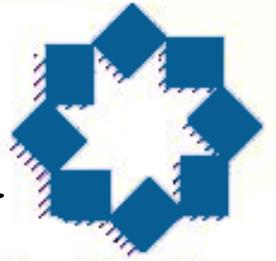




STEM Ed



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The STEM Education Institute continues to evolve. Some of our current programs are winding down, but others have started, and more proposals are pending for additional support.

Our biggest and longest running program is the Science, Engineering, Mathematics, and Technology Teacher Education Collaborative (STEMTEC). It was designed to prepare more and better trained math and science teachers and is now in its eighth and nominally final year. However, we expect that the NSF funds remaining will permit the continuation of the new teacher support programs for an additional year. The NSF/GK12 STEM Connections program which places STEM graduate student fellows in middle school classrooms also ends in May 2005.

The 2003-2004 academic year saw the start of STEM Adventures: Saturday morning programs for Girl Scout troops. In March 2005, we ran a conference in the Washington D.C. area for the principal investigators of three kinds of NSF teacher preparation programs. We also undertook the task of developing a web-based Guide to Teaching Renewable Energy for the Massachusetts Technology Collaborative. This project will continue.

Our newest program is the NSF funded STEM Bridge for Noyce Scholars. This will provide a total of \$500,000 in generous scholarships for undergraduates preparing to become science or math secondary teachers. The first awards will be made for the fall, 2005 semester. When added to the earlier STEMTEC and STEM Connections funding, we have received over \$2,500,000 in funding for scholarships and fellowships in support of STEM education since 1998. Finally, we are participating in the new PV STEMNET collaborative and have received some funding from the Board of Higher Education Pipeline program to help support the Science and Engineering Saturday Seminars.

More information on these programs is in this newsletter. ■

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UNIVERSAL DESIGN FOR LEARNING WORKSHOP

On Saturday, December 4th, Mary A. Moriarty will present a workshop on Universal Design for Learning aimed at a higher ed and k12 audience. UDL is based on the premise that alternatives to traditional instruction and assessment will serve to enhance learning for individuals from diverse backgrounds as well as for those with a range of abilities and disabilities.

Her topics include the changing nature and demographics of students in higher education, the theoretical constructs of UDL, practical and technological UDL applications, and

teaching strategies. An interactive component for evaluating curriculum for UDL will also be included.

Ms. Moriarty is the NSF/DOE Project Director and ADA Coordinator at Springfield Technical Community College. The free session is 8:30 -1 at UMass Amherst. Directions will be sent to those who register.

To register or for more information, please contact Irene Starr: istarr@umassk12.net or 413-545-0734. ■

Pathways 2004

One of the problems with doing something well is that you get asked to do it again. Basically that is how Pathways 2004 came about. Included in the original STEMTEC proposal written in 1996 was a commitment to sponsor an international conference. This conference evolved into Pathways to Change 2002, An International Conference on Transforming Math and Science Education in the K16 Continuum. This combined the promised international meeting with the annual meeting for Principal Investigators of projects like STEMTEC which were part of the NSF Collaboratives for Excellence in Teacher Preparation (CETP) program. The conference was so successful that nobody volunteered to host a PI meeting in 2003.

As a result, we were invited to submit a proposal to host the 2004 PI meeting for the CETP and two other programs, Science, Technology, Engineering, and Mathematics Teacher Preparation (STEMTP) and Advanced Technological Education (ATE). The conference was held March 14-15, 2004 at the Doubletree Hotel, Crystal City, Arlington VA, the same site as Pathways 2002. About 125 people attended, and 50 papers were presented.

Again, evaluations of the conference were very positive. A major reason the conference went so well was the excellent work done by Marie Silver, who rejoined us temporarily; our former project manager, she is now at the Children's Museum in Holyoke. She was ably assisted by graduate assistant Paula Valencik. They had managed Pathways 2002 and knew exactly what to do.

The conference agendas and proceedings for both meetings are available at www.stemtec.org/pathways. ■

STEM BRIDGE FOR NOYCE SCHOLARS

We are pleased to announce that a major new scholarship program, STEM Bridge for Noyce Scholars, has been funded by the National Science Foundation. This project is a joint effort of the UMass School of Education and STEM Ed. The lead Principal Investigator is STEM Ed Associate Director Allan Feldman (Science Education); co-PI's are Mort Sternheim (STEM Ed), Farshid Hajir (Mathematics), and Portia Elliot (Math Education).

The Robert Noyce scholarship program is named in honor of the co-founder of Intel. It seeks to encourage talented science, technology, engineering, and mathematics majors and professionals to become K-12 mathematics and science teachers. The program provides \$500,000 over three years to support scholarships, stipends, and programs for students who commit to teaching in high-need schools. Specifically, they must agree to teach two years in such a school for every year they receive funding.

STEM Bridge for Noyce Scholars will award 52 scholarships averaging over \$8000 a year to juniors and seniors majoring in science or math who are enrolled in UMass secondary teacher preparation programs. Special efforts will be made to recruit minority and nontraditional students by working with the community colleges and with the University Without Walls (UWW) at UMass.

STEM Bridge scholars will be supported through an introductory course in math and science teaching, academic and social events, and mentors and advisors. Once they are in the classroom, new teacher support will include a New Teacher Support Group, Science and Engineering Saturday Seminars, STEM Ed seminars, and the opportunity to enroll in several innovative M.Ed. programs for math and science teachers.

More information is available at www.umassk12.net/bridge. ■

THE PIPELINE FUND

The popular Science and Engineering Saturday Seminars have a new source of funding this year: the "Pipeline Fund" administered by the Massachusetts Board of Higher Education. This is one of several Pioneer Valley projects supported by this program.

The purpose of the Pipeline Fund is "to increase the number of Massachusetts students who participate in programs that support careers in fields related to mathematics, science, technology, and engineering . . . to increase the number of qualified mathematics, technology, engineering and science teachers in the Commonwealth, and to improve the mathematics, technology, engineering and science educational offerings available in public and private schools."

Last spring the Board of Higher Education made seven small grants that facilitated the creation of regional PreK-16 Networks spanning the state.

These support the collaboration of higher education, PreK-12, businesses, and non-profit agencies for the improvement of math and science education. This led to the formation of the Pioneer Valley PreK-16 Science, Technology, Engineering and Mathematics (STEM) Education Regional Network (PV STEMNET). STEM Ed is one of the more than 40 participants in this network. UMass is the lead partner, and STEM Ed Associate Director Allan Feldman is the contact for the network.

The networks were invited to submit proposals for the current academic year that would fund activities in support of the announced goals. PV STEMNET received strong reviews for its proposed agenda, and an award of \$261,966. This includes \$15,000 for the Saturday Seminars.

More information about PV STEMNET and the Pipeline Program is online at www.umassk12.net/pvnet. ■

With more than 500 students and teachers attending the end-of-year project conference on campus, the second year of the UMass version of the National Science Foundation's Graduate Students in K-12 Education drew to a close. As John Mullin, then the vice-chancellor for outreach put it, "I've never experienced so much energy in a room of students." For the success of this particular event we are grateful to a large number of people, but especially the Project Manager, Sharon Palmer, who made things happen at very short notice, and PI Kathy Davis who persuaded Chancellor Lombardi to underwrite the event to the tune of several thousand dollars.

As in our first year, 10 science graduate students spent up to 10 hours a week working alongside one elementary school teacher, 12 middle school teachers and two high school teachers (see Table I, page 4) while involving several hundred students in inquiry-based learning through hands-on investigations of questions related to five environmental themes. Each theme involved one or more UMass faculty members as content experts. In addition, the teacher participants and most of the Fellows met regularly as part of Education 795, "Project-Based Instruction," taught by PI Kathleen Davis with assistants Tarin Weiss and Hongqin Zhang.

With the benefit of our experiences in year one, we made a number of improvements: a streamlined methods course for the fellows (thanks to Instructors Jack Czajkowski, Jeff Kenney and Sheila Zabko); a two-week workshop for the fellows, teacher-scholars and faculty; and a speedier start to getting the program going in the schools.

Joe Kunkel, a faculty participant, summarized the essence of the program in his description of his team's activities: "The STEM Connections project creates an exchange of teachers and graduate students between UMass and Springfield Middle Schools. The objective is to provide models of scientists to the multicultural environment of the K-12 City School. Multicultural aspects are a focus of discussion in the planning

and execution of this program. One of the Teacher Scholars in my group is Stan Coly, a teacher at the Robert M. Hughes Academy Charter School in Springfield. Another Teacher Scholar in my group is Angela Ducharme who teaches at the Chestnut Accelerated Middle School in Springfield.

"I visited both schools for an entire academic day, giving an interactive workshop on echinoderms and an introduction to hypothesis testing. Stan's classes visited my lab at UMass to see how university research is done.

"We developed a website for the 2003-04 and 2004-05 academic terms which illustrates our exchange of ideas about how to do science. The URL is <http://bcrb.bio.umass.edu/coursewiki/index.php/StemFellows>. This will give the faculty advisor, the STEM fellows, the teacher scholars and the Springfield students an interactive Wiki Website at which to report our activities and cooperate in telling the story of our classroom interaction. My goal is to develop a rapport among our members (faculty, fellows, teachers and students) that is bonded by our mutual interest in doing good science. This NSF funded project may address the underlying problem of lack of understanding of science in the general public at a critical point, middle school grades of multicultural inner city schools."

Teacher Scholar Tara Kisiel summarized her experiences: "The STEM Connections program allows students to integrate what they are learning in the classroom into their real life. By completing personal science investigations, the students can research and investigate their scientific interests and create their own 'need to know!'"

STEM Connections also encouraged teachers, fellows, and faculty to communicate their experiences at professional society meetings. A group presenting at the Massachusetts Environmental Education Society

meeting in Worcester in early March included: Andria Schwartz, Sharon McDonald, Steve Mangine, Kate Parrot, Diana Moore, Steve Schneider, Richard Yuretich, Uma Palreddy, Toni Reale, Laurin Seivert, Kerry Kelly, Debbie Hoppe, and Julian Tyson. Another STEM Connections group presented at the National Science Teachers Association National Convention in Atlanta in late March. This group included: Sharon McDonald, Kate Parrot, Steve Mangine, Steve Schneider, Toni Reale, Mary Seccareccia, Diana Moore, Tara Kisiel, Andrea Fidler, and Kerry Kelly.

Fellow Bobbie Coleman, 2003 Project Assistants Kelly Johnson and Claudette Giscombe, and PI Kathy Davis presented their research on the influences of Project Based Instruction (PBI) on the students' science learning and attitudes about science, at several conferences including 1) the Annual Meeting of the Association for

the Education of Teachers of Science in Nashville in January and 2) the Annual Meeting of the National Association of Research in Science Teaching in Vancouver, BC in March.

Andria Schwartz presented highlights of the STEM Connections project at the Annual Meeting of the American Astronomical Society. In May, Bobbie Coleman, Claudette Giscombe, Andria Schwartz, Laurin Sievert, Kara Belinsky, and Kathy Davis

presented key aspects of the STEM Connections project and examples of students' projects and activities at a conference on urban science education sponsored by New York University in New York City.

One of the striking features of this second year of the program is the significant increase in the numbers of students involved in inquiry-based learning activities in the various schools; close to 1500 students worked on inquiry projects in 2003-2004. In addition, several schools organized on-site science fairs or conferences, and several classes came to the campus for visits during the academic year.

"The STEM connections program allows students to integrate what they are learning in the classroom into their real life."

STEM ADVENTURES

Aided by a grant from the Vice-Chancellor for Outreach, last fall we started STEM Adventures, Saturday morning programs for scout groups. About 400 girls and adults attended one of the four programs. Each morning included two, 75-minute sessions; Amazing Physics, Chemistry Fun, and Food and the Environment were all offered one or more Saturdays. The highlight of Chemistry Fun was making especially delicious ice cream with liquid nitrogen. Snacks were a big hit too.



The girls had an exciting morning and enjoyed the hands-on activities led by UMass faculty and undergrads. For most of the girls and their escorts, it was the first time they had been on the UMass campus. We had a successful program for Cub Scouts September 2004, and two later dates for Girl Scout troops have been sold out weeks in advance. A third date has been added. More dates will be scheduled for the spring, 2005 semester.

Feedback from the children and adults has been overwhelmingly positive. Nearly every scout indicated "strongly agree" or "agree" to statements such as *I enjoyed Fun Physics* or *I would like to attend again*.

Some typical comments: *I loved the chemistry, It's my favorite subject. It was too cool for words. I liked the dancing fire. I liked the ice cream and slime. Chemistry and physics rock. Best trip I ever had! I haven't had this much fun ever. I want to come to UMass and be a physics major.*

The adults also gave very positive evaluations. They agreed that the program met their goals, was interesting for the scouts, would like to attend again, and would recommend the program to others. More information about the program and a photo gallery are available at www.umassk12.net/adventures. ■

STEM Connections: Year Two (2003-04) continued from page 3

Although NSF declined to fund any independent study opportunities for teachers this year, that did not deter one determined arsenic investigator (Teacher Debbie Hoppe) who not only continued her own studies but facilitated the participation by one of her middle school students (Leslie Rivera) in research in the Tyson lab during the summer.

We look forward to the third year of the program. The 2004-05 cohort of teacher scholars contains 14 members including several returning for a second year and seven new fellows joining three fellows continuing from the first year (see Table II). The Principal Investigators (Julian Tyson, Kathy Davis, and Mort Sternheim) are eternally grateful for the excellent administrative support provided by the Project Manager, Sharon Palmer, and the STEM Institute Secretary, Eugenie Harvey. We wish Sharon well in her new position as a chemistry teacher at Amherst Regional High School, and we welcome Irene Starr as our new Project Manager. We are grateful for the useful formative evaluation provided by Will Snyder, who continues into the third year of the program. ■

Table I 2003-2004

ARSENIC

Faculty: Julian Tyson, Chemistry
 Fellows: Bobbie Coleman, Kerry Kelley
 Teachers: Debbie Danoff-Hoppe (Forest Park MS, Springfield); Kevin Gunnison (Fairview MS, Chicopee); Robert Janik (Agawam HS); Elbert Mercado (Duggan MS, Springfield)

BIRDS & FISH

Faculty: Bruce Byers, Biology; Jeff Podos, Biology
 Fellows: Kara Belinsky, Gonzalo Mendez
 Teachers: Tara Kisiel (Van Sickle MS, Springfield); David Powell (Kennedy MS, Springfield); Joann Tratiak (W. Springfield MS)

THE EARTH AS A LABORATORY

Faculty: Richard Yuretich, Geosciences
 Fellows: Toni Reale, Laurin Sievert
 Teachers: Ronald Burney (Donahue ES, Holyoke); Uma Palreddy (Chestnut MS, Springfield); Mary Seccareccia (Fairview MS, Chicopee)

GLOBAL WARMING

Faculty: Steve Schneider, Astronomy
 Fellows: Diana Moore, Andria Schwartz
 Teachers: Steve Mangine (Elias Brookings, Springfield); Sharon McDonald (Pathfinder Voc Tech, Palmer); Catrina Paterson (Smith Acad, Hatfield)

GROWTH & DEVELOPMENT

Faculty: Joseph Kunkel, Biology
 Fellows: Andrea Fidler, Izabela Santos
 Teachers: Stan Coly (Hughes Academy, Springfield); Angela Ducharme (Chestnut MS, Springfield)

Table II 2004-2005

ARSENIC

Faculty: Julian Tyson, Chemistry
 Fellows: Bobbie Coleman, Maura Mahar
 Teachers: Debbie Danoff-Hoppe (Forest Park MS, Springfield); Uma Palreddy (Chestnut Accelerated MS, Springfield)

BIRDS

Faculty: Bruce Byers, Biology
 Fellows: James Kearns, Kathryn Lord
 Teachers: David Hale (S. Deerfield ES); Kevin Gunnison (Fairview Veterans Memorial MS, Chicopee); Kate Parrott (JFK MS, Northampton); David Powell (Kennedy MS, Springfield)

WATERSHED

Faculty: Richard Yuretich, Geosciences
 Fellows: Bree Carlson Laurin Sievert
 Teachers: Ron Burney (Donahue ES, Holyoke); Steve Mangine (Chestnut MS, Springfield); Jacob Wheeler (Mahar Regional, Orange)

GLOBAL WARMING

Faculty: Steve Schneider, Astronomy
 Fellows: Edgardo Ortiz, Lisa Provencher
 Teachers: Tara Kisiel (Hampshire Regional HS, Westhampton); Mary Seccareccia (Fairview MS, Chicopee)

GROWTH & DEVELOPMENT

Faculty: Joseph Kunkel, Biology
 Fellows: Versa Clark, Nancy Croteau
 Teachers: Stan Coly (Hughes Academy, Springfield); Maureen Keating-Lessard (Wilbraham MS)

Is it possible to include renewable energy and global warming topics in the curriculum of middle schools and high schools in an era of high stakes testing?

The Massachusetts Science and Technology/Engineering Framework is a 98-page document that lists hundreds of learning standards in earth and space science, life science, physical science, and in technology and engineering courses. That framework, as well as the frameworks for Mathematics and for History and Social Science, guides teachers as they prepare students for the MCAS tests administered by the Massachusetts Department of Education.

At first glance it would seem as if the curriculum frameworks developed by the Massachusetts Department of Education (DOE) might limit the time that teachers could devote to the study of the wise use of energy resources and the preservation of our environment. However, a STEM Ed project funded by the Massachusetts Technology Collaborative (MTC) has revealed that renewable energy and global warming topics are very compatible with learning standards of the DOE curriculum frameworks.

The guide prepared by STEM Ed is now available by visiting the MTC's website at www.mtpc.org or by going directly to www.masstech.org/2004dev/cleanenergy/curriculum/about.htm

Reviews of curriculum materials are organized into categories of renewable energy technologies, global warming subjects, and Massachusetts Learning Standards Frameworks in Science and Technology/Engineering, Mathematics, and History and Social Science.

The Review Process

Federal and state agencies, local school districts, individuals, consulting companies, professional associations, and organizations like the Northeast Sustainable Energy Association (NSEA) have published educational materials that focus, to varying degrees, on renewable energy

resources and global warming. The STEM Ed Project Team established specific criteria for educational materials to be considered for possible inclusion in the guide. It was necessary for the materials to be designed for use in middle school and high schools and the materials had to be readily available.

The STEM Project Team obtained resources that met those two criteria. A review of each resource was generated that included a listing of specific framework learning standards that could be met by using that resource. The project team's reviews were then sorted into categories and posted on the STEM Ed web site. The project team's reviews were reviewed again by teams of middle school and high school teachers. Those "reviews of the reviews" provided an opportunity for the STEM Project Team to make decisions about which resources would be included in the guide.

The Guide's Potential

The Guide to Teaching Renewable Energy and Global Warming provides a variety of resources. In addition to the review of specific curriculum materials, the guide includes a listing of organizations, agencies, vendors, and companies that can be contacted. Since many of the curriculum materials can be downloaded from an Internet website, the guide includes a listing of resources for evaluating websites. The guide also includes a separate listing of the many Massachusetts Learning Standards that can be met using renewable energy and global warming curriculum materials.

The combination of resources included in the guide serves many purposes. They provide teachers with information about curriculum materials that have been carefully reviewed by other teachers. They help teachers communicate the specific educational goals of the curriculum materials to their administrators and their school community. They indicate how the study of renewable energy and global warming can be integrated into existing programs of study.

by ROBERT SNYDER, robsnyder@hotmail.com
Robert Snyder retired in 2003 from teaching science at Brookline H.S. and is now active in STEM Ed Institute programs.

MTC's Guide to Teaching Renewable Energy and Global Warming website also reveals how organizations like the NSEA support the effort of many teachers and parents who recognize the role that middle schools and high schools can play in encouraging the development of renewable energy resources. ■

The project team included:

- Morton M. Sternheim, Director, STEM Ed Institute
- Andrew Rice, math education graduate student
- Stephen Schneider, Professor of Astronomy
- Robert Snyder, retired chemistry and physics teacher, Brookline HS
- Tarin Weiss, science education post-doctoral fellow, former Longmeadow MS science teacher
- Shelly Whalen, science education graduate student

The following teachers assisted in reviewing the materials:

- Kathi Chlanda, science and math teacher, South Hadley MS
- Mary Farrin, social studies teacher, South Hadley MS
- Thomas Gralinski, technology teacher, Amherst Regional HS
- James Kohrman, technology teacher, Northampton HS
- Lois Moulton, science teacher, Eaglebrook School
- Kate Parrott, science teacher, Smith Academy, Hatfield
- Norman Price, science teacher, Amherst Regional MS

The following people helped locate materials:

- Chris Mason, NSEA
- Will Snyder, UMass Extension
- Frank Keimeg, Geosciences, UMass
- Michael Arquin, Wright Center for Science Education, Tufts University
- Julie Johnson and Ted Watt, Hitchcock Center for the Environment
- Naka Ishii, UMass library
- Stephanie Ciccarello, Amherst Climate Action Campaign

SCIENCE AND ENGINEERING SATURDAY SEMINARS *Report*

The conventional wisdom is that professional development for teachers requires an extended program of instruction, callbacks, and other work. While there is certainly a lot to be said for this model, there is a place for a one-time workshop that introduces new materials and ideas. The Science and Engineering Saturday Seminars (SESS) offer a series of such seminars on an eclectic mix of topics.

SESS began in the spring of 2001 with funding from a Raytheon Corporation grant to the UMass College of Engineering and from the STEMTEC grant, and have been offered every semester since. They have been very popular with teachers, and a mix of new and experienced teachers continues to attend. Typically 25-35 people come each Saturday from 8:30 to 1. Funding for this school year has been obtained as part of the Board of Higher Education Pipeline grant to the Pioneer Valley network.

Workshop topics and the faculty presenting them change each semester and have included the following as examples:

- The Physics of Music. James Walker, Physics
- Engineering Catalysts. Susan Roberts, Chemical Engineering
- The World in Motion. Raytheon Engineers
- My DNA: Bringing the Human Genome Home to Everyone! Molly Fitzgerald-Hayes and Frieda Reichsman, Biochemistry
- Bird Biology. Bruce Byers and Kara Belinsky, Biology
- Drinking Water Supply and Treatment. Michael Switzenbaum, Civil and Environmental Engineering
- Kitchen Chemistry. Sharon Palmer, STEM Ed
- Bridges. Professors Susannah V. Howe and Alan J. Lutenegger, Civil and Environmental Engineering
- Global Warming and Ozone. Steve Schneider, Astronomy

There is no charge to teachers. Free educational materials are distributed, and teachers can receive Professional Development Points (PDP's) needed for recertification. An option to register for 3 graduate credits at reduced cost with additional readings and activities is offered each semester. Five sessions are held each term, plus a callback for those signed up for credit.



Learning new ways of teaching.

More than 200 teachers have participated in at least one SESS session. Many return year after year. While most of our participants teach in the Western Massachusetts area, attendees have come from as far away as Marblehead and Chatham in eastern Massachusetts. During the Spring 2004 semester, 26 teachers registered for graduate credit, and an additional 12 teachers attended one or more sessions. They represented a wide range of science teaching assignments at the middle school and high school level; two elementary teachers also participated. Teachers receiving graduate credit completed a curriculum project. Teacher reports indicate a direct impact on 1700 students this semester.

The seminars attract a mix of new and experienced teachers, as well as a few pre-service teachers. Participants report that the conversations among the beginning and experienced teachers are very useful in sharing ideas and providing advice and encouragement.

Here is the breakdown for the Spring 2004 group:

Preservice	6
1 - 5 years	19
5 - 10 years	4
11 - 20 years	6
20+ years	3

Joseph Berger, from the UMass Center for Public Policy and Administration, is currently conducting an evaluation of the program. His data are not yet available. However, the following quotes from recent focus participants illustrate their very positive reactions to the program.

"Substantive inquiry based activities, not just generalities of some workshops that just keep kids busy but lack content."

"I got a lot of help with the frameworks."

"Incredibly useful."

"Level is about right."

"Three SESS sessions led to major student projects."

"I got ideas that are simple but I had never thought of."

"I obtained and used free software for the analysis of bird songs."

"I got the opportunity to teach material a whole different way."

"Wonderful new ideas and materials integrated with frameworks."

"The relaxed pace is good."

"Sharing the final projects with other teachers is great."

"I had an opportunity to learn about UMass research, and to know the faculty and grad students."

"I like that you can choose your own project for that part of the course; it gives you time and incentive to work on something meaningful."

"The access to UMass resources is invaluable."

"It lets you keep current in other fields, gives you an idea of what is going on."

"Addresses the needs of kids directly, very concrete."

"Chris Emery (course instructor) was very useful."

Continued next page

NEW TEACHERS SATURDAY LUNCH CLUB

The support program for new science and math teachers now offers the New Teachers Saturday Lunch Club. The meetings include time to share ideas and materials, seek advice, and discuss topics of particular concern for new teachers under the guidance of veteran teachers Marlina Duncan and Janice Wing.

...share ideas and materials, seek advice, and discuss topics of particular concern for new teachers.

Topics are likely to include classroom management, lesson plans and pacing, grading, incorporating frameworks, classroom organization, assessment techniques, curriculum ideas, planning, interdisciplinary projects, MCAS preparation, professional development, and resources.

Four dates are scheduled for fall 2004: October 2, October 16, November 13, and December 11. The location is UMass Amherst, at 1 p.m. The meetings immediately follow the Science and Engineering Saturday Seminars (www.umassk12.net/stem/sessf04.html) for the convenience of those who wish to attend both the seminar and the Lunch Club. There is no fee, and parking on the UMass campus is free and plentiful on Saturday. More details are at <http://stemtec.org/newteacher/>, or contact Irene Starr at 545-0734, istarr@umassk12.net. Separate reservations are required for both the seminars and the Lunch Club.

The club welcomes first, second, and third year science and math teachers and, in the case of elementary schools, new teachers who are especially interested in math and/or science education. ■

SCIENCE AND ENGINEERING SATURDAY SEMINARS Report continued from previous page

It is well known that in spite of a teacher's membership in a greater school faculty, teaching is an isolating profession. In light of this, these comments made by SESS participants in the wrap-up workshop for the Spring 2004 Seminars are notable. When asked about the most important thing they learned in the workshop, teachers replied:

"Shared curriculum ideas and constructive criticism concerning our projects."

"I had good discussions with other teachers about instructional approaches and concerns."

"Time to share idea at a professional level is lacking as part of the regular working day for teachers. This was a great opportunity for us to do that."

Each individual seminar is evaluated by the participants. Here are typical remarks about one of the sessions this term:

"This was a relevant and interesting seminar that is directly and realistically applicable."

"This was fantastic, fun and informative, I would do all of these activities with my classes."

"The seminar provided good hand-outs and hands-on activities. Thank you!"

From the project report of a recent SESS teacher:

"Two years (3/2002) ago STEMTEC offered a Saturday Seminar on flight, presented by two representatives from Raytheon Company. Participants designed, built, and tested gliders that were to meet specific challenges such as a barrel roll (360 degree horizontal loop), longest flight, and a 360 vertical loop. The only catch was that participants had to use the same fuselage in all the tests, although wings were allowed to be interchangeable to meet the different challenges. As a Technology Education/Engineering teacher I found this presentation and topic extremely inspiring. The result was I would later develop lesson plans regarding flight, make good connections with the SAE Foundation and eventually incorporate a flight unit into my 7th grade curriculum at the JFK Middle School.

"As with all lessons there are strong points and weak points. Although I enjoy teaching my flight unit and realize that it has been quite successful with my students over the past year and a half, I have always felt there was something lacking.

"It wasn't until I sat through the Saturday Seminar on Bird Biology that I realized what was missing. I wasn't explaining to students what keeps an aircraft in the air. As I sat through the Bird Biology class the name of Daniel Bernoulli and

It wasn't until I sat through the Saturday Seminar on Bird Biology that I realized what was missing.

Bernoulli's Principle or Law was mentioned. It came forth that Bernoulli (18th century Swiss mathematician) was fascinated with the flight of birds and would later spend a great deal of time studying and discovering what exactly it is that keeps a bird aloft.

It was also his findings (Bernoulli's Law) that would later be applied to the development and success of the first flying machines. Therefore, I decided that the following lesson plans (not included here) would be used to enhance my original flight lessons and hopefully students would leave my classroom with a more thorough understanding of not only the properties of a plane, but a comprehension of what actually enables those heavy machines to stay in the air." ■

BUILDING A BRIDGE FOR FEMALES TO EQUITABLE, INCLUSIVE, AND PARTICIPATORY SCIENCE ACTIVITY

BY KATHLEEN S. DAVIS,
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& CHRIS IRWIN, UMASS AMHERST

This study investigates how the instructional practices of an inquiry-, project-, and technology-based college science course facilitated the legitimate participation of females in science activity.

The site of this study was a college, freshman-level Marine and Fresh Water Ecology and Conservation course taught during the Fall 1999 semester at a small, private college in the northeastern United States. This site was chosen for several reasons. The faculty in the Natural Sciences at this institution believed that science is best learned through student-initiated and student-designed projects that are interdisciplinary and carried out in the laboratory and/or the field. Faculty viewed their college science program as a successful context for females. They reported that females regularly made up approximately half of the institution's science graduates. In addition, for more than 20 years, faculty at this college have developed project-based outreach programs that provide pre-college females with opportunities to engage in science activity.

The Marine and Fresh Water Ecology and Conservation course was chosen for its emphasis on student inquiry through project-based instruction. The course included the following major components: 1) the salt marsh study; 2) the coastal eutrophication problem study; and 3) the urban aquaculture project.

Student activities included readings of the primary literature, class discussion, a field trip to Cape Cod to collect data and a written paper in which students analyzed that data, as well as team-designed and implemented studies and subsequent analysis papers to answer a question or solve a problem relative to a particular issue of urban aquaculture.

The instructor of the course was a faculty member in the Natural Sciences for over 20 years and taught biology, marine biology, and ecology courses and guided students in their research. Eleven, white female students from various SES (social economic status) backgrounds who were enrolled in the course (out of a total of 13 students) consented to participate in this study.

Data were collected over a period of 12 weeks in several forms: 1) classroom observations, 2) course documents and student work, and 3) pre- and post-student interviews. Data was analyzed using domain, taxonomic, and componential analysis to determine critical patterns and themes. The analysis includes particular description (direct quotes), general description (taxonomies, charts, and diagrams), and interpretive commentary.

Several elements in this science education setting were key to students' meaningful, legitimate science activity and their learning of critical inquiry

skills and marine ecology principles. These elements included, first of all, the teacher's ability to effectively scaffold students' inquiry activity, beginning specifically by addressing skills of observation, questioning, critical analysis, then using guided discovery to engage students in data collection and analysis, and lastly using project-based instruction to engage students in all aspects of investigation design, implementation, and analysis. Additional elements included: the teacher's encouragement of discussion and questioning; the interaction and communication between students, often in the context of structured, small group work; the presence of contextualized, relevant science activity that incorporated the use of primary data and research resources including in- and out-of-classroom fieldwork data and the authentic use of science tools; and the predominance of student-directed activity and ownership of their research —“finding things out for yourself.” ■

They reported that females regularly made up approximately half of the institution's science graduates.

Formative Assessment in Teaching Physics

BY CHRIS EMERY, cemery@k12.nsm.umass.edu
UMASS, AMHERST REGIONAL HS (RETIRED)

Formative assessment may be defined as a process of “checking-in” on where students are, not only in their acquisition of knowledge, but also in their thinking about a particular concept or small piece of the course content. Formative assessment is a “two way street”: both students and the teacher play important roles in the activities involved with sharing, analyzing and applying information. The results of this process – both the data made available to the instructor and student, and the act of questioning their own understanding on the part of students – can enhance the learning which goes on in the classroom.

The following techniques are some that I have used over a period of approximately 10 years with students at the high school, undergraduate and graduate (inservice elementary and middle school teachers) levels in Conceptual Physics courses; class sizes ranged from 16 – 35 students.

Moving On

This fall, Sharon Palmer, the STEM Education Institute Project Manager, departed for a position teaching Chemistry at Amherst Regional High School. Although she certainly will be missed, we wish her well in her new position. She worked hard to make a smooth transition before her departure.

Graduate Student and Project Assistant Dave Millette oversaw Summer Fall Options and the Science and Engineering Saturday Seminars. In May, he completed a B.S. in biology and an M.Ed. in science education. He is now in Seattle with his wife and son and is teaching biology.

Moving In

The new STEM Education Institute Project Manager is Irene Starr. Her background is in physics, technology, and management. She combined the latter two for many years at the UMass Foreign Language Resource Center. Recently she has been teaching math at HCC.

Sandra Turcios Payne, a recent UMass biology graduate, is now studying for her M.Ed. to become a high school biology teacher. She's in charge of the Science and Engineering Saturday Seminars.

Continuing

Terry Dun is Director of Technical Services for UMassK12 and technology coordinator at Franklin County Technical School.

Allan Feldman is STEM Ed Associate Director and Professor of Science Education. He writes a lot of proposals.

Dan Gullage provides technical support for UMassK12 and the STEM staff. He helps with many other tasks as well. He started working for STEM in the summer of 2000 after high school graduation.

Eugenie Harvey's main responsibilities are paying STEM's bills, people, travel reimbursements, etc - all complex undertakings at UMass. Her studies this term focus on web page design and technologies for generative writing and discussion.

Andy Rice has an engineering degree from Cornell and is enrolled as a math education graduate student. He manages our STEM Adventures program.

Helen Sternheim is Director of User Services for UMassK12, our pioneering Internet service for K12 teachers.

Mort Sternheim is STEM Ed Director. He "retired" from the UMass Physics Department in 1997. He spends a lot of time writing proposals for new STEM Ed programs.

Paula Valencik is a doctoral student in geology; she spends her summers in Colorado collecting data and samples. She runs the Tuesday STEM seminars program and maintains our displays. She played a key role in the Pathways 2002 and 2004 conferences. ■

Formative Assessment in Teaching Physics continued from previous page

- Writing - beginning of class - explain a concept, solve a problem from previous class
- Writing - beginning of class - explain a concept, solve a problem from 2-3 weeks earlier in the semester
- Writing - end of class - summarize key points from today's work
- Writing - end of class - respond to the question: "I still don't understand the following ..."
- Writing - design/write one or two "test" or quiz questions which would be appropriate for the material just covered.
- Listening - to students (small group) discussing a question, lab result/data, problem solution, reading summary or homework question
- Writing - chart paper with summary/key points from small group in-class assignment

It is important to note that all of these techniques -none of which are new - involve student writing, or extended verbal response/dialogue. In addition, they do not take a long time to be completed by students, or processed by the instructor. Recognizing that an answer or response is incorrect is only part of the issue; understanding why it is, is critical to making this a worthwhile endeavor.

Recognizing that an answer or response is incorrect is only part of the issue; understanding why it is, is critical to making this a worthwhile endeavor.

How is this information useful? When students provide "good" responses, it is reassuring to know that

they've "learned" something which is valued. But, I'm also more aware of how critical it is to ask the "right question", and to pay close attention to what's included in student responses when they are not completely right (or even close!). A brief explanation - perhaps using a different context or example, demonstration or simple review lab activity - may be all it takes to move the individual or class as a whole in the right direction. I believe that I've been able to make students more aware of the importance of thinking about why they believe what they believe (evidence, basis for reaching conclusions, connections to other course material or concepts), and as a result recognize that their new confidence - relative to understanding - has validity. ■

STEM Education Institute Seminars

Seminars are usually held at 4 PM on the first and third Tuesdays of each month during the academic year. Everyone is welcome; no reservations are needed, and there is no charge. Parking is available in the Campus Center Garage. See umassk12.net/stem/events.html for additional information and the spring 2005 calendar.

September 21

John Stoffolano

Department of Plant, Soil and Insect Sciences

University of Massachusetts

“Once Your Course is Online, What Do You Do?”

Let me begin by telling you that after 35 years of teaching at UMass, I can confidently say “I prefer teaching online.” I firmly believe that there isn’t anything I can’t do online that I could do in a regular classroom. I will share with you how my course is organized and the types of instructional tools or materials that I use to deliver Ent. 671 – Using Insects in the Classroom to teachers and graduate students planning to teach. Finally, I will enter into the area of what one does once their course has been taught online for a few years. This is the exciting part and an area I believe few faculty take advantage of once their course is online.

October 5

Richard Yuretich

Department of Geosciences, University of Massachusetts

“Davis Mine in Rowe, Massachusetts: An Opportunity for Environmental Education”

One of the original goals of the STEM Education Institute was to foster interactions relating to science and math education among faculty in various parts of UMass that would not readily occur in the normal course of events. The Davis Mine project is a unique outgrowth of such interactions, since it involves faculty from Geosciences, Microbiology, Civil and Environmental Engineering, and Education. The project is also remarkable for its dual research and outreach agendas. The research aims to understand the natural biogeochemical processes involved

in the remediation of acid mine drainage, while the outreach component focuses on involving teachers in real research experiences to aid in classroom instruction. A detailed article about the Davis Mine is on page 11.

October 19

James W. Walker

Department of Biology

University of Massachusetts

“Cosmos to Humanity: From the Big Bang to the Space Age: The Use of PowerPoint Presentations and Online Material in a Course Specially Designed for the Commonwealth Honors College”

Biology 270H: Cosmos to Humanity_ From the Big Bang to the Space Age is a course specially designed for students in the Commonwealth Honors College that provides the prerequisite background in the natural sciences that all well-educated persons of the 21st century should possess. The course, which is jointly taught by faculty from the Departments of Physics, Astronomy, Geosciences, Microbiology, Biology, and Anthropology, covers the grandest panorama of all - beginning with the origin of the universe and ending with the rise of humanity. Emphasis is on the greatest questions posed by the human mind. Major topics include the ultimate nature of nature: space-time and matter-energy, origin and ultimate fate of the universe, evolution of galaxies, stars and the elements, origin of the solar system and the Earth, origin of life on Earth, the micro-bial world, plant and animal evolution, primates and the origin and evolution of humans, and Charles Darwin and the process of biological evolution. Students read articles by leading scientists and science writers at an online course

website in preparation for discussion sections. The course website is: <http://bcr.bio.umass.edu/courses/fall2004/biol/biol270h/>

November 9

Avi Hofstein

Department of Science Teaching The Weizmann Institute of Science, Rehovot, Israel.

“The Development of Leadership Among Science Teachers for the Implementation of New Content and Pedagogical Standards”

New standards in science education are being advocated which reflect the current vision of the content, classroom environment, teaching methods, and support necessary to provide a high quality education in the sciences for all students. One of the ways to attain these goals is to treat teachers as equal partners in the attempt to attain these goals. In other words, teachers have to play a greater role in providing key leadership at all levels of the educational system. I will describe a program that was used to develop leadership among chemistry teachers; similar models were used to develop leadership among physics, biology and general science teachers).

November 23

Krishna Vedula

College of Engineering

University of Massachusetts

Lowell.

“Working Together to Improve the STEM Pipeline”

The presentation will focus on successful collaborations between K-12, higher education and business to improve the STEM Pipeline. In particular, Dr. Vedula will describe his efforts to build such collaborations over the past seven years in Massachusetts.

STEM Education *Institute Seminars* continued

Such efforts have multiple goals and need to emphasize the importance of STEM education for future of the economy and jobs for youth; demonstrate real world engineering and technology examples for improving MCAS math and science scores; engage business leaders and higher education faculty; assist STEM teachers to enhance student performance in STEM disciplines; help recruit women and minorities; and help recruit and retain high quality STEM teachers. The recently formed Regional PreK-16 Networks are focusing on these goals. Dr. Vedula will describe progress of these Networks which were formed with support from the State in the form of a Pipeline Fund.

December 7

Chris Emery

Physics and Electronics

UMass

Amherst Regional H. S (retired);

**Mary Mawn, Teacher Education
& Curriculum Studies, University
of Massachusetts.**

“Science Education Online:

***Inquiry and Electricity and
Magnetism Course - What We
Learned”***

This past summer the graduate course Inquiry and the Teaching of Electricity and Magnetism was offered online for the first time. One of the goals for this course was to have students “learn by doing” by participating in a variety of guided and open-ended inquiries. Throughout the course, students were able to answer existing questions and to ask deeper questions as a result of doing lab work in the home, thinking about the results, and interacting with others via online discussions. This talk will provide an overview of the structure of this course and describe lessons learned while teaching online. Data about the effectiveness of the course consists of anecdotal comments, student performance on weekly quizzes and major assignments, and pre-/post-confidence survey results. ■

DAVIS MINE:

BY RICHARD YURETICH, yuretich@geo.umass.edu

AN OPPORTUNITY FOR ENVIRONMENTAL EDUCATION

One of the original goals of the STEM Education Institute was to foster interactions relating to science and math education among faculty in various parts of UMass that would not readily occur in the normal course of events. The Davis Mine project is a unique outgrowth of such interactions, since it involves faculty from four schools and colleges: The principal investigator of this NSF funded grant is Richard Yuretich, Professor of Geosciences. The co-PI's are Klaus Nusslein from Microbiology, Sarina Ergas and David Ahfeld, Civil and Environmental Engineering, and Allan Feldman, Education.

The project is also remarkable for its dual research and outreach agendas. The research aims to understand the natural biogeochemical processes involved in the remediation of acid mine drainage, while the outreach component focuses on involving teachers in real research experiences to aid in classroom instruction.

Davis Mine in Rowe, MA operated from 1882 until 1911, producing pyrite from a mineralized zone in the bedrock of this part of the Berkshire Mountains. Since the time of the mine collapse in 1911, the shafts have filled with water and produced very acidic (pH =2 to 3) effluent that contains very high concentrations of sulfate, iron, and trace metals from the exposed tailings piles in surface runoff and groundwater. This effluent flows into Davis Mine Brook, which is a sub-watershed of the Deerfield River basin. Fish are absent from the entire length of Davis Mine Brook, more than 2 km downstream from the mine. In areas peripheral to the site of acid mine-drainage generation, there is evidence of an active microbial community that reduces the dissolved sulfate, and possibly iron, to remediate the acidic drainage. The project is exploring ways to enhance the activity of these organisms to help mitigate the effect of the mine drainage.

Teachers serve as important members of the research team. During the spring and fall semesters they take part in a weekly journal club. In the summer they undertake research projects in the laboratory and at the field site. They have produced results that are fundamental to the progress of the research. Each teacher develops a plan to integrate aspects of his or her research into their curriculum. Not only have participating teacher-scholars been immersed in the process of scientific research, they have also been instrumental in making fundamental discoveries for the project. For example, they have shown through laboratory work that the types of bacteria needed to reverse the contamination processes are already present in the soils of the Davis Mine area. This will focus the research on the conditions needed to stimulate their activity. The Davis Mine site is also proving to be an excellent locus for environmental education of undergraduates and the general public.

Four teachers have been involved to date: Jason Jean, a general science teacher at Southwick High School; Shelly LaMontagne, general science teacher at Greenfield Middle School; Bill Girardi, earth science teacher at Frontier Regional Middle School; and Janice Wing, environmental science teacher at Quaboag Regional Middle School. The teachers are very positive about their experience. Wing reports that she experienced the full scope of developing and implementing a research project. She gained a different perspective on science and what it means to really do research. She also says she is more supportive of science, and has a new respect for what it takes to earn a Ph.D. in terms of motivation, patience and resilience. The project is looking for additional teacher-scholars for the next cycle beginning in Spring 2005. ■

FALL 2004 CALENDAR OF EVENTS

UNIVERSAL DESIGN FOR LEARNING WORKSHOP

December 4 Mary Moriarity, STCC [see page 1].

STEM EDUCATION INSTITUTE SEMINARS

STEM talks take place at 4 p.m. in Hasbrouck 138, usually the first and third Tuesdays of the month. Everyone is welcome. Refreshments are served at 3:45. There is no charge, and parking is in the nearby Campus Center Garage.

September 21 "Once Your Course is Online, What Do You Do?" John Stoffolano, UMass Amherst.

October 5 "Davis Mine in Rowe, MA: An Opportunity for Environmental Education." Richard Yuretich, UMass Amherst.

October 19 "Cosmos to Humanity: From the Big Bang to the Space Age: The Use of PowerPoint Presentations and Online Material in a Course Specially Designed for the Commonwealth Honors College." James W. Walker, UMass Amherst.

November 9 "Professional Development for Science Teachers." Avi Hofstein, Weizmann Institute of Science, Rehovot, Israel.

November 23 "Promoting Science and Engineering in Massachusetts and Across the Country." Krishna Vedula, UMass Lowell.

December 7 "Science Education Online: Inquiry and Electricity and Magnetism Course - What We Learned." Chris Emery, Amherst Regional High School (retired), and Mary Mawn, UMass Amherst.

SCIENCE AND ENGINEERING SATURDAY SEMINARS

This free program for K12 teachers is funded by the Pipeline Fund and the National Science Foundation. Teachers meet on Saturdays, generally at UMass from 8:30 to 1. For more information or to register go to the SESS website at www.umassk12.net/sess or contact Mort Sternheim, mort@umassk12.net, 413-545-1908.

September 18 Assistive Technology and the Engineering Design Process. Donna Cohn, Hampshire College, and Kathy Rubin, UMass Amherst.

October 2 Wind Energy. Michael Arquin, Kidwind Project, Tufts University.

October 16 Meteorology and Climatology Standards. Rob Snyder, Brookline High School (retired).

October 30 Project Wild. To 3 PM. Gini Traub, MA Dept. of Environmental Management.

November 13 Investigating protein, DNA and RNA 3D molecular structures to see how they work. Eric Martz and Frieda Reichsman, UMass Amherst.

November 20 Weather makeup date.

December 11 Additional class for those registered for graduate credit.

Spring 2005: February 12, March 5 & 19, April 2 & 9, May 7.

NEW TEACHERS SATURDAY LUNCH CLUB

1-3PM, October 2 & 16, November 13, and December 11 at UMass Amherst [see page 7 for details].

STEM ADVENTURES SCIENCE SATURDAYS

8:45 – noon, September 11, October 23, November 6, and December 11 [See page 4 for a related article].

Spring 2005: Tentative spring dates are April 30, May 7. Check out our web site in late December or early January for details: www.umassk12.net/adventures.

STEM Ed Institute

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