

LIST OF AWARD RECIPIENTS
UB2020 RESEARCH AND DEVELOPMENT ACTIVITIES FUND (IRDF)

**Corresponding Investigators
and Co-Investigators
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“Mechanisms of Phytotoxicity of Pharmaceutical Contaminants in the Environment”

Corresponding Investigator

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Co-Investigator's

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Project Description

Antibiotics and other pharmaceuticals that are used to treat illness in humans and animals often pass through treated organisms in a form that is largely intact and still active. Estimates of veterinary use alone indicate millions of pounds of active antibiotics entering the environment, their primary point of entry through the application of manure and sewage onto croplands as fertilizer. While crop fertilization is highly beneficial, scientists are beginning to realize the impact of so much active antibiotic entering the environment. Some antibiotics are highly mobile in soil, allowing them to enter surrounding surface and ground waters. This can lead to human exposure via drinking water. Others persist in soils, affecting plants and their associated microorganisms. We have found that chlortetracycline (CTC), an antibiotic highly used for human and animal treatment, negatively impacts some crop species (such as pinto beans), while having no affect on others (such as maize). In greenhouse studies, we determined that CTC-exposed maize plants induce the detoxification enzyme glutathione *s*-transferase (GST), while pinto beans do not. This IRDF grant will combine the expertise of James Berry (plant molecular biology) and Diana Aga (analytical chemistry), to understand the remediation by plants of antibiotic contaminants in soil. Our goals are 1) to characterize the induction and activity of plant GSTs by CTC and 2) determine the mechanism of CTC toxicity in pinto beans. These experiments will provide knowledge for the biological remediation of contaminated soils, and for the development of more environmentally beneficial agricultural practices to reduce future contamination.

“Glass Bottom Float”

Corresponding Investigator

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Program Description

The Glass Bottom Float project (GBF) combines robotics, real-time water quality monitoring and ubiquitous computing to create a new experience of shared natural resources, in particular fresh water lakes. GBF will have a double life. It will be a state-of-the-art measurement platform to monitor water quality as well as a sentient machine in the form of a float that lets one experience a dip in the lake in a novel way.

GBF will combine established physical, chemical and biological input parameters together with experimental monitoring methods (such as audio and sonar) to create a site-specific, complex and robust representation of lake water quality that experts can make use of and lay people can relate to. It will act as an intervention into the centralized assessment and control of aquatic resources. Beach-goers will be able to dial in to the GBF to see if the water conditions are conducive for swimming. GBF will also be a valuable helper for beach operators in assessing water conditions. GBF will share its results with swimmers relaxing on the float and anyone with Internet access back on the shore.

GBF is designed particularly for applications in the Great Lakes region but could be active on fresh water systems anywhere in the world. The IRDF grant will enable initial research and development of this ambitious project.

“Structural and Functional Analysis of Archaea RNA Ligase”

Corresponding Investigator

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Co-Investigator

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Program Description

Ribonucleic acid (RNA) is a molecule that carries information encoded by the genetic material, DNA. Damage in RNA can lead to cell death, if not repaired properly. Although RNA is generally more prone to breakage than DNA, it is not well understood how cells correct such damage. RNA ligase is an enzyme responsible for repairing breaks in RNA molecules and is essential for cellular RNA maturation. This research project aims to understand the molecular basis of RNA repair pathway, using archaeal RNA ligase as a model system. Thermostability

and an established protein production method make archaeal RNA ligase an ideal enzyme for biochemical and structural studies. Our goal is to elucidate the mechanism of how RNA ligase recognizes and restores the damaged RNA. We will attempt to co-crystallize the enzyme with RNA to capture atomic structures of the RNA ligase at different functional states along its repair pathway. Since RNA breaks are triggered by exposure to certain drugs used in cancer treatment, this study may aid in developing new approach in cancer therapeutics.

“Remote Control of Proteins and Neurons by Magnetic Field”

Corresponding Investigator

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Co-Investigator's

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Project Description

Controlling nerve cell activity remotely by magnetic fields to study brain circuits.

Nerve cells in the brain form complex communication networks. We are developing novel tools to aid the understanding of these network structures and their communication. Our approach will allow to remotely turn on and off the signaling of a specific nerve cell in an intact brain. Hence, it can be used to disrupt a brain circuit specifically aiding the deciphering of the signaling circuits.

The ability of nerve cells to signal depends on the ratio of the concentration of certain ions on the outside of the cell to the cell inside. This ratio is controlled by channels in the cell surface. Most of these channels are triggered to open by voltage or small molecules. Some special channels can be opened by heat and are usually not found in nerve cells, but provide our skin with temperature sensitivity. Our approach is to introduce these channels into nerve cells and to develop a way to specifically heat these. The heating can be achieved by attaching tiny magnetic nano-particles to the channels. In an alternating magnetic field these magnetic nano-particles absorb energy from the magnetic field, heat up and hence trigger the channels to open which temporarily disrupts the nerve cells ability to signal. As we can express the temperature sensitive channels selectively in only specific cells, this methods allows us to dissect circuits in brains cell-by-cell.

“Effects of Social-Skills Training on Recreational Activities in Youths”

Corresponding Investigator

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Project Description

Considerable research has been conducted on the impact of peer relationship and social isolation on the cognitive, psychological, and emotional health of youth. Yet, the impact of peer relationships on other important health behaviors such as weight control and physical activity has not been systematically studied. Previous research in our laboratory indicates that the presence of peers promotes healthier eating and physical activity in overweight children. Building on these findings, we contend that part of the motivation to engage in physically active play is likely a function of the social context in which these activities are performed. By contrast, social isolation resulting from teasing and weight criticism may decrease the motivation to be physically active and involvement with peers. These constraints may account for the impediments met when trying to substitute physical activity for sedentary behavior in overweight youth.

This research assesses whether a validated social-skills training intervention increases overweight and normal-weight youths' social involvement and, as a result, increases children's time allocation to physically active leisure activities. This intervention is aimed at teaching overweight children social skills that will enable them to form new friendships and minimize peer difficulties, including peer victimization and rejection. These improvements in peer relationships could, in turn, lead to increases in physical activity. This research will bridge clinical, social, behavioral and exercise sciences research to develop interventions targeting childhood overweight and obesity, and expand investigations outside the laboratory.

“Micromachined Implantable Gradient Scaffold for Guided SGN Cell Culturing”

Corresponding Investigator

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Project Description

This research proposes a macromachined implantable biodegradable scaffold with gradient neurotrophic factors such as brain-derived-neurotrophic-factors (BDNF) and neurotrophic-factor 3 (NT-3) in biodegradable polymer such as poly-(lactic-glycolic)-acid

(PLGA) matrix for the guided culturing of spiral ganglion neurons (SGN). The conventional neuron guiding studies are using gradient liquid to guide neuron growth. The disadvantage of using liquid material is that it is not implantable to the inner ear in a compact and convenient way. The proposed scaffold is solid-state and therefore implantable. Ultimately, the scaffold is naturally degraded out in a body after completing its mission of assisting guided culture. We use ultraviolet (UV) lithography for the fabrication of a microfluidic system to generate a gradient fluidic mixture, and use a micromolding process to form a final solid-state gradient scaffold structure. In-vitro SGN culturing on the fabricated structure will be performed with this seeding fund and external funding for further in- vivo study will be pursued. This would be the first demonstration of solid-state BDNF/NT-3 gradient scaffold for SGNs culture. This is also going to have a scientific impact on study with the functionality of cultured SGN in conjunction with the cochlear implant (CI) for hearing recovery. The technology development of a timed-releasing bio nano composite device can also be used for therapeutic applications, such as the regeneration of peripheral nerve and central nerve systems.