2014-2015 DYF Awardees' Info and Abstracts

1. Name (Last, First): Liu, Chao
Program/Dept.: Chemistry
Dissertation Chair/Advisor: Gonghu Li
Abstract: Carbon dioxide is a renewable carbon feedstock for the production of chemicals, materials, and fuels. Photochemical reduction is a promising approach to achieving sustainable CO2-to-fuel conversion by using natural sunlight as the energy input. Currently, we still lack efficient photocatalysts for CO2 reduction. I have been working on photocatalytic CO2 reduction for 3 years and have published several peer-reviewed journal articles. Built on my recent results, my thesis research will combine light-harvesting quantum dot nanocrystals with catalytic metalorganic frameworks to achieve efficient CO2-to-fuel conversion under photochemical conditions. This highly interdisciplinary project involves extensive catalyst synthesis and catalyst characterization with a variety of techniques, including BET surface area analysis, gas chromatography, and spectroscopy. My dissertation highlights the advantages of integrating well-defined transition metal catalysts with robust nanostructures in photocatalysis. Therefore, results generated through my dissertation research will provide key insights regarding the design of novel photocatalysts for efficient solar energy conversion.

2. Name (Last, First): Mensching, David
Program/Dept.: Civil Engineering
Dissertation Chair/Advisor: Jo Sias Daniel
Abstract: If you have driven a car over asphalt pavement, you have encountered a crack or worse, a pothole. They frustrate us all, requiring countless dollars to rehabilitate the roadway (or your own car!). My research on asphalt materials is intended to streamline design of crack resistant pavements by developing a parameter that will predict whether or not the pavement will crack. Cracking occurs due to a combination of traffic loading, pavement materials, environmental conditions, and the properties of the underlying layers. The parameter will be calibrated with commonly used materials and structures to create a relationship where a "material score" and a "structure score" lead to a final cracking index. The dissertation research will benefit the field by enabling contractors and owners (states and local governments usually) to gain insight into which asphalt mixtures work with which pavement structures, allowing for time and cost savings to the industry and public.

3. Name (Last, First): Li, Ying
Program/Dept.: Computer Science
Dissertation Chair/Advisor: Radim Bartos
Abstract: When a disaster strikes, the ability to communicate is of the utmost importance during the search and rescue operations. Disasters may occur in locations without any communication infrastructure, or may cause the destruction of or serious damage to the existing infrastructure. The need for rapid response and limited resources may not permit a complete communication infrastructure buildup or full repair. Despite this need, there are no existing network technologies that can provide low-cost reliable communication in scenarios characterized by intermittent connectivity and lack of communication infrastructure. In my research, I define a new category of networks to provide communication for such scenarios, and in particular, I am studying, designing, implementing, and evaluating protocols for such networks that address issues of routing, error control, flow control, storage management, and energy-efficiency.

4. Name (Last, First): Wight, Shauna
Program/Dept.: English
Dissertation Chair/Advisor: Christina Ortmeier
Abstract: Students whose parents do not hold a bachelor's degree are less likely to enroll in college or complete a degree. Although multiple factors contribute to this achievement gap, limited access to academic literacy both at home and school often restricts these students' educational trajectories within and beyond high school. With poor performance on literacy assessments often segregating these students into low-level coursework with limited writing instruction, this cycle of inopportunity denies them exposure to the literacy experiences necessary for advancement and prevents them from identifying themselves as college material. My dissertation explores a possible disruption in this cycle, Upward Bound, a federally funded college preparatory program that serves this specific population. By examining the role of a literacy resource unexplored within existing scholarship and identifying factors that can undermine transitional programs, this study provides educators with valuable knowledge for designing interventions and reforms that can address existing achievement gaps.

5. Name (Last, First): Dietrich, Lucas
Program/Dept.: English Literature
Dissertation Chair/Advisor: Sarah Sherman
Abstract: At the turn of the twentieth century, prior to the Harlem Renaissance, U.S. writers of color were just beginning to gain access to mainstream literary publication. While studies of this literature often deal with important themes of racial oppression, much less is known about how the authors themselves took part in a predominantly white publishing industry. My research examines a selection of writers of color from this era—Charles W. Chesnutt, Zitkala-Sa, Finley Peter Dunne, Sui Sin Far, and W.E.B. DuBois—with a focus on the way they were marketed, advertised, and reviewed. The project will offer a literary history for the way these writers were understood, across lines of race, by a contemporary audience. It thus has broader implications for how literary writing influenced the emergence of a multicultural U.S. nation.

6. Name (Last, First): Aklilu, Behailu
Program/Dept.: Genetics
Dissertation Chair/Advisor: Dr. Kevin Culligan
Abstract: Challenging human health issues include treatments for genetic diseases, and providing improved agricultural crop output to feed the growing world population. My project described here, which focuses on how cells respond to chromosomal (genomic) damage, has significant implications in each example. In humans, accumulation of DNA-damage-induced mutations can result in genetic disease such as cancer, and in plants can similarly result in genome instability, reducing productivity. Organisms from plants to humans have conserved repair mechanisms to counteract DNA damage. Specifically, my research focuses on the role of RPA1 as a regulator of the cellular response to DNA damage, in the model plant Arabidopsis. While this research may not directly lead to cures for cancer, my project will lead to valuable information about the basic principles of how cells react to DNA damage, and in plants could lead to improved crop species that are resistant to environmental agents that damage DNA.

7. Name (Last, First): Gallaher, Molly
Program/Dept.: History
Dissertation Chair/Advisor: Lucy Salyer
Abstract: Religious historians have long ignored the borderlands of northern New England- Maine, New Hampshire, and Vermont- in their studies of American Catholicism. Focusing on the city of Boston during the period following Irish Famine immigration, they have told a story which begins during the mid-nineteenth century, peaks at the turn of the twentieth century, and overlooks the contributions of other racial and ethnic groups to the institutional Church. In response, my dissertation argues that a borderlands approach to North American Catholic history is necessary. In looking at the lands situated between America and Canada, a vivid picture of religious life among French Canadians, Native Americans, and English converts from Protestantism emerges well before the period of Irish immigration. I argue that during the early nineteenth century, the idea of "American" Catholicism was fluid, as the northern New England borderlands shared a close connection with the Catholic Church in Canada.

8. Name (Last, First): Zang, Ye
Program/Dept.: Mathematics
Dissertation Chair/Advisor: Don Hadwin
Abstract: The study of the Calkin algebra and Fredholm theory has been an important part of many areas of mathematics and physics: functional analysis, operator algebras, differential geometry, logic, integral equations and partial differential equations. Hundreds of papers have been written on the subject by famous mathematicians. My work studies Calkin algebras related to different sizes of infinity, and it will add new useful information to this rich theory

9. Name (Last, First): McClain, John
Program/Dept.: Integrated Applied Mathematics
Dissertation Chair/Advisor: Jian-Ming Tang
Abstract: An understanding of material surfaces is crucial to the discovery of new materials and the design of new devices for energy and electronics applications. The most important processes in solar cells and batteries occur at surfaces. Displays and touch screens are surfaces through which we interact with devices filled with components built layer by layer (with a surface at each stage). My dissertation project consists of creating a better computational method for the analysis of data from an important experimental probe of the surface layers of materials, the low-energy electron microscope (LEEM). Using modern simulation techniques in quantum mechanics, I will produce a framework for the analysis of LEEM data that makes fewer assumptions and is applicable to a wider class of materials than existing methods, making this device a more useful probe of nanoscale properties of materials and an even more valuable tool in the creation of new technology.

10. Name (Last, First): Wen, Baole
Program/Dept.: Integrated Applied Mathematics
Dissertation Chair/Advisor: Gregory Chini
Abstract: A pressing environmental protection issue is how to reduce global atmospheric carbon dioxide (CO_2) levels. One promising means of addressing this challenge is via injection of captured CO_2 into geological formations. However, reliable evaluation of injection scenarios, estimation of reservoir storage capacities, and assessment of leakage risks requires improved mathematical and computational models. A primary modeling challenge is predicting the flow of the liquid brine within the porous rock layers, which is driven by the dissolution of the injected gaseous CO_2: the resident brine becomes top-heavy and sinks in plumes, a phenomenon known as buoyancydriven convection. My dissertation

research on porous medium convection will provide valuable insights into the transport of dissolved CO2, ultimately helping geo-scientists predict the reservoir capacity and storage security of terrestrial aquifers. More fundamentally, porous medium convection is a prototypical pattern-forming, spatiotemporally-chaotic system. Thus, this study will also further our general understanding of nonlinear systems.

11. Name (Last, First): Firat, Eren
Program/Dept.: Mechanical Engineering
Dissertation Chair/Advisor: May-Win Thein
Abstract: Unmanned Underwater Vehicles (UUVs) are used in underwater operations that are difficult and dangerous for human divers. Such operations include search and rescue missions, inspection of large underwater structures, investigations of ship wrecks, and non-invasive observation of marine wildlife and sea/ocean floors. My research of developing a Dynamic
Positioning (DP) system using optical communication sensor systems would enable the simultaneous control of multiple UUVs. With the use of a multiple UUV system, instead of using only a single UUV at a time, the efficiency of performing underwater operations would be significantly increased, reducing mission time and costs. In addition, by using cost-efficient optical sensors, as opposed to expensive acoustic sensors, operating and manufacturing these
UUV systems would further reduce UUV mission costs. As a result of this research, UUV systems would be more widely accessible and would more effectively help perform dangerous underwater operations without risk to human divers.

12. Name (Last, First): Walsh, Jennifer
Program/Dept.: Natural Resources and Earth Systems Science
Dissertation Chair/Advisor: Adrienne Kovach
Abstract: Hybridization (the successful interbreeding of two species) has numerous potential consequences for interacting species, as well as important evolutionary and conservation implications. Investigating the outcomes of hybridization in natural populations can help predict the future status and distribution of the interacting species, provide insight for managing “pure” populations of a vulnerable species, and increase our knowledge of the speciation process and mechanisms responsible for maintaining biodiversity. My dissertation research focuses on investigating patterns of hybridization in two bird species of high conservation priority in the northeastern U.S. – the Saltmarsh and Nelson’s sparrows. Through integrating ecological and genetic approaches, I will investigate the causes and consequences of hybridization between these two species. To address my objectives, my research design tests key predictions of evolutionary theory. My results will inform conservation efforts for Saltmarsh and Nelson’s sparrows and increase our understanding of the mechanisms underlying speciation.

13. Name (Last, First): Larson, Amanda
Program/Dept.: Physics
Dissertation Chair/Advisor: Karsten Pohl
Abstract: Understanding electronic devices down to the atomic scale is essential for the development of novel organic molecule based nanotechnologies. For organic solar cells where photon energy is converted through processes occurring between individual molecules and atoms, it is beneficial to be able to ‘see’ the interactions taking place at this scale. Through the use of a state-of-the-art scanning tunneling microscope, I image new organic molecules to understand their structural and electronic properties at the molecular level. By focusing on the promising molecule TTPO, my dissertation examines this unique organic molecule on a metal surface at the nanoscale, with the motivation of

improving the energy conversion efficiency in this model organic photovoltaic interface. My fundamental research on understanding TTPO at the molecular level can potentially be used for the tailoring of promising photovoltaic devices with dramatically increased efficiency.

14. Name (Last, First): Cole, Lindsey
Program/Dept.: Psychology
Dissertation Chair/Advisor: Ellen Cohn
Abstract: Eyewitness testimony is one of the most influential aspects in a trial; however, it is also notorious for being an inaccurate source of information. Who the eyewitness is may affect how credible that witness is perceived to be as well as the verdict rendered by a juror. Police officer witnesses have been shown to be perceived as more credible compared to layperson witnesses by jurors, despite the fact that they do not possess superior skill in identification or memory for an event.
Furthermore, the reputation of the police officer witness as well as the jurors' preexisting attitudes about the police have also been shown to influence juror decision-making about the case. The purpose of the current proposed studies is to use a multi-methodological approach to understanding the role of police officers versus laypeople as witnesses in the courtroom, witness reputation, and perceptions of police versus laypeople eyewitnesses in juror decision-making.

15. Name (Last, First): Young, Justin
Program/Dept.: Sociology
Dissertation Chair/Advisor: Michele Dillon
Abstract: Americans today are more likely than ever to live in neighborhoods where numerous racial/ethnic groups are represented. Sociologists argue that integrated neighborhoods are an important step toward reducing racial inequality and increasing tolerance, yet we know little about how residents of integrated neighborhoods are connected to one another. Research has focused on differences in the quantity of interpersonal ties (also known as "social capital") between residents in more and less diverse neighborhoods, ignoring how cross-racial connections are cultivated and whether they actually increase tolerance and improve quality of life. Using ethnographic observations, in-depth interviews and archival data, I examine the formation of interpersonal ties (and the outcomes of such connections) among residents in four neighborhoods of one diversifying city: Manchester, New Hampshire. This research will expand our knowledge of race relations in newly integrated neighborhoods while providing stakeholders of diversifying places information about how to encourage lasting connections between residents.