Polymers That Save Lives: Fire Prevention and Fire Fighting

A Polymer Education Project

www.psrc.usm.edu/macrog/proposal/fire.htm[1]

Principle Investigator: Patricia DePra, Westfield State College
Co-Investigators: Robert Badger, University of Wisconsin – Stevens Point
Lon Mathias, University of Southern Mississippi
Larry Scheich, St. Norbert College
Jeff Seyler, University of Southern Indiana

A racecar driver in full racing gear. A toddler in pink Pooh flame-retardant pajamas. The fully-equipped firefighter battling an out-of-control fire in a high-rise. New formulations in aviation materials. The common thread? Advances in polymer science have improved each of these technologies to help save lives.

With this project, our hope is that students and their communities gain a deeper appreciation for science in general, as well as for the scientific advances in polymer science that make our lives safer and more enjoyable. This education proposal interweaves an increased awareness of fire prevention and fire safety with concepts in polymer science and chemistry.

We propose to develop easy-to-use, content-and-process rich teaching modules to be disseminated locally and nationally. The topics are key – tangible with wide appeal – the kind of topics that students will talk about with their families and each other, while learning chemistry and the scientific method in the process.

Why: Significance of and Need for this Project

Teachers are under more pressure than ever to: meet/exceed the goals of the National Science Education Standards and, increasingly, state-specific Curricular Frameworks; ensure that students pass standardized tests; and above all, make chemistry interesting to the students, weave it into their lives. According to the National Science Education Standards, "Science Content must be embedded in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to students' lives."[2]

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[1] Information on this web site includes research and information links, a sample web page, a glossary, and a summary curriculum vitae for each investigator.

[2] National Research Council. (1996). National Science Education Standards., Washington, D.C.: National Academy Press. Chapter 7: Science Education Program Standards, Program Standard B.

We propose teaching modules that seek out new and exciting content, incorporate demonstrations and student activities, and are self-contained with background material and information for the teacher. These modules will provide an easily accessible method for teachers to fulfill the spirit of the issues discussed in the Science Education Standards (outlined below in *Curricular Objectives*) while having fun in the process.

As an added benefit, *Polymers That Save Lives* is a terrific means to project the chemical industry and the people behind the inventions in an extremely positive light. Chemical inventions have made a positive, life-saving impact on society, and the awareness and appreciation of this by students will help to encourage students to enjoy and study chemistry in the future.

Curricular Objectives

This project is designed to fulfill numerous goals within the following Content Standards of the National Science Education Standards: Science as Inquiry, Physical Science, Science and Technology, Science in Personal and Social Perspectives, and History and Nature of Science.

For example, a module that focused on strong, lightweight polymeric materials for the airline industry could show the history of the materials' initial development, applications, and discovery of shortcomings, including the production of toxic gases during combustion. Subsequent re-designs reduced the latter while enhancing fire-retardant properties. Industrial production and optimization can be discussed in the context of the process of technological design and the "enterprise of science."[3] The Physical Science Standards addressed are obvious: structure and properties of matter, chemical reactions, conservation of energy and increase in disorder, and interactions of energy and matter. A component that addresses the impact of this science on society will be geared towards the Science in Personal and Social Perspectives Standards.

The Guide to the Content Standard states that "Content is fundamental if it

- Represents a central event or phenomenon in the natural world.
- Represents a central scientific idea and organizing principle.
- Has rich explanatory power.
- Guides fruitful investigations.
- Applies to situations and contexts common to everyday experiences.
- Can be linked to meaningful learning experiences.
- Is developmentally appropriate for students at the grade level specified."[4]

We believe that the content proposed for this project fulfills all of the above. **To ensure that the materials developed will be grade-level-appropriate,we will include a high school chemistry teacher in the collaborative materials development process.** In addition, we will consult with experts in science education and high school and middle school teachers.

In short, students will learn fundamental concepts in chemistry, the inquiry process of science, the connection to technology, and will gain new historical perspectives. Moreover, students will connect these learnings to their individual life experiences and to their greater community.

What: Description of Project

The target audience for this proposal is multi-level, with an initial focus on developing teaching modules for high school chemistry and science teachers. These modules will subsequently

[3] *Ibid.*, Chapter 6: Science Content Standards F and G (Science and Technology).
[4] *Ibid.,* Chapter 6: Science Content Standards

be developed for the middle-school level by adjusting the depth of the theory behind the concepts, the activities, and the presentation, and by addressing the differences in the Science Content Standards for Levels 5-8. For example, at the most general level, the primary content would consist of the histories of the various inventions, including a qualitative description of the science of the discoveries and the people behind the scenes. To create modules appropriate for the college level, the depth and amount of theory will be increased. Also, these modules may be expanded into case studies or student-directed investigative projects.

Specific Topics for Teaching Modules May Include:

- Flame retardant (or flameproof) fabrics, including protective clothing/equipment for firefighters, race car drivers, and others
- Fabrics such as rayons that catch fire very easily and should not be worn in high-fire-risk areas, such as near campfires or in laboratories
- Airplanes and automobiles: how improvements in polymeric materials have reduced the risk of fire and the emission of toxic fumes upon combustion
- Recent research in new polymeric materials: the science of creating fire-proof materials (e.g., polymers that release water as they burn, or that create an oxygen-impenetrable char on the surface that protects the rest of the material from burning)
- How a tiny amount of a very long polymer chain [poly(ethyleneoxide)] helps the stream of water from a fire hose reach higher stories in a burning building
- Incomplete combustion and its effect on air pollution
- Comparison of natural vs. synthetic polymers (wood, chitin, wool, paper, polyester, and others). Include the effect of surface area, (e.g., wood vs. paper or sawdust)
- When polymer combustion (with a large release of heat) is a good thing: conversion of a manufacturing plant’s waste PET (and other narrowly defined materials) into energy (see the *Alternate Fuels Boiler*, http://www.pes-world.com/sdi.html)
- Bad Science Exposed: recent experiments that debunk “proof” of human spontaneous combustion
- The science of fire – What is combustion? The study of a burning candle, for example, involves phases of matter and other key concepts and exemplifies the complexity of combustion.

These topic-specific teaching modules could include:

- Historical background
- Overview of the scientific concepts involved
- Student activities (preferably inquiry-based) and their connection to the National Science Education Standards
- Methods of assessment
- Web-based and multimedia tools
- Other materials for developing lesson plans

For classroom materials, manipulatives (including samples of the various materials) will be combined with inquiry-based activities. Carefully chosen samples of polymeric materials can initiate discussions of protective clothing or building materials. What would be a good application for a specific material (that has been handed to students)? What might be a *safe* way to test various materials for specific applications? At this point, examples of how industry tests flammability can be presented. The Internet is a rich source of photographs and videos in addition to technical information.[5]

Worth emphasizing here is the safety component of the activities. A natural suggestion by students is the use of fire in their investigations. The inquiry process must be carefully planned so that safety is of utmost importance. For example, *given* that a particular material is fire retardant, how might we test other properties for its potential use in specific applications? How might a fire-fighting agent be tested for properties such as coverage, penetrability, and heat transfer? Why might foam be better than a liquid or powder spray?

At a more advanced level, such as college-level general (or organic) chemistry, the differences in molecular structure of the various polymeric materials will be described, then related to the manner in which the molecular structure affects the macroscopic properties. Often, it's not obvious which materials are flameproof, flame retardant, or undergo rapid combustion. These properties depend upon the individual polymeric functionality. Polymers, by their very nature, amplify the effects of intermolecular forces and properties. As such, polymers dramatically demonstrate these concepts.

Finally, chemistry-specific topics in fire safety can be expanded into case studies. These case studies could investigate the causes of fatal accidents, such as the Apollo 1 accident that resulted in the death of three astronauts, and the Valujet fire and subsequent crash related to the improper transportation of oxygen generators. Also, the nature of many industrial chemical reactions, including chain reaction polymerization, are potential combustion hazards that must be carefully controlled by industrial chemists. An obvious positive result of this discussion is an increased awareness of the importance of personal protective equipment in all laboratories and fire safety precautions.

Following is an example of a personal, accessible approach that would appear as part of the supplemental web-based materials in the teaching modules. Note that each of the underlined phrases would be links to further pages.

Polymers That Save Lives

[5] See the Research and Information Links at our web site: http://www.psrc.usm.edu/macrog/proposal/fire.htm.

Fire and Polymers: *let's look at the concepts below in more detail (and find out about some neat science while we're at it).*

- Why things burn…*kinetics and thermodynamics of combustion*
- How things burn…*chemistry of combustion*
- Why polymers burn differently…*macromolecules respond to heat strangely*
- Polymers that just *don't* burn…*aramids and PBO, to name two*
- The toxic dangers of fires…*it's not just the heat, it's CO and smoke*
- How to keep things from burning…*change the chemistry, of course*
- Measuring flammability…*what controls the chemistry of combustion?*
- Fighting fires with polymers…*superabsorbants and "slippery water"*
- Fires in space…*"if it ain't the same, it's different"*
- How we use fire for good…*roasting hot dogs just wouldn't be the same*
- Spontaneous human combustion…*and other urban myths*

How: Strategic Implementation Plan

Prior to Summer, 2001	Collection of background information, including: literature searches; preliminary collections of samples and materials, and connection with key individuals from governmental fire research laboratories, academia (both researchers and fire academy professors), and museums.*
Summer, 2001. Two weeks at USM.	Collaborative work: component development and integration at USM.
Sept.-June 2001/2.	Materials evaluations workshops with local teachers.
January or June, 2002. One week at USM.	Reassess; modify materials; prepare teacher workshop.
Fall, 2002.	Workshop submitted to a national science education meeting.

* Current connections include: Dr. Jeffrey Gilman, a research polymer chemist from the Materials Fire Research Group of the National Institute of Standards and Technology; Dr. Mary Virginia Orna of the Chemical Heritage Foundation, Barbara Bennett, Education Coordinator at the National Plastics Center and Museum; Melissa Dempsey, Program Manager for Courses at the Museum of Science in Boston, numerous local high schools in and surrounding the towns of Westfield, MA; Hattiesburg, MS; DePere/Green Bay and Stevens Point, WI; and Evansville, IN.

Methods of Dissemination

Teacher workshops will provide training to use the modules described above. Initial workshops will be held at local schools on weekends and actively solicit teacher input to enhance the modules. Upon completion of useful modules, a workshop will be held at an appropriate national scientific education meeting for high school chemistry teachers. These workshops will focus on how to optimize the use of these materials in the classroom.

Public outreach to schools and community groups, especially during *Fire Prevention Month* (October), is another important aspect of this project. Invitations to these workshops will also be extended to local American Chemical Society (ACS) executive boards. For example, the public affairs and/or education committees of the local ACS section might be interested in taking these program materials into a specific middle school science class, a community group, or for planning a hands-on activities night for kids. Print, television, and radio publicity will be sought for community events.

Collaboration with the National Plastics Center and Museum (NPCM) in Leominster, MA, the Museum of Science in Boston, and the Springfield Science Museum will provide further means of dissemination. The workshop space at the NPCM is ideal, and their teacher packets and/or touring shows (with their outreach van) will incorporate materials developed as a result of this project. The NPCM currently has a complete firefighter's outfit on display, the content of which may be expanded as well. Boston's Museum of Science actively solicits the development of grade-specific hands-on courses taught by educators in the community. A recent discussion with them sparked an interest in a new course developed from the modules described in this project. Connections will also be made with local fire departments.

Dissemination to those middle and high school teachers who are (and have been) in the Polymer Ambassador program will ensure feedback from experts in grade-specific science education and in polymers, as well as broadening the geographical area covered. Teachers who participate in the Polymer Expeditions grant (funded by The Camille and Henry Dreyfus Foundation, Inc., and directed by Lon Mathias) will be a rich resource as well as a terrific avenue for dissemination.

Web page modules will be designed such that the casual web surfer, the middle school science teacher, the organic chemistry professor and beyond will find something of value. Web pages will include text, still photographs, and short video clips and will be linked to the *Macrogalleria* site (http://www.psrc.usm.edu/macrog/index.htm), which gives an in-depth description of specific aspects of the polymer science. This is not an extension of the *Macrogalleria*, but will use this resource as one of many sources of information.

Publication in the appropriate chemical/science education literature and research presentations at national meetings will, of course, be an integral dissemination tool.

Assessment

Assessment will primarily consist of a review by an outside evaluator with expertise in science education, and surveys of teachers participating in workshops. Surveys, direct observation, and/or interviews will assess the impact on students.

In terms of student assessment, built-in self-evaluation will help students to recognize areas that they do not understand and affirm their comprehension when they do.

Project Continuation: Long-term Planning

The theme *Polymers That Save Lives* may be expanded into other arenas, such as high strength – high performance materials or biomedical materials. Further funding and/or sponsorship will be sought to create a documentary or television special along this theme.

Participating teachers will be encouraged to develop ideas and materials for further modules, with publication on the internet and elsewhere.

Resources at Hand: Our Expertise and Our Institutions

The investigators of this proposal have a wonderfully complementary mix of expertise and focus in their teaching, research, and institutions. A touch of camaraderie and enthusiasm effect extremely productive brainstorming sessions.

The strengths that we each bring to this project are unique:

- Patricia DePra – Organic/polymer chemistry, outreach, focus on teacher education, ties to teachers and museums in MA, training and experience in public relations and publicity; Westfield State College Physical Science Department (www.physci.wsc.ma.edu)
- Robert Badger – Organic chemistry, computer expertise, directs undergraduate research; University of Wisconsin – Stevens Point Chemistry (www.uwsp.edu/chemistry)
- Lon Mathias – Polymer chemistry teaching and research, Macrogalleria, multimedia and computer resources, polymer research instrumentation, directs graduate and undergraduate research, ties to teachers and industry in MS; University of Southern Mississippi Polymer Science Research Center (www.psrc.usm.edu/)
- Larry Scheich – Physical chemistry, outreach and school connections, directs undergraduate research, teaches polymer

chemistry; St. Norbert College Chemistry (www.snc.edu/chem) (St. Norbert graduates more than nine chemistry majors per year.[6])

- Jeffrey Seyler – Inorganic chemistry, directs undergraduate research, teaches polymer chemistry; University of Southern Indiana Chemistry (www.deepcnet.usi.edu/chemistry)

Patricia DePra teaches at Westfield State College, where the focus of the majors[7] in the Physical Science Department is the preparation of excellent teachers, primarily for high school chemistry or science at either the high school or middle school levels. Because of this focus, a strong connection with local schools currently exists through our student teacher placements, our graduates who teach locally, and an External Advisory Committee.[8] Currently, we have at least eleven graduates teaching in local schools, with six teaching chemistry. Additional connections to local academia and industry exist as a result of service as Chair of the Connecticut Valley ACS Local Section. The Clinical Master of Education in Secondary Education: Chemistry is a recent edition to our offerings, with graduate classes first being offered in the Fall Semester, 1999. One of our faculty holds a Ph.D. in science education (with a specialization in chemistry), and teaches Methods in Chemistry Education and Methods in Science Education within our department.

As mentioned above, a high school teacher (to be selected) will also collaborate with us directly to develop these teaching modules. Several excellent potential teachers have been identified through the grant, *Expeditions to the Real World of Chemistry and Polymers*, directed by Lon J. Mathias and funded by the Camille and Henry Dreyfus Foundation, Inc.

[6] Data from 1996-2000. Averages: 9.2 graduates in chemistry; 57% of whom continue in chemistry graduate programs, 73% to all graduate programs (includes medical school).

[7] Although the Physical Science Department at Westfield State College does not have a separate chemistry major, the Chemistry focus within the General Science major is preparatory for teaching chemistry, and includes Physical Chemistry, two semesters of Analytical, and either a third semester of Analytical or an internship. For more information, see http://www.physci.wsc.ma.edu/.

[8] This External Advisory Committee includes a high school science department chair, a science supervisor (7-12, Westfield Public Schools), and an Acting Director of Science (Springfield Public Schools).

Patricia DePra

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Westfield State College, Westfield, MA 01086-1630 pdepra@foma

Education: Juniata College, Huntingdon, PA, BS, Biochemistry, 1984.

Northwestern University, Evanston, IL, MS, 1985, Ph.D., 1989. *Electrically Conductive Polymers and Polymer Composites from High Performance Materials*

Professional Experience

1996 – present	Assistant Professor, Physical Science Department, Westfield State College
Spring, 1996	Adjunct Professor: University of North Carolina – Asheville, Departments of Chemistry and Environmental Studies; Mars Hill College, Chemistry Department
1994 – 1995	Visiting Assistant Professor, University of North Carolina – Asheville, Chemistry Department
1989 – 1994	E.I. DuPont de Nemours & Co., Inc., Imaging Systems, Brevard, NC: Materials Management Supervisor (1993-1994); Business Information Specialist (1991-1993); Research Chemist (1989-1991); Patent

Professional Affiliations: American Chemical Society, member, Chemical Education Division; Connecticut Valley Section Chair, 2001; Member-at-Large, 1997-1999; Chair-Elect, 2000.

Professional Activities

American Chemical Society Presentations:

- *Encouraging Creative Processes in Teaching Organic Synthesis: Make That Molecule!,* San Francisco, CA, March, 2000.
- *General Chemistry II Linked with a Biology Course*, Boston, August, 1998.
- *Enlivening a Lecture Course with Case Studies and Debates as Learning Tools,* Orlando, 1996.

Reviewer, Organic Chemistry, 5th Ed., by John McMurry; Brooks-Cole Publishing, ©2000.

Presenter, *Science Seminars 2000: Science and Education for the 21st Century*, Powder Mill Middle School, Funded by MA Board of Education Goals 2000 and the Dwight D. Eisenhower Professional Development Program

Laboratory Safety Coordinator for the Physical Science Department.

Numerous guest lectures and outreach in polymers, chemistry, and performance poetry

Funding: Competitive Internal Westfield State College Teaching Grants or Foundation Grants

- Grant currently under review: *The Effect of Macromolecular Structure on Polymer Properties: Development of an Organic Chemistry Laboratory and a High School Outreach Program*.

- *Making Chemistry More Attainable, Retainable, and Interesting for WSC Students…and… Increasing the Outreach Capability of the Physical Science Department.* 1998
- *Improvement of the Organic Chemistry Laboratory; Drawing Chemical Structures for Publications and Lecture/Lab Materials.* 1998
- *Calculator-Based Laboratories for General Chemistry and Physical Science.* 1998 with P. Romano and M. Young
- *A Proposed Biology-Chemistry Learning Community.* 1997 with B. Hoagland

Additional Summer Research Experiences:

- Bowling Green State University with Dr. D. Neckers, 1983; "Chelating Copolymers Containing Photosensitive Functionalities" (two papers in Macromolecules: 1984, 17, 1912-1917 and 2463-2467.
- DuPont Central Research, Wilmington, DE, with Dr. D.Y. Sogah, 1984; Project: Uncatalyzed Group Transfer Polymerization; see Makromol. Chem., Macromol. Symp. 1990, 32, 75-86.

Please see the proposal site ***www.psrc.usm.edu/macrog/proposal/fire.htm*** for further publications.

Robert Charles Badger

Professor, Department of Chemistry (715) 346-3700
University of Wisconsin-Stevens Point, Stevens Point, WI 54481 rbadger@uws

Education: Ohio University, Athens, Ohio 1966-70 BS Chemistry, cum laude.

University of Toledo, Toledo, Ohio (1970-77) Ph.D. in organic chemistry, 1977.

Wayne State University, Detroit, Michigan (1977-78) Postdoctoral research fellow

Professional Experience

1996 - present	Professor, Chemistry Department, University of Wisconsin-Stevens Point
1992 - 1996	Quarter time summer appointment to serve as Macintosh Lab administrator.
1991	Summer appointment with Academic Computing Services at UW-SP. Research and development on: Windows 3.0 environment on the UW-SP network. Macintosh testing, evaluation, and integration into the UW-SP network.
1990	Summer appointment with Academic Computing Services at UW-SP. Research and development on a Windows 3.0 environment on the UW-SP network.
1988 -	Associate Professor, Chemistry, University of Wisconsin-Stevens Point
1988	Postdoctoral Research Fellow, Chemistry Department, University of Wisconsin-Milwaukee, with Dr. James Cook, summer appointment.

Professional Affiliations: Sigma Xi, American Chemical Society, American Association for the Advancement of Science

Publications and Presentations

- R. Badger, J. Lesniak, and S. Rutta, "NMR Simulation and Interactive Drill/Interpretation," J. Chem. Ed., 1989, 66, 52. (I have received 26 requests for this program at $5 per request to provide a modest department income of $130)
- *The Computational Chemistry Laboratory at UWSP.* Invited paper, Great Lakes Regional ACS Meeting, La Crosse, Wisconsin, June, 1995. (R. C. Badger and S. R. Bondeson).

External Funding

1999	“The Polymer Science Learning Center: A Comprehensive Educational Experience in Polymer Science with Teacher Training and Empowerment" funded by NSF by Lon J. Mathias University of Southern Mississippi; Mary Virginia Orna, Chemical Heritage Foundation; John P. Droske and Robert C. Badger, University of Wisconsin-Stevens Point; $80,391.00.
1998	"Upgrade of The Nuclear Magnetic Resonance Spectrometer in The Chemistry Department" funded by NSF-ILI program by Robert Badger, $98,000.00.
1994	"An Undergraduate Laboratory for Computational Chemistry" submitted to NSF-ILI program by Stephen Bondeson and Robert Badger, $145,000.00.

Jeffery W. Seyler

Associate Professor, Department of Chemistry (812) 464-1923
University of Southern Indiana, Evansville, Indiana 47712 jseyler@us

Education: University of Nebraska – Omaha, NE, B.S. 1987
Purdue University, Ph.D. 1992

Professional Experience

1993 -present	University of Southern Indiana, Evansville, Indiana
1992 - 1993	Postdoctoral Research Associate, University of Utah, Salt Lake City, Utah

Professional Affiliations: American Chemical Society, Inorganic Division; Indiana Academy of Science

Current Teaching Duties: General Chemistry, Polymer Chemistry, Inorganic Chemistry, Chemical Literature and Seminar, Introduction to Research

Please see the proposal site www.psrc.usm.edu/macrog/proposal/fire.htm for further information.

Lon Jay Mathias

Professor of Polymer Science, Department of Polymer Science (601)266-4871
University of Southern Mississippi, Hattiesburg, MS 39406-0076 Lon.Mathias@usm.edu

Education: University of Iowa, Dubuque, IA; B.S. (with honors), Chemistry, 1971
University of Michigan, Dearborn,MI, M.S., Chemistry, 1974; Ph.D., 1976

Professional Experience

1989 - present	Professor, Department of Polymer Science, University of Southern Mississippi
1983 - 1989	Associate Professor, University of Southern Mississippi
1981 - 1983	Assistant Professor, University of Southern Mississippi
1977 - 1981	Assistant Professor, Department of Chemistry, Auburn University
1976 - 1977	Post-doctoral Research Fellow and DHEW Trainee, Univ. of California-San Diego

Professional Affiliations

American Chemical Society and its Divisions of: Polymer Chemistry, Polymeric Materials: Science and Engineering, Chemical Education, Organic Chemistry; Sigma Xi, Mississippi Academy of Science

Professional Activities

Funding: Over $5 million over last 18 years
Published: Over 200 refereed papers
Referee for: Journal of Polymer Science; Macromolecules; Makromolecular Chemie; Reactive Polymers; National Science Foundation; Journal of the American Chemical Society; Industrial and Engineering Chemistry; Petroleum Research Fund of the ACS
Member, Editorial Boards of: Journal of Polymer Science, Chemistry; Macromolecular Syntheses; Polymer Composites
Miscellaneous: Contributing Editor, Polymer News; 1994 USM Basic Research Award; Chairman, Mississippi Section, American Chemical Society, 1991; Co-organizer, Symposium on Advances in Polymer Characterization, Honolulu, Hawaii, December, 1989; 1988 USM Applied Research Award; Faculty Member, 1984 Mississippi Governor's School Recipient; Visiting Professor, University of Northern Iowa, April 9-11, 1985

Larry A. Scheich

Associate Professor, Chemistry Department (920) 403-3213
St. Norbert College, DePere, Wisconsin schela@mail.snc.edu

Education University of California-Santa Cruz, Ph.D. in Physical-Inorganic Chemistry, 1983
Alma College, B.S. in Chemistry and Mathematics, 1978

Professional Experience

1983-Present	Associate Professor, St. Norbert College
Summer Sessions 1985-1991	Visiting Assistant Professor of Chemistry, University of California, Santa Cruz
4/83-7/83 and 6/82-7/82	Instructor of Chemistry, University of California, Santa Cruz

Professional Affiliations : American Chemical Society, Midwestern Assoc. of Chemistry Teachers in Liberal Arts Colleges

Professional Activities

- Valencia Community College, 1999: Editor, *Laboratory Manual for General Chemistry*
- Brigham Young University, 2000: Editor, *Organic Chemistry: Microscale Laboratory Techniques, 4th Edition*
- Harcourt College Publishers, 2000: Reviewer, *Chemistry: Principles and Reactions*
- Prentice Hall, 2000: Reviewer, *Solutions Manual for Chemistry for McMurry and Fay, 3rd Edition*
- Presentation: T. J. Melton and L. A. Scheich, *Active Learning in the Division of Natural Science*, Ninth Annual Faculty Development Conference, St. Norbert College, Jan 11, 1996
- **Outreach Programs**: Presented thirty-six "Chemistry Magic Shows" at local elementary and middle schools since 1993.

Please see the proposal site www.psrc.usm.edu/macrog/proposal/fire.htm for further information.

Budget $ 22,900

Travel	$6,250
On-Campus Room and Board	3,000
Faculty Stipends	9,000
Supplies	1,150
External Evaluator	1,000
Teacher Stipends	2,500

Travel

Key to the success of this project is the pooling of creativity and expertise in a focused environment. The Polymer Science Learning Center at the University of Southern Mississippi, with its extensive computer/multimedia facilities and polymer research instrumentation/expertise, is an ideal location for this focus.

Four Faculty x $ 550 x 2 visits = $ 4,400

One High School Chemistry Teacher x $ 550 x 2 visits = $1,100

One Faculty member to a national meeting (plus registration) = $ 750

On-Campus Room and Board:

(4 Faculty + 1 HS Teacher) x $200/week x 3 weeks = $ 3,000

Faculty Stipends:

(5 Faculty + 1 HS Teacher) x $ 500/week x 3 weeks = $9,000

Supplies

- materials and supplies for activities and demonstrations
- reference text on fire retardant materials: Ecological Aspects of Polymer Flame Retardancy by S.M. Lomakin and G.E. Zaikov, ISBN 90-6764-298-3.
- fabric, paint, and other polymeric samples. Donations of samples/products will be requested as appropriate, i.e., only when it's clear that this program will be under no pressure to advertise said sample/product.
- photocopying/printing costs for teacher workshop materials
- blank CD-ROMs for dissemination and data storage
- other teacher workshop materials

External Evaluator:

$ 250/day for 4 days, to interview participating teachers and students, provide specific surveys as assessment tools, and

to provide grade-specific, science-teaching-method feedback prior to dissemination.

Teacher Stipends:

25 teachers x $100 per workshop day (paid upon delivery of assessment)