1. Co-Co interactions through a cross-conjugated ligand

Class: Graduate Student

Authors: Sean N. Natoli, Tong Ren,

Affiliation: Department of Chemistry, Purdue University

Abstract: Oligomers of iso-triacetylene have been investigated as components for electronic materials, due to their interesting structural and nonlinear optical properties. Recent efforts have been geared toward the incorporation of these cross-conjugated ligands into “wire-like” organometallic scaffolds. The development of organometallic complexes can assist in the elucidation of charge transfer through these cross-conjugated systems. Although recently there has been considerable progress, only a few examples of cross-conjugated first row transition metal complexes have been synthesized. Our emphasis has been on the integration of geminal diethynylethene(gem-DEE) species onto a versatile, redox-active [Co(cyclam)]+3 synthon. The preparation and characterization of compounds [Co(cyclam)(gem-DEE-TIPS)Cl]Cl, [Co(cyclam)(gem-DEE-TIPS)2]Cl, and the bridged complex [{Co(cyclam)Cl}2 μ-gem-DEE]Cl2 are presented here.

Key Words: Co-Co interaction, Cyclam, Cross-conjugation

2. An Analytic Approach to Decipher Usable Gestures for Quadriplegic Users

Class: Graduate Student

Author: Hairong Jiang

Affiliation: Dept of Industrial Engineering

Abstract: With the advent of new gaming technologies, hand gestures are gaining popularity as an effective communication channel for human computer interaction (HCI). Unfortunately, most gesture-based gaming systems are designed for able-bodied users and are difficult and costly to adapt to people with upper extremity mobility impairments. While interface customization is an active area of work in assistive technologies (AT), there is no existing formal and analytical grounded methodology to adapt gesture-based control systems for quadriplegics. The goal of this work is to solve this hurdle by developing a mathematical framework to project the patterns of gestural behavior designed for existing gesture systems to those exhibited by quadriplegic subjects due to spinal cord injury (SCI). A key component of our framework relied on Laban movement analysis (LMA) theory, and consisted of four steps: acquiring and preprocessing gesture trajectories, extracting feature vectors, training transform functions, and generating constrained gestures. The feasibility of this framework was validated through user-based experimental paradigms and subject validation. It was found that 100% of gestures selected by subjects with
high-level SCIs came from the constrained gesture set. Even for the low-level quadriplegic subject, the alternative gestures were preferred.

**Key Words:** Hand gesture-based interfaces; assistive technology; mobility impairments; Laban space.

3. Reflections of Plant Science Graduate Students Engaging K-12 Students While Utilizing Learner-Centered Teaching Strategies

**Class:** Graduate Student

**Authors:** Melissa Leiden Welsh, Neil A. Knobloch,

**Affiliation:** Dept of Youth Development and Agricultural Education

**Abstract:** Industry, academia and societal pressures are influencing the training of future research scientists to acquire teaching skills beyond traditional university teaching assistant positions. As such, graduate students (N = 24) studying to become plant scientists were taught LCT strategies to disseminate their research to K-12 audiences. Graduate teams planned, assembled and facilitated lessons about plant science. Upon completing the teaching experience, graduate students assembled a reflection essay and self-evaluated using retrospective LCT and comprehensive teaching assessment rubrics. Graduate students self-reported higher ratings on both the LCT and comprehensive teaching assessment rubrics. All self-reported rating differences for both rubrics had large effect sizes (d ≥ 0.8). Reflection essays detailed the graduate students’ enjoyment of facilitating plant science research lessons, the challenges and benefits of using LCT strategies versus their embedded lecture habits and the creation of plant science engagement tools. International students expressed fascination with observing learning environments in American schools. Graduate students conveyed a passion to share elements of their research and motivations for career exploration in plant sciences. Graduate students with previous TA responsibilities noted professional development differences when engaging with a K-12 audience. Graduate students valued this experience as a part of their preparation to become plant scientists.

**Key Words:** Teaching, training scientists, plant science
4. Vegetation and soil characteristics of pine plantations and naturally-regenerated hardwood forests on the Hoosier National Forest, Indiana, USA

Class: Graduate Student

Authors: Patrick Duffy, Mike Jenkins, Douglass Jacobs, John Kabrick,

Affiliation: Dept of Forestry and Natural Resources

Abstract: Conifers and mesophytic hardwoods differ in their nutrient acquisition and allocation strategies. Conifers have tough litter, which breaks down slowly and leaves the soil nutrient poor, and they form ectomycorrhizal (ECM) associations, which allows for competitive dominance in nutrient-poor habitats. Litter and ECM release strong organic acids, lowering nutrient availability, and increasing Al toxicity. Conversely, mesophytic hardwoods contain nutrient-rich, rapidly decomposing litter and have arbuscular mycorrhizal associations, which allow for high fertility and rapid nutrient cycling. These strategies help to replicate conditions in which they are competitively dominant, which alters the understory beneath them. Conifers show association with Fagaceae and Betulaceae, who also have ECM, and conifer stands are lower in diversity and average vegetation coverage. Mesophytic hardwoods show quite the opposite, with higher coverage and diversity. This study, in the Hoosier National Forest, investigates these soil and vegetation differences in a concentric plot design of 500 m², and used non-metric multidimensional scaling (NMS) ordination and ANOVA. Surveys supported these theories, wherein conifers have reduced pH, nutrient availability, and increased Al, thus promoting understories with low diversity and high oak cover. Hardwoods showed the opposite, with rich soil, diverse understories, and were dominated by mesophytic functional groups.

Key Words: Conifers, Hardwoods, ectomycorrhizae, arbuscular mycorrhizae

5. Solvent Selection For The Recovery Of Acetic Acid; Comparison Of Simulated And Laboratory Results For Liquid-Liquid Extraction

Class: Graduate Student

Authors: Mahdieh Aghazadeh, Abigail Engelberth,

Affiliation: Dept of Agricultural and Biological Engineering, Purdue University

Abstract: Acetic acid is a well-known fermentation inhibitor for the conversion of biomass sugars to ethanol. Liquid-liquid extraction was used to assess the ability of a solvent to extract acetic acid from a dilute aqueous solution prior to fermentation. Thirty-two solvents were simulated in AspenPlus® to evaluate their ability to extract acetic acid from a dilute aqueous solution. The solvents were selected based on their ability to extract the acetic acid at a lower solvent consumption rate while not extracting water from the raffinate. In the next step the fate of the
sugars in the aqueous solution was studied. A desired extraction system allows the sugars to remain intact and to leave the extraction column with the aqueous stream. A group of nine organic solvents were selected for laboratory experimentation based on the mentioned criteria. Laboratory experiments were performed on a solution of acetic acid, water, glucose, and xylose mixed with varying levels of solvent. The results indicated that with single stage extraction acetic acid will reach to a level that is not toxic to the fermentation yeasts while the sugar contents remain intact.

**Key words:** Value added bioproducts, acetic acid, liquid-liquid extraction

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6. **Construction Operations Automation using Modified Discrete Event Simulation Models**

**Class:** Graduate Student

**Authors:** Joseph Louis, Civil Engineering, Purdue University

Abstract: Although the automation of construction tasks has been an active research topic since the 1970s, few robots can be found on the worksite today and the fundamental construction process has remained unchanged since pre-industrial times. On the other hand, planning and design stages of construction projects has benefited greatly from the advances made in simulation and modeling technologies for construction operations and products. In this research, a novel mechanism for leveraging information-rich simulation models to automate construction operations is developed. The methodology presented uses Discrete Event Simulation (DES) models of operations to drive the process in the real world using autonomous robots. Technically, this necessitates a rethinking of traditional DES models due to the fact that the durations of activities will not be known a-priori when the model is controlling a real world operation in real time. The state of the art in construction simulation, visualization, and automation serves as the foundation to answer the questions that pave the path towards the overarching goal of construction automation. An initial demonstration of the proposed framework's feasibility was performed using modified RC models of construction equipment. A discussion of the results and conclusions of this preliminary experiment are provided in the poster.

**Key words:** Construction, Automation, Simulation, DES
7. Sustainable Electrode Materials for Next Generation Energy Storage Devices

Class: Graduate Student

Authors: Jialiang Tang, Vinodkumar Etacheri, Arthur D. Dysart, Chulgi Hong, Ram Saraswat,

Affiliation: Prof. Vilas G. Pol. ViPER Group, School of Chemical Engineering, Purdue University

Abstract: Biomass-derived carbonaceous materials provide a green alternative to artificial carbons synthesized from scarce nature hydrocarbon resources. In addition to their renewability, biomass-derived carbon often exhibit intriguing micro- and nano-structures that are impossible to reproduce synthetically; once optimized, these carbonaceous structures can archive comparable or better electrochemical performance than the commercial graphite anodes used in modern lithium-ion batteries. Moreover, they can be decorated with nanoparticles made of cost-efficient elements, e.g. Si, Sn, Ti, S, and their oxides, to archive even higher energy storage capacity. Thus, the main objectives of the ViPER group are to identify and produce these biomass carbons from traditionally neglected waste streams, and to synthesize their corresponding low-cost composite materials for applications in high-capacity energy storage devices.

Key Words: Sustainability, Energy, Energy Storage, Battery, Nano


Class: Graduate Student

Authors: Arthur D. Dysart, Chulgi Hong, Dr. Vinodkumar Etacheri,

Affiliation: Prof. Vilas G. Pol. ViPER Group, School of Chemical Engineering, Purdue University

Abstract: In recent years, there has been developing interest in the rechargeable Lithium-Sulfur (Li-S) cathode since its chemistry provides several key advantages over its Li-ion counterpart. Primarily, sulfur can accommodate two electrons per molecule of active material as Lithium sulfide Li2S, permitting a theoretical capacity of 1675 mAh/g and high theoretical energy density of 2600 Wh/kg. Sulfur is also naturally abundant and provides safer cathode performance. Despite these advantages, Li-S presents challenges such as low sulfur conductivity and the infamous polysulfide shuttle effect: a phenomenon in which the spontaneous formation of polysulfides during cycling inhibits Li-S performance. To meet the needs of an economical Li-S solution, we propose a sonochemical approach toward synthesis of effective, conductive carbon-sulfur composites. The utilized carbon substrate offers an economical, one-step synthesis with high micro and meso-sized porosity that permits a high theoretical loading of sulfur (~80%). The actual sulfur load can be adjusted by modification of the reaction conditions. Further optimization of the Li-S system using a partially-fluorinated ether co-electrolyte demonstrates radical improvement in the cumbic
efficiency and stable cycling. The demonstrated Li-S cathode has shown stable performance of 
~750 mAh/g and columbic efficiency >96% for all cycles at a current density of 28 mA/g.

**Key Words:** Lithium Sulfur, Sulfur, Energy, Sustainability, Commercial, Li-S, Hotels, Carbon Hotels, Sulfur guests

9. **Optimization of Lactic Acid production from Food Waste**

**Class:** Graduate Student

**Authors:** Raymond Red Corn*, A. Engelberth**

**Affiliations:** Laboratory of Renewable Resources Engineering, Agricultureal and Biological Engineering, *Ecological Sciences and Engineering Interdisciplinary Program, **Ecological and Environmental Engineering

Abstract: There is a rising demand for lactic acid (HLa) for the production of biodegradable polymers and to aid biological nutrient removal in wastewater treatment. Food waste offers a source of soluble sugars to produce HLa which does not increase land demand or compete with food supply, but fermentation conditions have yet to be optimized when co-fermented with sludge. Food waste was collected from cafeterias, homogenized and seeded with primary sludge. Response surface methodology was used to optimize HLa production based on pH, temperature, loading rate, and retention time. When optimized for concentration, titers were up to 58 g/L HLa. When optimized for yield, titers were up to 48 g/L HLa and a 3x reduction in retention time over previous experiments was achieved. ~60% of HLa produced was L(+) lactic acid. The ratio of soluble chemical oxygen demand to NH4-N was 176. Digestion of carbs, lipids, and proteins were characterized.

**Key Words:** Anaerobic Digestion, Bioplastics, Biological Nutrient Removal

10. **The Importance of Symbiotic Microbes in Termite Lignocellulose Digestion**

**Class:** Graduate Student

**Authors:** Brittany F. Peterson*, Hannah L. Stewart*, Micheal E. Scharf*

**Affiliations:** Department of Entomology, Purdue University.

Abstract: Lower termites are important models for insect-microbe symbiosis because of the diversity, complexity and functionality of their unique tripartite symbiosis. This collaboration consisting of all three domains of life allows termites to thrive on a diet of nitrogen-poor
The eastern subterranean termite, Reticulitermes flavipes, houses over 4,000 species of protists, bacteria and archaea living symbiotically in its gut. Recent investigations of lignocellulose digestion in R. flavipes and other lower termites have primarily focused on the functional contributions of the eukaryotic members of the termite holobiont (termite and protist). Here, using multiple antimicrobial treatments, differing degrees of dysbiosis were induced in the termite gut, leading to variably altered prokaryotic abundance, prokaryotic diversity and lignocellulolytic capacity. These findings quantify the saccharolytic role, directly or indirectly, of prokaryotic members within the termite gut holobiome. This is specifically manifested by reductions of 23-47% and 30-52% in glucose and xylose yields respectively from complex lignocellulose. Thus, all members of the lower termite holobiont (termite, protists and prokaryotes) collaborate for efficient, sustained lignocellulase activity. This unprecedented quantification emphasizes of the relevance of lower termites, like R. flavipes, as models for inter-domain symbioses.

**Key Words:** Termites, Symbiosis, Microbiome, Biomass Processing

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**11. Efficiency gains in cotton price forecasting using different levels of data aggregation.**

**Class:** Graduate Student

**Authors:** Luis M. Pena-Levano*, and Dr. Octavio Ramirez**.

**Affiliations:** *Agricultural Economics, Purdue University. ** Agricultural and Applied Economics, University of Georgia.

Abstract: The forecasting efficiency gains that can be obtained by building time series models in which the data are optimally aggregated have been studied from a theoretical perspective in numerous studies. However, an empirical study focused on the potential beneficial effects of temporal disaggregation in commodity price forecasting has not been conducted. This is the case even though commodities markets are extremely important for the economic performance of the U.S. agricultural sector such as cotton, which generated approximately $25.0 billion in revenue and was responsible for 200,000 jobs in 2008. This study evaluates the efficiency gains in forecasting cotton cash prices using alternative ARMA models with varying levels of temporal aggregations (daily, weekly, monthly and annual). The results proposed, the weekly model was the most efficient in forecasting the cotton prices suggesting that overall, disaggregation leads to gains in efficiency; consistent with the results of theoretical studies of Tiao, Amemiya and Wu, Koreisha and Fang, and the empirical study of Ramirez in oil prices and federal fund rates. These results can be very important for cotton farmers because it could allow them to elaborate better investment and hedging strategies and make money in the cotton commodity market. It does appear.

**Key words:** Forecasting, efficiency, Cotton, pricing.

Class: Graduate Student

Authors: Emre Gençer*, Dharik S. Mallapragada*, Mohit Tawarmalani**, Rakesh Agrawal*

Affiliations: *Chemical Engineering, **Krannert School of Management

Abstract: For the past century, petroleum derived liquid hydrocarbons have been the predominant fuel for the transportation sector. However, concerns regarding scarce petroleum reserves and increasing greenhouse gas (GHG) emissions from fossil fuels urge advancements in alternative transportation fuels as well as production of liquid fuels from alternative carbon sources, such as natural gas (NG), coal, and biomass. Liquid fuels derived from biomass can result in lower lifecycle GHG emissions relative to petroleum-derived fuels. However, the supply of biomass-derived liquid fuel is limited by the sustainably available (SA) biomass feedstock and the relatively low (30-40 %) carbon conversion during standalone liquid fuel production. Biomass carbon conversion to liquid fuel can be increased by using supplemental non-carbon energy. However, such processes have to overcome the intermittent nature of most non-carbon energy sources as well as their high economic cost in the short-term. The recent surge in shale gas reserves and its production, most notably in the U.S., has led to interest in utilizing NG as a bridge for the transition to a sustainable economy. Towards reducing the CO2 emissions associated with the transportation sector, we investigate the design of carbon and energy efficient processes for integrated biomass and natural gas (NG) conversion to liquid fuel. Subsequently, a mixed integer nonlinear programming model (MINLP) is formulated to identify the process configurations that maximize the energy output as liquid fuel for different ratios of NG to biomass carbon feeds (δng). For 1 % ≤ δng ≤ 150 %, the optimal process configurations are capable of producing ~5-14 % more liquid fuel output than the combined fuel output of individual standalone processes converting the same amount of biomass and NG. This synergy originates from synthesizing additional liquid fuel by combining the residual biomass carbon with the excess hydrogen per carbon available from the NG feed. These integrated processes are also estimated to achieve up to 80 % reductions in greenhouse gas (GHG) emissions relative to petroleum-based fuels.

Key words: Biomass, natural gas, liquid fuel, Greenhouse Gases
13. Redefining Engineering Education: Transformational Learning for Sustainable Communities.

Class: Graduate Student

Authors: Lindsey Payne*, Lauren Kennedy**.

Affiliations: *ESE, EAPS, Purdue University; **EEE, Purdue University

Abstract: Addressing today’s complex problems requires an integration of biophysical and socio-cultural knowledge aligning technical solutions with the interests of the users. In response to these challenges, scholars call for educational experiences for engineering students that include an understanding of the relationships between the environmental, social, political, and economic spheres of sustainability and how they affect design solutions. Unfortunately, traditional engineering education’s core focus is on technical problem solving excluding non-technical dimensions in order to make the process more efficient. This traditional engineering approach can distort problem definition and lead to inappropriate solutions for the users for which they are created. Additionally, strong historical drivers for the compartmentalization of knowledge in higher education have left researchers and practitioners without a framework to integrate multiple knowledges while addressing today’s complex societal issues. Effective project design strategies for engineers will require a significant shift from traditional business-as-usual approaches in knowledge creation toward socially engaged, context-sensitive, and transdisciplinary approaches. A synthesis of the research surrounding transdisciplinary knowledge, however, revealed that those responsible for identifying and integrating multiple forms of knowledge lack a clear understanding of what transdisciplinary knowledge is and how it is generated. This research discusses the need for a new knowledge creation framework and proposes that integrating transdisciplinary knowledge into decision-making support processes will generate useful knowledge for engineering students participating in community-based design projects. To address complex societal problems, a method for increasing awareness and understanding of, and ability to apply transdisciplinary knowledge should be created for engineering students working on community-based design projects.

Key Words: Transdisciplinary knowledge, engineering, community-based design
14. **Conventional and two-stage ditch macroinvertebrate communities**

**Class:** Graduate Student

**Authors:** Julie Speelman** and Jeffrey D. Holland*.

**Affiliations:** **Department of Entomology and Ecological Science and Engineering, * Department of Entomology, Purdue University**

Abstract: Intense agricultural practices have negatively affected water quality both near the farming sources and thousands of miles downstream. Nutrient-rich subsurface drainage enters streams and causes hypoxia, influencing aquatic communities in Midwestern agriculture ditches. These effects also contribute to hypoxia in the Gulf of Mexico. Research has shown that two-stage ditches reduce nutrient transport to streams, however, little work has been published on the biological integrity of these ditches. The purpose of this research is to compare the aquatic invertebrate communities in two-stage ditches to conventional ditches in two Indiana counties where the major land use (>90%) is row crop agriculture. Sampling was performed at each two-stage ditch and paired with a nearby conventional drainage ditch. Composite samples were taken from the sediment and the vegetated edges. Artificial substrate samplers were also allowed to be colonized at each site for a period of six weeks. Results from this study will be used to further our understanding of the macroinvertebrate communities inhabiting drainage ditches as well as lead to the creation of a water quality index that can be used to monitor this type of ecosystem.

**Key Words:** Macroinvertebrates, drainage ditch, water quality, two-stage ditch

15. **Beetle functional diversity responds to forest fragmentation**

**Class:** Graduate Student

**Authors:** Ashley L. Kissick* and Jeffrey D. Holland**.

**Affiliations:** *Entomology, Ecological Sciences and Engineering, **Entomology, Purdue University**

Abstract: Habitat fragmentation affects wood-boring beetles (Coleoptera: Cerambycidae) and their beetle predators. These two taxa respond differently to edges and exhibit different dispersal patterns. However, a functional diversity approach has not been used to explore landscape and local-scale responses to habitat fragmentation among these communities. We used biological and ecological traits of cerambycid beetle species their beetle predators to categorize these into functional groups. Abundance data on these species were collected throughout the state of Indiana among sites representing a gradient of forest fragmentation. Functional groups and functional diversity indices were calculated with trait and abundance data for these communities. The functional diversity and landscape metrics describing habitat fragmentation and quality were used in a redundancy analysis to investigate predator and prey response to forest fragmentation at
multiple spatial scales. Redundancy analysis revealed that at a spatial scale of 0.6 km landscapes that minimize forest edge harbor both cerambycid and predator communities with higher functional diversity. Furthermore, in more fragmented Indiana forests, wood-borer communities are more functionally-similar, but predator communities are more functionally-diverse.

**Key Words**: Functional diversity, forest fragmentation, environmental gradients, Cerambycidae

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16. **Therapeutic Applications for Novel Thiazole Compounds Against Multidrug-resistant Bacteria**

**Class**: Graduate Student

**Authors**: Haroon Mohammad*, Abdelrahman S. Mayhoub**, P. V. Narasimha Reddy***, Mark Cushman*** and Mohamed N. Seleem*.

**Affiliations**: *Department of Comparative Pathobiology, Purdue University; **Department of Organic Chemistry, Al Azhar University, Cairo, Egypt; ***Department of Medicinal Chemistry and Molecular Pharmacology, Purdue University College of Pharmacy and the Purdue Center for Cancer Research

Abstract: Methicillin-resistant Staphylococcus aureus (MRSA) is a bacterial pathogen that is a global health concern and is responsible for the majority of skin infections present in the United States. Many first-line antibiotics, such as mupirocin, and drugs of last resort, such as vancomycin, have been rendered ineffective as treatment agents. This underscores the urgent need for development of novel antimicrobials and unique therapeutic strategies to deal with this significant public health crisis. In the present study, we demonstrate the ability of thiazole compounds synthesized by our research group to effectively inhibit the growth of clinically-relevant strains of MRSA. Interestingly, the lead compound and two derivatives were found to be capable of being used in combination with mupirocin and vancomycin (at subinhibitory concentrations) against MRSA. When tested in a MRSA skin infection model in mice, four compounds produced a dramatic reduction in the bacterial load present in infected wounds. Furthermore, these compounds have been shown to be capable of disrupting established biofilms caused by multidrug-resistant staphylococci. Collectively, the results presented demonstrate the vast therapeutic potential of these novel thiazole compounds as potential treatment options in the future for multidrug-resistant staphylococcal infections in humans.

**Key Words**: Bacterial infections, antimicrobials, MRSA, drug resistance, skin wounds
Abstract: Due to their high nutrient content, one of the management strategies of biosolids is their reuse as a fertilizer in agronomic cropping systems. Recent studies, however, have detected relatively high concentrations of emerging contaminants in municipal biosolids including: poly/perfluorochemicals, synthetic musk fragrances, pharmaceuticals, personal care products and hormones. Preliminary research suggests that these contaminants may also be present in commercially available biosolids-based fertilizers. Application of these products in urban and suburban gardens and green space may therefore provide a pathway for these organic contaminants to enter the terrestrial food web and nearby ecosystems. The objective of this study is to quantify the degradation kinetics of targeted contaminants present in commercial biosolids-based fertilizers. Of particular interest are: the poly/perfluoroalkyl substances, pharmaceuticals (e.g., ibuprofen), personal care products (e.g., triclosan, triclocarban, and methyl parabens), hormones (e.g., estrone and estradiol), plasticizers (e.g., bisphenol A, S, and AF), synthetic musk fragrances (e.g., galoxide and tonalide) and brominated flame retardants. Based on previously published studies, we hypothesize that many of these compounds (e.g., poly/perfluoroalkyls, fragrances, brominated compounds) will persist after application; however, other compounds (e.g., estradiol and estrone) will degrade rapidly after application. The slow-release nature of these fertilizers, however, may allow these contaminants to persist longer than predicted. For this study, three soils were selected based on their relevance to urban and suburban gardens: a soil obtained from a community garden, a commercially-available top soil, and a commercial potting mix. Aerobic microcosms are prepared by pre-incubating soil at 75% field capacity. Soils are then amended with a heat-treated commercial biosolids-based fertilizer (i.e., Millorganite, Bay State Fertilizer, or OceanGRO) based on the recommended application rates. All microcosms are stored in an incubation chamber at 23° C, in the dark, until time of sacrifice. Microcosms are weighed, sterile ultra-pure water added (if needed), and aerated weekly to maintain a consistent moisture content and aerobic conditions. Sampling design of microcosms includes sacrificing triplicate sets at 0, 7, 14, 28, 56, 112, and 168 days. Soil blanks and no-solid controls are included to discern background concentrations of contaminants in the soil and extract solutions. Fertilizer only controls are included to evaluate the stability of the compounds in the fertilizers in the absence of soil. CO2 and O2 are monitored periodically after 2 weeks to confirm that the microcosms are still viable. All samples are extracted using 3 sequential ultrasonic assisted extractions using MeOH+base, followed by a single extraction of MeOH+acid. Extracts are combined, concentrated under nitrogen, and cleaned up using ENVI-CARB. Internal standards for representative compounds are added prior to analysis to account for matrix effects. All samples are analyzed on an LC-QToF/MS or GC-MS. Although still early in the study, this work, combined with future work assessing the potential for
bioavailability and transport, will improve our ability to make accurate risk assessments and help provide guidance for the safe use of these fertilizers in urban and suburban systems.

**Key Words:** Biosolids-Based Fertilizer, Persistence, Aerobic Degradation, Emerging Contaminants

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**18. Cross Talk: Communicating Across Cultures as a Model for Interdisciplinary Research**

**Content and Context**

**Class:** Graduate Student

**Authors:** Ronald Smith¹, Pamala Morris², and Errol Rhoden³

**Affiliations:** ¹Ecological Sciences and Engineering, Purdue University, ²College of Agriculture, Purdue University, ³Department of Agricultural and Environmental Sciences, Tuskegee University

Complex problems require interdisciplinary solutions. Interdisciplinary research requires intercultural communication, and these interactions are location- and context specific, and shaped according to need. Hall's cultural taxonomy is a means for evaluating the context and outcomes of interdisciplinary groups. The course “Communicating Across Cultures” was audited to evaluate intergroup norms and their implications for interdisciplinary research. The main findings of the course were: (1) students displayed different levels of cultural and disciplinary awareness, (2) cultural and disciplinary values and biases affected problem evaluation and framing, and communication and contributions, (3) participants exhibited different responses to uncertainty and complexity in mixed group situations, (4) democratic, self-reflective groups utilized difference and conflict as drivers of creativity, and (5) top-centered decision making added context to groups and inhibited communication. Group success was determined by group size, leadership behavior, perceived expertise and performance of group members, and understanding between completion and cooperation. These factors determined the likelihood of and quality of conflict, and the transition from low context to high context using Hall's taxonomy of culture. These results have implications for enhancing the adaptive capacity of current interdisciplinary collaboration and Land Grant University leadership in the future.

**Keywords:** Interdisciplinarity, culture, communication
19. Energy Harvesting using Piezoelectrics

Class: Undergraduate Student

Author: Seung Yun Song.

Affiliation: Material Science and Engineering, Purdue University.

Abstract: Various engineering solutions to obtain clean and efficient energy source such as solar cells, biofuel, and wind turbines are heavily researched. However, piezoelectric materials emerge as a novel solution that can harvest electrical energy from mechanical vibrations created by footsteps in crowded places such as concerts or any moving machinery such as automobiles. In order to find the material with strong piezoelectric behavior, we have defined a computational simulation model using Object Oriented Finite Element model (OOF2) that generates a realistic piezoelectric microstructure of ceramics such as Barium Titanate (BaTiO3) and BCT (BaCaTiO3) with different grain size, poling (direction of crystal orientations), texture (randomness of crystal orientation), and granular piezoelectric behavior. Simulation results show that higher degree of poling and texture of polycrystalline sample directly relate to greater electromechanical response and closer resemblance to single crystal properties.

Key Word: Energy Harvesting


Class: Graduate Student

Authors: Tolu Omotoso, Rabi Mohtar, Ernest R. Blatchley III, Bernard Engel3, Klien Illeleji, Juan Sesmero4, Martin Keulertz, Basel Daher

Affiliations: Civil ENgineering, Agriculture and Biological Engineering, Purdue University;Texas A &M University

Abstract: By 2050, the world will need to feed 9 billion people. This will require a 60% increase in agricultural production and subsequently a 6% increase in water use (FAO, 2012). With only about 7% of the hydropower capability in Africa utilized so far, it is projected that this value will increase over the next 35 years (World Energy Council, 2010). Although hydropower is not a net consumer of water, water held behind dams for this purpose is not immediately available for other uses such as irrigation. This creates a trade-off scenario between water, energy and food, which is not properly understood. This project aims at quantifying these trade-offs using a staple crop production zone in Nigeria as a case study.
21. Seedling Uptake and Fate of Soil-applied Capsaicin, a Potential Browse Deterrent

Class: Undergraduate Student

Authors Carmen Dobbs, Joshua Sloan, and Douglass Jacobs.

Affiliation: Department of Forestry and Natural Resources, Purdue University

Abstract: Seedling damage due to browse constitutes a major challenge to afforestation and reforestation efforts in the Central Hardwood Forest region of the USA. Many efforts have been made to deter herbivores, but the costs, implementation methods, and relative ineffectiveness of existing mitigation options often preclude operational implementation. An alternate means of deterring wildlife browse is capsaicin, a hot pepper concentrate, which has been reported to decrease herbivory of tree seedlings and is available in a controlled-release form designed to act systemically following application to the soil and subsequent plant uptake. However, the degree to which seedlings are capable of absorbing capsaicin from the soil solution and the location of absorbed capsaicin within the plant remain largely unexamined. A greenhouse experiment was conducted to determine the potential absorption of soil-applied capsaicin in post-transplant northern red oak (Quercus rubra L.) seedlings in conjunction with a growth chamber study investigating the fate of capsaicin in the soil. In the first experiment, each seedling received the recommended dose of 0.03g of soil-applied capsaicin, was separated into roots, leaves, and stems at three and five weeks after capsaicin application, and was analyzed using QQQ-LC/MS. No capsaicin or capsaicinoids were found in any of the tissues. Capsaicin was quantified in the soil, leachates, and ambient air using QQQ-LC/MS in a related experiment with the same growing conditions and capsaicin application rate. These results reflect observed efficacy of capsaicin in the field, and the implications of this study should be considered when evaluating animal browse mitigation measures.

Key Words: Deer browse, capsaicin, forest restoration, animal browse

22. Develop a software application translates manufacturing data into meaningful information for improvement of design process.

Class: Graduate Student
Abstract: Manufacturing firms design and make products to satisfy the needs of customers. Often times, the manufacturing firms are not able to translate designs into tangible goods because the existing manufacturing process capability is not considered within the design process. Scholars and practitioners have identified the need of using manufacturing process capability data to achieve producible designs.

This research aims to develop a new design tool in a form of software. This new design tool translates manufacturing process capability data into meaningful information and delivers the information to designers. The new design tool is in a format of software which has an interface capability with computer aided design (CAD) program. A precision machining manufacturing firm will be selected for the development and validation of the design tool. The new technology will be evaluated and validated through a field experiment. This new technology will minimize the amount of wastes such as redesign, scrap, rework or long lead time within the design process.

Key Words: Manufacturing technology development

23. Characterization and Reclamation of Railroad-Impacted Soils

Class: Undergraduate Student

Abstract: While creosote is a common wood preservative used to protect railway ties from degrading, its use can pose an environmental risk if polycyclic aromatic hydrocarbons and heavy metals in the preservative leach into the surrounding environment. In addition to the impact on local vegetation, including plant death, these contaminants have been linked to adverse ecological and health effects. This study focuses on the characterization and reclamation of railroad-impacted soils from locations near urban, suburban and rural/agricultural railways. Sampling sites were selected based on evidence of plant toxicity (i.e., decreased yields) in the rural/agricultural soils and concerns raised by stakeholders regarding land use planning (e.g., playground and community gardens) in suburban and urban sites. The objectives of this study are to (1) identify contaminants present in selected soils (e.g., PAHs, pesticides, and heavy metals), (2) evaluate the soil's ability to support intended stakeholder use (e.g., playground and community gardens), and (3) assess the impact amendments (e.g., biosolids, biochar, synthetic fertilizers) have on plant health and contaminant uptake. Organic contaminants will be extracted using ultrasonic-assisted solvent extraction, while metals will be extracted using microwave-assisted acid digestion. Extracts will be
analyzed for organic contaminants and heavy metals using an LC-QToF/MS, GC/MS, or ICP/MS. Following the identification and quantitation of contaminants in the soil, a greenhouse study will be used to quantify the uptake potential and impact of these contaminants in site-specific vegetation (e.g., tall fescue and rye grass as models for forage and recreation). Changes in plant health, contaminant levels in the plant, and contaminant stability in the soil with the addition of biosolids and biochar will be compared to an inorganic fertilizer-only amendment. Plant tissues, roots, and the bulk soil will be sampled at plant maturation to quantify organic contaminants and heavy metals. We hypothesize that biosolids will improve plant health/yield by decreasing the uptake of contaminants into plant tissues while increasing soil health via the addition of nutrients and soil organic matter. Biochar will slow the mobility of potential contaminants, but it may also tie up plant nutrients and reduce biodegradation of organic contaminants. Results of this study will help address concerns about decreased plant yield in rural/agricultural soils, aid in risk assessment of suburban/urban soils and subsequent land use decisions, and improve our understanding of how soil amendments may aid in reclamation of railway impacted soil.

**Key Words:** Creosote, heavy metals, biochar, biosolids, railroad, reclamation

24. **Stabilization of Antimony, Lead, and Arsenic in Small Arms Firing Range Soils.**

**Class:** Undergraduate Student

**Authors:** Joaquim P. Cuvaca*, Michael L. Mashtare**, and Linda S. Lee**.

**Affiliations:** * College of Agriculture, EARTH University, Costa Rica and ** Department of Agronomy, College of Agriculture, Purdue University

Abstract: There are currently over 12,000 active military and non-military small arms firing ranges (SAFRs) in the United States. The deposition of spent and unspent ammunition in SAFR soils has resulted in hotspots of EPA priority pollutants including lead, antimony, and arsenic. These contaminants have demonstrated potential toxicity in mammals (e.g., acute and chronic illness, carcinogenesis, and reproductive disorders) and in plants (e.g., decreased yield, stunted growth, and plant death). Although SAFRs are typically confined to small geographic areas, there is a large number of SAFRs and design of these areas (e.g., surrounding by impermeable parking lots, etc.) has a high potential for SAFRs’ contaminants to runoff into nearby surface waters or leach into ground water. The stabilization of lead, antimony, and arsenic, has proven to be a challenge conditions favorable for reducing the bioavailability of lead (e.g., alkaline conditions) can increase the lability of arsenic and antimony. The current study focuses on the reclamation of SAFR-impacted soils. A composite of three U.S. military SAFR soils was selected: (1) to characterize the metal and metalloid concentrations in the representative SAFR soil; and (2) to evaluate the effect of soil amendments on plant/groundcover health and contaminant uptake. Metals and metalloids will be extracted using microwave-assisted acid digestion. Extracts will be analyzed using an ICP/MS. A greenhouse study will be used to quantify the potential contaminant uptake and impact on groundcover health (e.g.,
tall fescue and rye grass). Differences in plant health/yield and contaminant levels in the plant tissues, roots, and bulk soil will be compared between the following treatments: (1) neutralized mine tailings, (2) neutralized mine tailings and biosolid amendments, (3) biosolids amendments, and (4) an inorganic fertilizer-only amendment. Relative to the inorganic fertilizer, we hypothesize that biosolid amendments will support plant health/yield by improving soil tilth and providing nutrient support, while increasing sorption of lead (thus decreasing lability). The addition of mine tailings, which contain iron oxides, will increase sorption of lead, arsenic, and antimony, even under alkaline conditions. These amendments should decrease the soil-solution concentrations of these contaminants, decreasing their potential for plant uptake and leaching. The improved plant health and yield should also decrease the potential for runoff of contaminated soils during rain events. Results of this study may provide a potential reclamation strategy of SAFR-impacted soils, while providing another use of recycle waste including mine tailings and biosolids.

**Key Words:** Antimony, arsenic, lead, mine tailings, SAFR, reclamation

### 25. Evaluating Contaminants of Emerging Concern in Commercial Biosolid-based Fertilizers.

**Class:** Undergraduate Student

**Authors:** John R. Hemmerling*, Michael L. Mashtare**, Linda S. Lee**.

**Affiliations:** *School of Chemical Engineering and **Department of Agronomy, Purdue University.

**Abstract:** The production and popularity of commercially available biosolid-based fertilizers are increasing because of their economic, environmental, and plant nutrition benefits, particularly in urban and suburban areas. Because biosolid-based fertilizers are derived from waste water treatment plant residuals, we hypothesized that there is the potential for micropollutants to persist in these products. Their presence would be of particular concern due to their potential impact on human and ecological health and risk of bioaccumulation. This study involves quantifying contaminants of emerging concern in three biosolid-based fertilizers, and 2 non-biosolid-based fertilizers, a composted animal manure and an organic compost. Our extraction method employed ultrasonic assisted solid-liquid extraction followed by a 20 h equilibration during which samples were rotated end-over-end. Prior to analysis, all solvent extracts were concentrated under nitrogen and cleaned up with ENVI-carb to minimize matrix effects during sample analysis. High performance liquid chromatography tandem mass spectrometry (LC-MSMS) and quadrupole time of flight liquid chromatography mass spectrometry (QTOF-LCMS) were used to identify and quantify a suite of micropollutants including perfluoroalkyl substances (PFASs), hormones, parabens, pharmaceuticals, and personal care products. Variable levels of contaminants ranging from 8.22 to 11,300 ppb were found in the biosolid fertilizers, while the nonbiosolid fertilizers contained much smaller concentrations. Milorganite had 14 contaminants, OceanGRO had 13, Elite Lawn had 16, New Plant Life Composted Manure had 1, and Pro-Mix Ultimate Organic Mix had 3. Although many of these chemicals persist in commercially available biosolid-based fertilizers,
future research is still needed to determine what, if any, potential risk these contaminants may pose to human or ecological health at the concentrations detected.

**Key Words:** Biosolid, contaminants of emerging concern, fertilizer

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26. **Designing Curriculum for Middle-School Students (5-8 Grades) to Teach Soundscape in Science Camps through Informal Learning.**

**Class:** Graduate Student

**Authors:** MaryAm Ghadiri, Bryan C. Pijanowski.

**Affiliations:** Department of Forestry and Natural Resources.

**Abstract:** Industrialization and urbanization made people disconnected from nature, especially younger generations. Children are exposed to different electronic devices such as televisions, portable gaming devices and computers that make them spend most of their time indoors and be deprived of exploring nature. Soundscape is a natural resource that is getting scarce due to land use change and climate change and children need to be aware of them to appreciate natural soundscape and help scientist to protect nature. Soundscape is the acoustic properties of a place, composed of sounds from biological, geophysical and anthropogenic sources in a particular location. Biodiversity is known to correlate with the diversity of biological sounds occurring in an ecosystem, and the geophysical sounds are produced by the movement of fluids – air and water – that is a reflection of earth's climate. Anthropogenic sounds, many of which we consider to be noise, are produced by our activities. Using all of these sounds gives scientists a means to measure ecosystems and human activities at the same time. Students can learn about this ecological topic through informal learning in science camps. We are designing a curriculum that is a collection of activities that teach middle school youth about sound, soundscape and why it is important and why it needs to be protected from interference by us which is called YELLs (Your Ecosystem Listening Labs).

**Key Words:** Education, Soundscape, Middle-school, Curriculum

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27. **Investigating Constraints to Attaining Food and Nutritional Security among People Living with HIV/AIDS in Western Kenya.**

**Class:** Graduate Student

Affiliations: *Department of Agronomy, **Center for Global Food Security, ***Department of Horticulture and Landscape Architecture, Purdue University, West Lafayette, IN, ****Academic Model Providing Access to Healthcare (AMPATH) Kenya.

Abstract: For people living with HIV/AIDS, food insecurity is associated with decreased antiretroviral adherence, incomplete virus suppression, and decreased survival. We conducted a preliminary investigation on the constraints to food production faced by rural smallholder farmers infected and affected with HIV/AIDS in western Kenya. We did this by conducting preliminary soil and landscape assessments and focus group discussions among people living with HIV/AIDS in three rural communities. We found that up to 58% of farmers paid little attention to soil quality. Access to land still remains a challenge especially to women. All communities face a 'hunger season', when adequate food is scarce. Fertilizer use still remains organic due to expensive inorganic fertilizers. Even though crop diversification is practiced, corn (Zea mays) forms the main staple crop. Low agricultural production has been exacerbated by the parasitic weed Striga and this has led to an increasing lack of trust in seed companies as a result of continued failure of seed varieties that are resistant to Striga and drought.

Key Words: Hunger Season; HIV/AIDS; Striga.

28. Role of Catalysts in biomass gasification.

Class: Graduate Student

Authors: Nitish Kumar*, Elizabeth Wachs**, Prithviraja Basak*, Indraneel Sircar*** and Jay Gore*.

Affiliations: *Maurice J. Zucrow Laboratory and School of Mechanical Engineering, **School of Chemical Engineering, ***Celanese Corporation. Purdue University.

Abstract: Objective of the research is to make biomass gasification more energy efficient and make it energy sustainable. Study involved studying reaction rate of char+CO2 reaction. Effect of temperature and pressure are studied. Then, effect of time of addition of catalysts on reaction rate is studied. Future work is proposed on usage of nano-catalysts to improve reaction rate and make it more energy efficient.

Key Words: Biomass, Gasification, Catalysts

29. International Comparison of Maize and Soybean Production

Class: Graduate Student

Author: Elizabeth Lunik.
**Affiliation:** Agricultural Economics, Purdue University.

Abstract: One of the greatest challenges of this century will be how to “feed and fuel” growing populations given scarce resources, climate change, and unstable economic markets. Only the most competitive and efficient farmers will be able to survive in this future arena. But just how competitive are U.S. farmers—does the U.S. have the “BEST” agricultural system? This study looks at farm-level production data around the world to see which farmers are most competitive by comparing output and input quantities and prices. It analyzes which farm or agronomic characteristics explain these differences, such as crop intensity, rotation systems, or annual rainfall. Economics 101 concepts about quantities, prices, technology, and trade are extended to understand global food production. Comparing detailed production costs and input use across countries allows farmers to see how they match up to similar operations in other countries. The results explain the large differences among developed and emerging countries, which should be considered to design agricultural programs that integrate the best production practices to meet future food demands and ensure farmers can earn an equitable income.

**Key Words:** Corn; soybeans; efficiency; competitiveness

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**30. Agriculture in a changing climate: Does adaptation matter?**

**Class:** Graduate Student

**Authors:** Sajeev E.M.*, Benjamin Gramig*.

**Affiliations:** Department of Agricultural Economics.

Abstract: Climate change is affecting agriculture. Accumulation of GHGs in the atmosphere has led to rising temperatures, reduced precipitation and other extreme events like droughts and floods. Crop yields are vulnerable to these climate induced factors, as seen by a decreasing rate in crop production over the recent years. Although adaptation could be key in combating climate change impacts, the effectiveness of adaptation strategies are not well understood. Hence, there is a need to assess the impacts of climate change on agriculture and devise profitable adaptation strategies to combat its effects. This study using crop and empirical models along with a linear optimization platform aims to provide an integrated assessment of climate change impacts, identify farm-level adaptation practices and estimate their cost and subsequent profitability. The results would help farmers, crop advisors and policy makers better understand the impact of a changing climate on agriculture and identify viable adaptation strategies to combat its effects.

**Key Words:** Climate change, agriculture, adaptation, linear optimization, crop models
31. Validation of a Neutron Activation Analysis (NAA) System to Quantify Manganese In Vivo

Class: Graduate Student

Authors: Yingzi Liu, Wei Zheng, Linda H. Nie.

Affiliation: School of Health Sciences, Purdue University.

Abstract: Manganese (Mn) is an essential trace element to human health. However, overexposure to Mn can lead to various diseases, especially neurological disorders. There is by now no ideal way to assess the long term cumulative Mn exposure level. We hypothesize that bone Mn can be a desirable biomarker since bone is one of the main storage organs for Mn (~40%) and Mn releases slowly from bone. In this project, a novel transportable neutron activation analysis (NAA) system has been developed to quantify Mn in human hand bone in vivo. An advanced deuterium-deuterium (DD) neutron generator was used as the neutron source, a neutron moderating/reflecting/shielding construction was built to optimize the neutron characteristics, and a high efficiency HPGe detector was used to measure the Mn characteristic gamma rays. With the currently detection limit (DL) of 0.37 ppm, this system is promising for human studies.

Key Words: Mn, neutron activation analysis

32. A therapeutic protocol for treatment of brain metastasis through optically stimulated drug release

Class: Graduate Student

Authors: Akshay Prabhu Verleker*, Mi-Ran Choi**, Susan Clare**, Keith Stantz*.

Affiliations: *School of Health Sciences, Purdue University. **Indiana University - School of Medicine.

Abstract: Treatment of Central Nervous System (CNS) metastasis poses a critical clinical challenge due to limitations in drug uptake in the brain and adverse neurotoxic effects of mainstay therapies such as whole brain radiation therapy (WBRT) and stereotactic radiosurgery. The goal of this study is to deliver lapatinib-gold nanocomplex laden macrophages to brain metastasis and design a therapeutic protocol to optically stimulate drug release in target tissues in the brain. With the rate/quantity of drug release being directly dependent on the optical power delivered, this study will design an optical simulation protocol, using a fast 3D Monte Carlo simulation tool, to effectively predict the photon distribution and subsequent drug activation in the brain tissue. We have designed and calibrated an optical dosimetry probe with an isotropic response and tested the validity of the Monte Carlo in an optical brain phantom, which will be tested further in phantoms doped with drug molecules. Finally, an optical treatment protocol will be designed to predict the best irradiation conditions for optimized drug activation in the brain. An optimized treatment plan
using a fast Monte Carlo software would significantly reduce the treatment time and allow targeted
drug activation while sparing healthy tissues.

**Key Words:** Optically activated drug release, brain metastasis, cancer research, Monte Carlo
simulation

33. **Increased rainfall variability and nitrogen fertilization accelerate nutrient cycling in a
restored prairie**

**Class:** Graduate Student

**Authors:** Michael J. Schuster*, Jeffrey S. Dukes* **

**Affiliations:** *Forestry and Natural Resources, **Biological Sciences, Purdue University

Abstract: Both anthropogenic nitrogen deposition and climate change-induced increases in rainfall
variability are expected to strongly alter ecosystem functioning, yet no studies have examined the
interaction of the two on plant decomposition. Using a combination of rainout shelters and
fertilizer, we examined how more variable rainfall patterns and elevated nitrogen availability
influenced the leaf litter chemistry and decomposition of two dominant tallgrass prairie
species: Schizachyrium scoparium and Solidago canadensis. Leaf litter from each of our four
treatment combinations was decomposed in the same conditions under which it was grown as well
as the other three treatment combinations, allowing us to isolate the effects of our treatments
during litter production and during the decomposition process. During litter production, nitrogen
addition made litter more susceptible to future decomposition. In contrast, increased rainfall
variability resulted in more resilient litter. Surprisingly, this litter still decomposed more rapidly
than litter grown under ambient rainfall. During decomposition, nitrogen addition and increased
rainfall variability accelerated decomposition. In all cases, litter of S. canadensis decomposed faster
and was more responsive to our treatments than litter of S. scoparium. These results suggest
generally faster nutrient cycling in future grasslands exposed to increased rainfall variability and
chronic nitrogen addition.

**Keywords:** Climate, nitrogen, ecosystem services, prairie
Abstract: Enhancing students’ analytical ability of interpreting complex hydrologic processes from limited classroom environment has been a subject of long-standing research. From this perspective, a new internet-based educational tool, called RWater, is developed using Purdue University’s HUBzero technology. The current version of RWater interface includes the following three elements: (i) coding workspace, (ii) visualization window, and (iii) instruction modules, providing a self-contained learning environment that instructors and students can use from any location and/or device. Following real-time hydrologic data-driven modules, students can write small scripts in R to create visualizations identifying the effect of rainfall distribution and watershed characteristics on streamflow response, seasonal characteristics of hydrologic cycle, and investigate the impacts of landuse change on streamflow. Each module contains relevant definitions, instructions on data extraction and coding, as well as conceptual questions based on the possible visualizations which the students would create. While the development of RWater was motivated by the need to include cyber-enabled hydrology instruction for middle and highschool students, it can also be used for undgraduate or graduate education.

Key Words: RWater, Hydrology, Education