have helped Stutler's students win more than 30 science awards during the project's initial two years.

"It's been exhilarating," says Stutler. "It's extremely exciting to see the students get so engrossed in what they're doing..." Stutler and his students initiated the aquaculture project during the summer of 1995, after he'd taken part in a series of inservice seminars on "Using Aquaculture in the Classroom," offered by West Virginia University.

"I went in with a mild sense of curiosity," he recalls. "By the third or fourth class, I decided I just had to do this."

Stutler saw the lab as a means of incorporating "real-world" problems into the curriculum, while boosting interest in a struggling agricultural science program. He and his students were soon on the road, visiting other labs and aquatic

research stations. With the help of a \$1,500 grant from a local agricultural-extension agency, they were able to build their own laboratory in a small, isolated room of the school. Materials and expertise were supplied by a nearby Department of Interior fisheries center and a local environmental-research outfit.

"We were all new to this," remembers former student John Aliucci. "We were just getting our feet wet...literally."

The result is a home for hundreds of fish. Four 150-gallon tanks are joined by a web of pipes and tubing leading to a system of aeration pumps and filters. The apparatus is meant to mimic natural conditions for the trout and several schools of hybrid striped bass, all test subjects for seafood production. Stutler and his students vividly recall summer 1995, when they'd hooked everything together and the first bass arrived—three hundred of them, shipped in huge plastic bags, packed in foam-insulated crates by a supplier in Arkansas.

"The freight cost more than the fish," notes Aliucci, drawing a nod of agreement from fellow student Todd Wilt.

"The plane ticket was a killer," Wilt continued. In fact, the plane ride itself had been fatal to some fish. Others did all right for a few days, but then large numbers of them began going belly-up. ("You learn not to be personally attached," says Wilt philosophically.) The event sent students scrambling for information with an energy that holds them to the project today.

"It was stressful conditions," says Wilt of the dying bass. "They weren't adapting to the new environment."

The stress of relocating, he says, made the fish more susceptible to disease, including particular bacteria to which they are prone. The students launched more biochemical experimentation, treating the water first with potassium permanganate and later with salt solutions. Aliucci's research explored the limits of the new lab's biofilter, to see under what conditions it might be overexerting itself. (He's now exploring questions of water temperature.) Wilt did a

Tracy Stutler feeds a school of trout while Todd Wilt and John Aliucci look on.

student T-test to see whether the fish might improve their condition with exercise. He constructed an independent tank, in which he taught a group of bass to swim through a maze for food. After a regimen of “water aerobics,” Wilt was able to measure the oxygen-carrying capacity of the animals’ blood, comparing the results with that of a control group.

“The fish that exercised became better able to handle stress,” he concludes, pointing to the numbers that back it up. “They have a stronger immune system and can tolerate a higher level of exertion.”

All this involved a complicated line of inquiry, and supplied Wilt and Aliucci with science projects that helped them sweep several competitions and come up with papers that are just this side of publishable, according to their advisors. Altogether, the aquaculture lab incubated four science projects the first year, winning six awards at the local and regional levels. The second year, six agri-science projects won twenty-eight awards, including thirteen first places, and four Overall Grand Project Awards, with invitations to the International Science & Engineering Fair (for Wilt) and the National Agri-Science Competition (for Wilt, Aliucci, and several others). Aliucci was invited to present his analysis of the lab’s “closed-loop” bio-system to the West Virginia State Science Symposium, an honor normally reserved for high-school students.

“These kids are doing just extraordinary work,” says Wilson H. White III, head of the school’s math department. White scans the lab data for real-life math problems for his own students—problems involving volumes, dimensional analysis, and rates of flow. Miscalculation, he reminds the young people, could have dire consequences for hundreds of fish.

“Teachers need to realize that mathematics is a tool,” says White. “Unless you apply it to something that’s *real*—something that’s important and practical—it’s just not much fun, and it’s not very interesting.”

Others are getting use from the laboratory as well. Chemistry students are testing the fishes’ “turf” for nitrates, oxygen, and alkalinity. The

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Topper Sherwood is a freelance writer and publisher of educational resources in Martinsburg, West Virginia.

Eight Tips for Building Your Own Research Lab

- Start with a subject you know and love. It’s hard to generate enthusiasm for something in which you have little or no interest.
- Scan your community/state for resources—granting programs, industries, etc., that might be relevant to your subject and project.
- Don’t overlook that technical/vocational/“real-world” connection, including agricultural-extension offices. This can make project more interesting to students.
- Visit another facility, a role model, that will help you learn how easy or difficult your goals are. If you think you need more than one point of view, visit another facility.
- Get names of people who can offer potential resources. Learn about what they are doing and talk to them.
- Don’t be afraid to seek funding and spend it on your project. In some cases, a \$300 minigrant might be enough to get you started.
- Establish a track record, and look for opportunities to expand.
- Contact the Eisenhower Regional Consortium for Mathematics and Science Education at AEL about its technology minigrants of up to \$1,000 for classroom teachers in AEL’s four states.

Aliucci demonstrates the work of the aquaculture lab’s biofilter. Wilt is in the background.

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recently served as interim head of the Department of Psychology at Tennessee State University. Earlier employment includes 29 years with Metro Nashville Public Schools as a teacher, school psychologist, and program evaluator. She knows both Tennessee education and AEL well. In her role as resident director, Harris is in ongoing communication with AEL developers and implementors and acts as an on-site liaison for effectively linking AEL resources with Tennessee's education efforts.

Harris, the first AEL employee to serve full-time in Tennessee, can be contacted in her Nashville office at 615/386-9642 or by voice mail at 800/624-9120. A permanent office location has not yet been established but is a possibility as the resident director position develops.

AEL's home office continues to be in Charleston, West Virginia. Information about AEL, its programs, and services is available by calling 800/624-9120, by e-mail at aelinfo@ael.org, or by visiting AEL's web site at <http://www.ael.org>.

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lab's bio-pump and filtration system offer lessons in physics, while expired members of the species are examined in biology classes. Students work up all statistical information with help from White, who teaches them how to grind out usable data from school computers.

"We hope the new lab will allow us to branch out," Stutler said, adding that aquaculture is the fastest-growing area of agriculture. He envisions more projects—including student-run businesses—in trout, bass, baitfish, freshwater shrimp, eels, and especially ornamental koi. Ornamental fish and aquatic plants account for nearly 70 percent of the aquaculture industry in nearby Maryland, whose aquaculture industry increased from \$7 million in 1990 to an estimated \$18 million four years later.

The students' enthusiasm and achievement are paying off, both in terms of their education and winning support for their lab. They recently hosted county school board members at (what else?) a school fish-fry.

"The students showed the board some of their projects," Stutler smiles. "They can put on quite a show."



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