The Western Transportation Institute (WTI) announces the

UNDERGRADUATE RESEARCH EXPERIENCE PROGRAM IN TRANSPORTATION

To be competitive in any field, students must be able to show that they are capable of independent and creative thinking. The Western Transportation Institute (WTI) at Montana State University offers a unique Undergraduate Research Experience (URE) for students from a variety of disciplines at MSU to develop these important skills. Successful URE applicants will work together with a professional researcher at WTI to execute a research work plan on a transportation topic, to produce a final report, and to present their results to staff and peers at the end of the program.

The Undergraduate Research Program provides a one-on-one mentoring relationship with a professional researcher at WTI, paid hands-on research experience, assistance in developing invaluable skills in data collection, analysis, and interpretation and in communicating research results to a broader audience. Students will also receive paid travel opportunities for successful paper submissions to professional conferences.

Successful applicants will earn $13/hour during both the Fall and Spring semesters while gaining hands-on research experience and working flexible hours. Program participants will work one-on-one with a professional research mentor at WTI on a research project and will enroll for 490-R “Undergraduate Research/Creativity Activity” course credits (or a comparable alternative) during the Spring semester to earn academic credit for their research activities. The Undergraduate Research Program provides an excellent opportunity for undergraduates to fulfill the university core research requirement, earn academic credit, gain valuable academic skills, and build a professional resume. A 15-20 hour/week commitment is required.

To apply:
Please submit:
- A completed application form (attached)
- Resume (that includes all contact information as well as academic and employment history);
- A current web transcript;
- A one-page statement outlining reasons for wanting to participate in the program; future academic & career goals; and project of interest.

Application deadline: September 15

Submit applications to: Susan Gallagher, Western Transportation Institute, Montana State University, PO Box 174250. Email: sgallagher@coe.montana.edu; Phone: 994-6559.
Applications available at: http://www.wti.montana.edu/education/studentfundingopportunities/
Applicant Name  _______________________________________________________
Banner ID# ___________________________________________
Address  _______________________________________________________________
City __________________________ State _________  Zip Code  _______________
Email Address:  ___________________________________________________________
Home Phone:  _________________________  GPA:  _______________________
Academic Major: __________________________       GPA: ______________________
Academic Advisor: _______________________________________________
Standing in Fall 2010:  _____ Freshman ____ Sophomore  ____ Junior ____ Senior
Expected Graduation Date: _______________________________
Career interest:  ________________________________________

Please rank project(s) of interest (see attached list for project descriptions and required qualifications):

___ 1. Exploring Nanotechnology Solutions to Environmentally Friendly Asphalt

___ 2. Health-Oriented Elderly Transportation Initiative for Frontier and Rural America

___ 3. Update of the Transportation Toolkit for Federal Land Managers


___ 5. Hands-Free (Voice-Activated) Texting While Driving – Is it Safe?

___ 6. Rural Airport Issues and Best Asset Management Practices

___ 7. Development of an alerting system to warn rural work zone workers of dangerous vehicles

___ 8. Optimizing the gradation of aggregates for fly ash concrete based on the chemical interactions between the paste and aggregate phases

___ 9. Environmentally Friendly Anti-icing Liquids Customizable for Meeting the Needs of Winter Highway Operations

___10. Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements

___ 11. Performance of Reinforced Concrete made with Recycled Materials
Applications must include a completed statement of interest, a current academic transcript, and a resume (please attach all documents to your application).

Completed applications are due September 15, 2010 to:
Susan Gallagher, Education Program Coordinator, MSU Western Transportation Institute (CFT5 Building, 2327 University Way, Room 312), PO Box 174250, Bozeman, MT 59717-4250.
Email: sgallagher@coe.montana.edu Phone: 994-6559

Additional application materials can be downloaded at:
http://www.wti.montana.edu/education/studentfundingopportunities/
Western Transportation Institute  
2010-2011 Undergraduate Research Experience (URE)  
Project Selections

1. Project Title: Exploring Nanotechnology Solutions to Environmentally Friendly Asphalt

Research Mentors: Xianming Shi and Michelle Akin

Desired qualifications: Background in civil engineering, materials science, chemical engineering, chemistry, or equivalent; self-motivated, professional, and detail-oriented. Preferred: hands-on experience or coursework related to asphalt pavement or construction materials; knowledge or coursework related to polymers or nano-materials; hands-on experience on asphalt sample preparation or materials property testing; interest in general transportation and highway safety; basic statistical and/or mathematical coursework; experience with basic statistical software and/or Excel.

Project Description:
As costs of petroleum-derived asphalt materials and the recycling processes increase, there is an urgent need to develop new technologies (materials or methods) to extend lifetimes of asphalt pavement. Nanotechnology has demonstrated clear benefits in other fields (e.g., modification of polymer resins and plastics). This project will explore the benefit of adding nanomaterials to enhance the performance of environmentally friendly asphalt that uses recycled waste materials. When adding nanomaterials to enhance the properties of environmentally friendly asphalt, we aim to achieve performance improvements in multiple aspects, such as resistance to thermal cracking, aging, and moisture induced damage, etc. There are also multiple variables to be investigated, including the type and dosage of both nanomaterials and recycled materials to be added in the asphalt, the method of addition, etc. As such, the project will employ statistical design of experiments (DoE) and multi-objective optimization to limit the number of experiments needed to explore a large domain of unknown factors and their complex interactions. If successful, the proposed research would extend the lifetime of asphalt binder and mixture and reduce the amount of asphalt concrete waste produced each year, leading to significant benefits in light of increasing costs and environmental toll of petroleum-derived asphalt materials and recycling processes.

2. Project Title: Health-Oriented Elderly Transportation Initiative for Frontier and Rural America

Research Mentors: Jaydeep Chaudhari

Desired qualifications: Good writing skills and knowledge of Microsoft Office.

Project Description:
Senior citizens (65 and older) are the fastest growing population segment in the United States. By 2030, the senior population is projected to be 70 million, up from the current 35 million. More than 70 percent of senior citizens live in suburban or rural areas where they find lower-priced housing, less traffic, lower crime rates, lower living costs, and natural beauty. For the elderly population, a lack of transportation alternatives can lead to isolation from friends and family, more serious and expensive health problems, and the inability to actively contribute to society. As the percentage of Americans with rural living preferences continues to grow, this age group will present new challenges for a 21st century rural transportation system’s ability to provide convenient,
safe, and sustainable transportation service. Given the lack of major medical facilities, low population densities, and an increasing percentage of senior citizens in frontier and rural areas, the timing is critical to determine how transportation options and policies can be structured particularly to address medical-related transportation needs of senior citizens living in predominantly frontier and rural settings.

The goal of this study is to provide timely and relevant information on health-oriented elderly transportation alternatives to departments of transportation, departments of health and human services, emergency management agencies, non-profit organizations, public transportation agencies, assisted care facilities and other organizations that are engaged in elderly services. The project will include a literature review of current practice, demographic analysis, medical facilities analysis in conjunction with elderly health requirements, transportation service assessment, and identification and cost analysis of alternate modes of transportation. The focus of the study will be on senior citizens’ mobility planning, policies, and services with an evaluation of the adequacy of the transportation system to access health facilities in frontier and rural areas, and possible alternatives and improvements in this regard. Eastern Montana will be a demonstration study for the above mentioned assessments.

3. Project Title: Update of the Transportation Toolkit for Federal Land Managers

Research Mentors: Jaime Eidswick

Desired qualifications: Interest and motivation.

Project Description:
Federal land managers are the dedicated stewards of some of this nation’s most beautiful and iconic places. Every day they try to maintain the delicate balance between maximizing access for current visitors and preserving and protecting natural resources for future visitors. Alternative Transportation (AT) can help land managers maintain this balance. However, transportation is a secondary job for land managers and therefore many managers have no training or experience is transportation challenges or their solutions. A decision support system on alternative transportation systems can help land managers identify their transportation challenges, provide a wide array of solutions, and provide the necessary information and training available to them to make these solutions a reality. The purpose of this study is to create a decision support system on alternative transportation systems (ATS) for federal land managers that can be marketed by the Paul S. Sarbanes Transit in Parks Technical Assistance Center. This will be accomplished by determining what additional ATS content and functionalities are needed in the current Transportation Toolkit for Federal Land Managers.

4. Project Title: Development of a Standard Test Procedure for Aperture Stability of Geosynthetics

Research Mentor: Eli Cuelho

Desired qualifications: Mechanically savvy; ability to use word processing, spreadsheet and presentation software proficiently; demonstrated oral and written communication skills; basic knowledge of analytical research techniques.

Project Description:
Geosynthetics have been successfully used for filtration, separation, drainage, moisture barriers and reinforcement in flexible pavements. Several studies have been conducted to relate the performance of geosynthetic-reinforced pavements to specific material properties. One such property is the stability or in-plane shear strength of geogrid apertures. A new test method for determining the aperture stability modulus of geogrids is currently being developed within ASTM (American Society of Testing and Materials). This test standard has been under development for a long time and has several technical issues related to how the test is run, its appropriateness for a wide-variety of materials and the applicability of the results; therefore, it has not yet advanced to become a standard test procedure. Investigative work is needed to determine the state-of-the-practice of this procedure and to identify technical challenges. Various design modifications and laboratory experiments are needed to produce meaningful and useful results using a standard or modified test apparatus. The primary objective of this study is to document the current state-of-the-practice and issues with the test standard, and to design and build an apparatus to address these concerns.

5. **Project Title**: Hands-Free (Voice-Activated) Texting While Driving – Is it Safe?

**Research Mentor**: Laura Stanley

**Desired qualifications**: Ability to communicate effectively both orally and in writing. Ability to coordinate and communicate effectively with human participants. Experience with Microsoft Excel. Background in engineering.

**Project Description**:
The purpose of this study is to determine if hands-free texting is a safer (i.e. less distracting) alternative to conventional texting. Using Western Transportation Institute’s state-of-the-art driving simulator, this study will compare how hands-free texting compares to conventional texting, using hands-free cell phones, selecting a song on an iPod, and driving without any distractions. Furthermore, should texting be banned based upon the environment in which we drive? The outcomes of this project will contribute to the scientific body of knowledge regarding mitigating distracted driving practices and may have an impact on our federal and state laws.

6. **Project Title**: Rural Airport Issues and Best Asset Management Practices

**Research Mentors**: Jaydeep Chaudhari and David Kack

**Desired qualifications**: Interest in topic; self-motivated.

**Project Description**:
Rural airports play a pivotal role in communities by providing vital access for lifeline medical emergencies, fire fighting, agricultural operations, and essential air services. Many rural airports face issues of workforce, rising maintenance cost, and financial constraints. Some of these issues are tied to meeting Federal Aviation Administration and Transportation Security Administration Regulations and Standards in regards to safety and security, communications and environmental areas. The purpose of this project is to investigate rural airport issues in order to determine best assessment management practices and to secure the future of rural airports. This project will be focused on Montana’s rural airports and be conducted over a nine month period. The project is divided in the following four tasks:

1. Literature Review, Data Collection and Analysis;
2. Assessment of Rural Airports through a survey;  
3. Best Asset Management Practices for Rural Airport; and  
4. Final Documentation

7. **Project Title**: Development of an alerting system to warn rural work zone workers of dangerous vehicles  

Research Mentor: *Nic Ward*

**Desired qualifications**: Industrial engineering or other engineering design background (including psychology); experience with technical writing and statistical analyses; basic computer software and programming knowledge.

**Project Description**:  
Vehicles that speed through work zones pose a significant risk to work zone workers. This project is part of a larger effort to reduce speeding in work zones. The contribution of this project is to develop a device that would be worn by work zone workers to warn them when there is a speeding vehicle in the work zone area that may be a hazard. The device would also include automatic notification of emergency services in the case that a worker is injured in a crash. This project will require students to analyze the work zone environment and worker tasks to develop an interface device that can alert at risk workers. This project will involve specifying the design (or locating an existing product) and working with engineers to develop and evaluate the worker response and acceptance of that system.

8. **Project Title**: Optimizing the gradation of aggregates for fly ash concrete based on the chemical interactions between the paste and aggregate phases  

Research Mentors: *Xianming Shi and Doug Cross*

**Desired qualifications**: Required: Background in civil engineering, materials science, chemistry, or equivalent; Self-motivated, professional, and detail-oriented. Preferred: Hands-on experience or coursework related to concrete pavement or construction materials; Knowledge or coursework related to chemical analysis and/or surface characterization; Hands-on experience on concrete sample preparation or materials property testing.

**Project Description**:  
This project will explore the appropriate gradation of fine and coarse aggregates in 100 percent fly ash concrete, with a focus on using natural and industrial resources in optimized combinations. Statistical design of experiments and multi-objective optimization techniques will be used to investigate how the size distribution of aggregates affects the concrete workability and durability properties. This work will contribute to the development and implementation of “green” concrete mixes that feature outstanding performance and prolonged service life.
9. Project Title: Environmentally Friendly Anti-icing Liquids Customizable for Meeting the Needs of Winter Highway Operations

Research Mentor: Xianming Shi

Desired qualifications: Required: Background in chemistry, chemical engineering, environmental science, civil engineering, or equivalent; Self-motivated, professional, and detail-oriented. Preferred: Hands-on experience or coursework related to glycerol chemistry, additives chemistry, or green chemistry. Hands-on experience in chemical sample preparation, materials property testing, or product formulation.

Project Description:
While there are agro-based products in the market for highway anti-icing applications, a major breakthrough is still needed before such products can offer balanced properties desired by winter road maintenance agencies. Our approach is to formulate anti-icing liquids consisting of cost-competitive chemicals produced through a green technology, rock salt, and other additives (e.g., glycerol – a biodiesel byproduct). The objective of this project is to evaluate a series of anti-icers tailored to meet the varying requirements in highway anti-icing performance, cost-effectiveness, and minimized corrosion and environmental impacts.

10. Project Title: Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements

Research Mentor: Mike Berry

Desired qualifications: Required: Coursework on or knowledge of concrete; Hands-on experience with concrete and sample preparation; Self-motivated and creative. Preferred: Background and/or interest in structural/materials engineering; Background in civil engineering.

Project Description:
Each year, the highway construction industry in the United States produces over 100 million tons of reclaimed asphalt pavement (RAP) through standard rehabilitation and construction of our nation’s roads. Although this reusable material has been put to use in some applications (usually in the form of asphalt paving), a significant quantity of this material remains unused and is either stockpiled or land filled. Therefore, alternative uses for this material are needed. One possible use for this material is the replacement of conventional aggregates in Portland cement concrete pavement (PCCP).

A research effort funded by the Montana Department of Transportation (MDT) will soon be underway at Montana State University (MSU) to characterize RAP in Portland cement concrete (including durability), a necessary step in validating RAP in PCCP for use in transportation applications. This project will begin by developing mix designs with similar strengths, set-times, and workability to standard Portland cement concrete mixtures. Once these mix designs are developed, the resulting concretes will be evaluated with a suite of mechanical and durability tests. These results will then be analyzed and documented. Depending on the outcome of this feasibility study, recommendations will be made for a Phase II pilot project in which this material is used in place of traditional concrete in a transportation application.

The undergraduate student proposed herein will, in addition to assisting in all aspects of this research effort, be given ownership of testing the freeze-thaw durability of this material. That is, the student will be solely
responsible for designing, testing, recording data, and reporting results for the freeze-thaw durability of this material.

11. Project Title: Performance of Reinforced Concrete made with Recycled Materials

Research Mentors: Mike Berry

Desired qualifications: Required: Coursework on or knowledge of concrete; Hands-on experience with concrete and sample preparation; Self-motivated and creative
Preferred: Background and/or interest in structural/materials engineering; Background in civil engineering.

Project Description:
This project focuses on reducing the environmental impact of reinforced concrete construction by replacing key concrete components (Portland cement and conventional aggregate) with common waste products. In this case, fly ash will be used as the exclusive binder in the concrete, and glass will be used as the aggregate. While considerable data has been collected on the basic material properties of the performance of this new concrete, only limited data has been obtained on its behavior in reinforced concrete structural elements, particularly columns. The student will assist in the design, construction, and testing of approximately 8 reinforced concrete beams and 8 reinforced concrete columns made with 100 percent fly ash and pulverized glass aggregate. Mechanical properties of this material will also be tested and documented, as these properties are needed in predictive equations for column capacity.