FBRI EPSCoR Grant Partners (2007-2008)

Maine Center for Toxicology & Environmental Health

John Wise, Professor of Toxicology and Molecular Epidemiology
Director, Maine Center for Toxicology and Environmental Health
USM
(207) 228-8050
John.Wise@usm.maine.edu

This proposal is a continuation of the previously funded proposal submitted for the Educational Outreach Award. The complete project aims to help in the use of woody biomass to create new products, by studying the toxicity of cellulose nanoparticles as a first step towards identifying modifications to the nanoparticles that may make them less toxic and safer for human and environmental exposure and consequently commercially more valuable. The long-term objective of this research is to develop a model of wood product-based nanoparticle-induced genotoxicity in human lung and fish cells. This objective is important because the potential for exposure to nanoparticles as a result of their widespread use is an increasing public and environmental health concern. The short-term objective of this research is to focus on one class of nanomaterials of significant commercial value, cellulose nanoparticles, and determine if they are genotoxic to cells. In addition to a significant research project, the complete project provides an educational and research experience for a USM graduate student, 2 USM undergraduate students and a Portland High School student. The focus of this proposal is funding for the students internships and their needed supplies.

Woody biomass products are excellent candidates for new nanotechnologies. Cellulose nanoparticles are used in thermoplastics and in novel paints. They are also valued for their ability to align in magnetic fields for NMR-spectroscopy and for viscosity control. The long-term objective of this research is to develop a model of wood product-based nanoparticle-induced genotoxicity in human lung and fish cells. The short-term objective of this research is to focus on one class of nanomaterials of significant commercial value, cellulose nanoparticles, and determine if they are genotoxic to human or fish cells.

We will also be providing an educational experience with this research project as it involves a graduate student and 2 undergraduates and a high school intern who will perform toxicological studies of cellulose nanoparticles in the Wise Laboratory. This research merges two fields of great current interest: Toxicology and nanotechnology and thus it is likely that some of these students will be inspired to pursue further interests and education in forest bioproducts research.

In our research, we will be testing the hypothesis that cellulose nanoparticles are cytotoxic and genotoxic to human and fish cells and compare their toxicity to silver nanospheres and chromium microparticles. Dr. Doug Bousfield from the University of Maine (UM) has agreed to provide us with the cellulose nanoparticles. Our intent for this funding is to evaluate the toxicity of wood-product based nanotechnology in fish and human cells, two species likely to be threatened by the potential toxicity of these

products. Once the approach is established, future collaborative efforts with the Maine NSF EPSCoR Forest Bioproducts Research Project can examine the impact of modifications to these particles in an effort to identify which products and modifications might reduce potential toxicity and lead to a more environmentally friendly and safe wood product.

Low Impact logging Education Project

Jeff Dubis
Forest Technology Program Coordinator
Instructor of Forestry
University of Maine at Fort Kent
834-7543
jdubis@maine.edu

A Nova Jack trailer with forestry package and haul and dump package would be purchased with this grant. The trailer would be used in conjunction with the ATV purchased last fall through a Maine NSF EPSCoR grant for student and faculty projects in low impact timber harvesting for small landowners. This would include logging exercises conducted by students during class time as well as demonstrations and workshops presented by faculty, staff, and students for local small woodlot owners.

The equipment to be purchased through this grant includes a Nova Jack trailer with forestry package and haul and dump package. The trailer enables up to ½ cord of wood to be hauled by an ATV. A winch is supplied that enables logs to be easily lifted onto the bunk. It also includes a dump bed for hauling other materials including the ATV itself to the worksite. In addition to the trailer package, the request also includes a Nova Jack skidding kit. The kit will allow the users to winch harvested trees from up to 100' from the ATV and then to skid the wood roadside.

The primary objective to purchasing this equipment is to educate forestry students and small landowners in the region to the low-impact logging techniques which would lead to improved forest health and increased supply of marketable wood products for traditional and evolving wood products industries in Maine. This would also provide additional revenue for landowners, thus increasing viability of small woodlot ownership. Secondary objectives of this project are to improve efficiency of wood extraction during student timber harvest exercises and to make transport of research equipment easier for various research projects being conducted by faculty and students in the environmental studies program.

Improving Woody Biomass Separation by Enzymatic Means

Nancy Kravit, Ph.D
Chief Executive Scientist
Tethys Research LLC
(207)942-9044

ngkravit@tethysresearch.com

The difficulty of fractionating wood into separate lignin, cellulose and hemicellulose feedstreams has prevented forest biomass from fulfilling its potential to provide environmentally sustainable carbon-neutral raw material for energy and chemical synthesis needs. Softwood is particularly recalcitrant. This difficulty is due primarily to ether bonds between lignin and hemicellulose. We have synthesized a novel fluorogenic model of the ether bonds between lignin and galactomannan from softwood and used it to bioprospect for microorganisms that break ether bonds between phenyl and mannose residues. Tethys has discovered three microorganisms that can generate fluorescence from our model compound and are likely sources of lignin:hemicellulose etherase(s). In order to identify the new activity and to test its specific effect on wood, it must first be isolated from the *other lignocellulolytic enzymes likely to be produced by the microorganisms.*

This project will isolate novel hemicellulose:etherase activities from at least one of our three microorganisms, two of which are as yet unidentified.. The overall project objectives are: 1) to devise an isolation scheme, 2) to confirm activity on natural lignin-hemicellulose complexes as opposed to synthetic model compounds, and 3) to microsequence the activity and determine identity of the enzyeme. Standard methods of protein chemistry will be used and it is anticipated that a reproducible method of isolation will be devised.

Because these organisms are likely to produce other enzymes that digest hemicellulose and cellulose, the HLE activity must be isolated in order to be tested for its activity against lignin-hemicellulose complexes and for its identity to be determined. The isolated enzyme can then be used to design a new pulping process for wood fractionation. The nature of the isolation method, along with its yield and the characteristics of the isolated enzyme will determine the feasibility of basing a wood fractionation process on the isolated enzyme. The project is a necessary first step in developing a novel, environmentally friendly pulping process.

Upper St. John Valley Community Forest Project

Steven Young
Habitat Planning
(207) 543-5050
mail@habitatplanning.com

The overall goals of this project are to and to promote knowledge, awareness, and sustainable management of our forests, and enable my small business to offer spatial forest modeling services to clients in need of sustainable forest management planning. The goals will be achieved in two major components of this project, computer forest model development, and community forest management plan development which will take place concurrently.

A spatial and temporal computer simulation model will be developed to enable determination of sustainable harvest levels based on landowner objectives (maximum fiber production, maintenance of biodiversity, maintenance of specific forest habitat conditions, etc.). This model will be applied to forest information collected on all community-owned forest land in the Upper St. John Valley. The towns of Allagash, Fort Kent, St. Agatha, Frenchville, Madawaska, Grand-Isle, and Van Buren will be presented management options to meet a range of objectives from maximum sustainable fiber production, to maintenance and enhancement of specific habitat types and biodiversity on their community forest land.

This project, already funded in part by the Maine Outdoor Heritage Fund, will be conducted in partnership with local elementary and secondary schools of MSAD 33, the University of Maine at Fort Kent, and all towns in the Upper St. John Valley of northernmost Maine. This project will contribute to data on local forests, increase awareness in local students and other residents of the forest and its potential sustainable uses, open up possibilities for curriculum in Forestry and Environmental Studies at the University of Maine at Fort Kent (UMFK), and provide the project manager Steven Young with necessary tools to pursue forest modeling as a business.

Education Outreach in Support of the University of Maine Forest Bioproduct Research Initiative

Sherry Huber, Executive Director
Maine Tree Foundation
(207) 621-9872
sfhuber@worldnet.att.net

The Maine TREE Foundation proposes to carry out four activities involving Maine K-12 teachers to increase awareness of the goals and objectives set down by the Maine NSF EPSCoR FBRI during the grant period (May 2007-April 2008).

1.) Forests of Maine Teachers' Tours for K-12 teachers and non-traditional educators with a strong emphasis on renewable energy and forest bioproducts (July 2007)
2.) Three workshops offered by Maine Project Learning Tree (PLT) for K-8 teachers and high school teachers of math, science, ecology and environmental studies (fall 2007).
3.) Small equipment offered to schools of teachers participating in workshops above.
4.) Facilitator training offered to teachers who have completed workshops and want to build on that experience (March 2008).

University of Maine scientists and bioproducts specialists will be involved in all aspects of these projects to present research and describe careers in science, technology, engineering and mathematics (STEM). Teachers will engage in experiential learning offered by the PLT curriculum guides as part of these sessions.

Teaching middle and high school science using real environmental data

Molly Schauffler, Assistant Professor (adjunct)
UMaine Dept. of Earth Sciences

Climate Change Institute
Center for Science and Mathematics Education Research
(207) 581-2707
mschauff@maine.edu

This project will build the capacity of middle and high school science and mathematics teachers to apply technology skills (generating or downloading, analyzing, and graphing moderate-sized sets of environmental data) to answer environmental questions of interest and relevance to them and their students. It will promote students to think in terms of evidence when investigating environmental questions, and will help teachers develop an integrated understanding of environmental concepts (e.g. how forest ecology and climate are linked) and use that understanding to inspire student inquiry.

The project builds on an existing course for teachers being taught this summer at the Hutchinson Center in Belfast, SMT 504: Integrated Approaches to Earth Science Education (Monitoring Environmental Change). Components of the request include support for:
1.Research supplies and equipment for seven teachers (in-service and pre-service) participating in SMT 504; A graduate student to coordinate updates to the Maine Environmental Monitoring and Assessment Program Index and to further develop related teacher web resources available on the Center for Science and Mathematics Education Research web site;
2. PI Schauffler and participating teachers to offer five follow-up five hr. workshops in the fall semester that provide technical training for teaching colleagues of each participating teacher and to present the results of student inquiry at the Center's National Conference in June 2008: Integrating Research into Science and Mathematics Education;
3. PI Schauffler to assist EPSCoR staff in developing or enhancing other research opportunities for teachers.

The travel portion of this request is for the PI Molly Schauffler to present this professional development strategy and the results of teacher activities in the classroom at the March 2008 National Science Teacher's Association meeting in Boston, and at the Maine Science Teacher's Association Annual Meeting in October, 2007.

Engaging Youth through Participation: A Day of Workshops and Activities at the 2008 Forest for Maine's Future Public Expo

Summer Allen, Administrative Assistant
Center for Research on Sustainable Forests
(207) 581-3794
Summer.e.allen@umit.maine.edu

The Center for Research on Sustainable Forests, working as part of Forests for Maine's Future, is planning a day-long program of teaching and interactive workshop events for Maine youth at a March 2008 public expo, to be held in Portland, Maine. Planning and implementation of this workshop will be July 2007 through March 2008.

The University of Maine's Center for Research on Sustainable Forests (CRSF) conducts and promotes interdisciplinary research on Maine's forest ecosystems. As a primary part of its mission, the CRSF aims to educate Maine people on issues surrounding Maine's forests and the goods and services that our sustainable forests provide to all Maine citizens.

As part of a public information campaign, the CRSF collaborates with three other Maine organizations with similar goals and objectives. These are the Maine Forest Service, the Small Woodland Owners Association of Maine, and the Maine TREE Foundation. Together these organizations make up Forests for Maine's Future (FMF).

Based on the results of this first expo, FMF members are excited to expand it in 2008, and include a full-day youth section to create a fun learning experience that will hopefully foster children's interest in Maine's forests and increase their participation in activities that involve forests.Engaging children in a free community event setting will provide an educational opportunity that can be appreciated by families and teachers as well as students. An FMF partner, the Maine TREE Foundation, sponsors tours of Maine forests for teachers, and provides environmental education services through the Maine chapter of Project Learning Tree. Environmental educators from these organizations are willing to provide their services at the Expo at no charge as part of their outreach mission.

Some other ideas that are being investigated include wildlife demonstrations, a tree identification workshop, arts and crafts with handmade forest products, a forest careers talk, science experiments, demonstrations of small-scale biofuels production, and more. The group hopes that participation in these workshops will inspire Maine youth to be more interested and involved in Maine's forests. We hope to communicate ideas about the health of Maine's forests and the diversity of opportunities and resources that the forests provide. Having EPSCoR researchers contribute as presenters is also an option. If FBRI educational materials on forest bioproducts could be adapted for a youth program, those would be very beneficial, especially to children with a budding interest in science.

Upward Bound Bridge Students Become Research Capable

Linda Ives, Director
Upward Bound Programs- Classic and Math-Science
(207) 581-2523
Linda.ives@umit.maine.edu

Upward Bound Bridge students are high school students who have participated in Upward Bound since their sophomore year and are now preparing to enter postsecondary education in the Fall of 2007. To prepare them for rigorous academic work in the future, they are required to complete a research project during their final six-week residential summer experience.

The objective of the Upward Bound Bridge program is to provide an integrated research medium through which high school students will gain fluency with the scientific process, including inquiry, critical reasoning, research techniques, experimental design, data collection, data analysis, and animal use ethics. Through rigorous study and detailed design of the program, we hope to create an environment that stimulates students to ask questions and seek answers to their own questions, guided by the scientific process. We hope to help them understand the importance of basing their inquiry upon existing scientific literature, and using this literature as both a foundation and rationale for performing additional studies. We see this research experience as the first in these students' careers as future college undergraduates, providing foundational knowledge and practices for them to successfully continue scientific research in college and graduate school.

To be accepted into the bridge program, they were required to develop a proposal and a plan for their individual project. During the Summer of 2007, they will conduct the study/experiment, present the project to a panel of faculty judges or as a poster presentation at a science fair, and prepare an article to be published in a journal that will compile the work completed by these students. They will each be awarded $1500 summer research stipend for the successful completion of his/her bridge project.

The Northeast Bioproducts Puzzle: 2007 Forest Products Society Northeast Section Meeting

Jeff Benjamin, Forest Operations Science
University of Maine
(207) 581-2727
Jeff_benjamin@umenfa.maine.edu

The Forest Products Society - Northeast Section holds a meeting for its members each year. Topics and themes for these annual meetings are selected based on current conditions and trends affecting the forest products industry. Recent news about an emerging forest bioproducts industry in the Northeast is a topic of major interest. Therefore, we propose to develop a strategic planning session that will feature a series of speakers who will address the strengths, weaknesses, opportunities and threats (SWOT) for a forest bioproducts industry in the Northeast. The analysis will focus on the region's **production capacity, forest resource, public policy, and economic development** as it relates to a future bioproducts industry. This analysis will seek to provide a comprehensive evaluation of potential issues, strategies, and approaches for those involved in the forest products industry in the region.

The meeting will be held in Bangor at the Ramada Inn during the afternoon and evening of October 18th and during the morning of the 19th. Between 60 and 80 participants are expected and 9 speakers have already been confirmed from Maine, Massachusetts, and Washington DC. A compilation of biomass and other bio-related articles previously

published in the Forest Products Journal will be included in participant's registration packages.

This meeting will provide an opportunity for those involved and interested in an emerging bioproducts industry to understand how four key parts (production capacity, forest resource, public policy, and economic development) fit together. Results from the meeting and SWOT analysis of an emerging forest bioproducts industry in the Northeast will be distributed to all conference participants and submitted for publication as a featured article in the Forest Products Journal.

Maine Energy Education Program (MEEP) Bioenergy Outreach Education

Rob Lilieholm, Associate Professor
School of Forest Resources
(207) 581-2896
Rob_lilieholm@umenfa.maine.edu

The Maine Energy Education Program (MEEP) is requesting $1,400 for a short term research and implementation project on ethanol production from forest products that would provide Maine high school (and possibly middle school) classrooms with the following:

(1) Visual information in the form of power point slides, overheads and/or written information about energy from forest bioproducts to be integrated into existing alternative fuels presentations; and,

(2) An experiential activity for students investigating energy from forest bioproducts.

The Maine Energy Education Program is a 501(C)3 educational non-profit launched in 1985 with the focus of helping Maine students, our energy decision makers of tomorrow, to become energy literate citizens. Through an array of hands-on experiences, MEEP seeks to expand the thinking of 4^{th}-12^{th} grade students around energy use and its economic and environmental consequences. MEEP collaborates with a number of other organizations (Efficiency Maine, Maine State Energy Program, Maine DEP, Kids and Transportation, Maine Sierra Club, Maine Council of Churches, Hydrogen Energy Center) to engage thousands of students in more than 100 schools yearly.

Professional Development through Collaborative Networks: An Innovative Partnership to Strengthen K-16 Science and Mathematics Education

Amie Gellen, Assistant Director
Center for Science and Mathematics Education Research
Phone: 207-581-1021
E-mail:amie.gellen@umit.maine.edu

The University of Maine Center for Science and Mathematics Education Research (Center) proposes to enrich and expand upon the successes of Year 1 FBRI educational outreach activities, during Year 2. The June 2008 five-day national summer conference and summer academy entitled, "Integrating Science and Mathematics Education Research into Teaching: Resources and Tools for Improved Learning" (conference/academy), will be added to the three existing coordinated programs that link practicing and future K-12 mathematics and science educators and University faculty with the Forest Bioproducts Research Initiative (FPRI). In addition, a new middle school collaborative (MSC) focusing specifically on ways to bring guided-inquiry curricula into middle school mathematics and science classrooms, will be established. This request for support includes these two new networks along with the following Year 1 programs: Mathematics and Science Future Teachers Club's (MSFTC) annual Spring Conference, the High School Physics Teachers' Collaborative (HSPTC), and the Mathematics Cross-Tier-Teaching Team (CTTT).

The Spring Conference, the cornerstone of the MSFTC, offers prospective teachers a rare opportunity to interact at a single venue with some of Maine's most outstanding mathematics and science educators at a professional conference created and implemented solely by students for their peers. The conference is a day-long event featuring workshop presentations by exemplary, award-winning mathematics and science educators that furnish lesson ideas that pre-service educators can readily implement in their prospective classrooms. All presentations involve active learning, provide resources, include ideas for teaching with technology, and are in alignment with state and national standards. Three of the nine workshop presenters at the FBRI supported 2007 Spring Conference were FBRI staff and grant partners. Topics included ideas for ensuring gender equality in the classroom, global citizenship, forest bioproducts technology and life cycle-based sustainable consumption. The 8th annual MSFTC conference, planned for March 2008, is part of this educational outreach project. Presentations at this conference will again address FBRI themes and include teaching strategies for encouraging participation by underrepresented groups in the STEM fields.

The CTTT is a collaboration of post-secondary STEM educators, novice and exemplary middle and high school educators, and pre-service teachers who are dedicated to best practices in mathematics education. The CTTT networking model provides an ongoing forum to inspire and exchange innovative teaching ideas and presents an opportunity for both formal and informal discussion among mathematics educators. The team meets to jointly consider current issues in mathematics teaching and learning. CTTT meetings typically include a mathematics activity followed by a discussion of the content and pedagogy imbedded therein and a presentation or exchange of resources on timely topics such as state standards and assessments.. Two fall 2007 and two spring 2008 meetings are planned as part of this project. The CTTT meetings, supported by a FBRI Year 1 educational outreach award, included numerous presentations by FBRI faculty/staff and grant partners.

With FBRI support, the Center proposes to create the MSC using the CTTT and HSPTC model. Practicing and pre-service middle school mathematics and science educators will

attend two fall 2007 and two spring 2008 dinner meetings to explore and discuss detailed guided-inquiry methods of teaching specific middle school mathematics and science content.

The Center is planning a five-day national summer conference and academy for June 2008 as part of a two-year educational outreach project. The conference/academy will serve three purposes: to bring together all participants in the STEM education enterprise (practicing K-12 teachers, administrators, STEM and education faculty/staff, future teachers, and graduate students) to exchange ideas about research, curriculum innovation, and assessment in their fields; to help teachers integrate research-based instructional strategies and materials, particularly those that depend on innovative use of technology, into their teaching; and to build sustainable collaborations among teachers, STEM researchers, and education researchers, providing infrastructure to bring cutting-edge STEM content into K-12 classrooms in ways that enhance learning and broaden participation in STEM disciplines. Three major outcomes as expected from this work: (1) an improved and more diverse knowledge base for discipline-based researchers and educators from STEM fields; (2) an empirically grounded framework for understanding how K-16 students learn specific content, and how classroom teachers incorporate new ideas acquired during summer professional development programs into their teaching; and (3) revitalized networks of local and national scientists, mathematicians, and educators collaborating on discipline-based education research and its applications. The Center proposes to co-host the conference and summer academy with the FBRI and is seeking $15,000 in Year 2 funds for project planning.

Summer Laboratory School and Year-Round Environmental Club.

Elizabeth Haynes, Title I Grade 6 Mathematics Teacher
Troy Howard Middle School
207-338-3320 (work)
bhaynes@sad34.net

Existing programs at Troy Howard Middle School have created a foundation for students and community to be eager for more of these hands-on learning experiences. The staff would like to build on these exiting opportunities by developing and conducting a summer laboratory mathematics school for sixth and seventh graders. In addition they would also like to form an after school environmental club where more students would have the opportunity to apply their math skills to problems within an outdoor setting.

There is already a strong agricultural element to one seventh grade classroom teaching team (the Garden Team). This team maintains a greenhouse and organic garden on the school grounds by incorporating the district's required curriculum with their garden theme. This proposal would expand on this program so that more of our students could explore and learn about the forest and watershed surrounding the school building. Initial planning has already been accomplished by a committee involving some classroom teachers and community members with Paul Memmer of Sappi Fine Paper preparing the a forest management plan.

The environmental club would be held once a week after school for an hour. Depending on the season and weather conditions, students would vary their activities between outside projects, speakers, demonstrations, and informational lessons. Members of the FBRI faculty would be more than welcome to come and speak to the after school club where sixth grade through eighth grade students would benefit. (These visits could be open to any interested students not just club members). If possible the club would participate in a final competition or academic fair. The school has instituted a spring academic fair, which would provide an excellent opportunity for this club to demonstrate what the members have learned and to display what projects they have completed during the past academic year.

The success of this program will be evaluated by recording attendance of all events, student enrollment in both sessions of the laboratory school, a pre- and post-survey of student interest in environmental topics/careers, and a pre-and post-test of basic mathematical skills practiced during the laboratory school experience. Of course the administration would also hope to see some prolonged effect which might be evident in MEA score improvement.

Green Products Business Plan Competition 2007-08

Renee Kelly, Interim Co-Director
Student Innovation Center
University of Maine
207-581-1141
rwkelly@maine.edu

The University of Maine Student Innovation Center proposes to again offer an innovation and commercialization plan contest to student innovators from Maine's Universities and Colleges. The contest topic for the year 2007-08 will be "Green Products." Students will be encouraged to form interdisciplinary teams to develop new commercial products or services in this field. Plans may be based on ideas from the students or from ideas nominated by the FBRI. Winners will receive a cash prize to execute their plan. Through workshops and individual counseling, students will learn the fundamentals of writing a commercialization plan and about bioproducts business opportunities.

The Student Innovation Center will coordinate the competition, workshops, and provide ongoing assistance to the winning teams. In addition, the Student Innovation Center will work with FBRI researchers to identify commercialization opportunities to offer to teams, and will use funds from this program and try to leverage additional prize and support money from other resources. Judges of the contest will include experts from the university, industry representatives, and the Target Technology Incubator Advisory Board.