University of Manitoba

department of MICROBIOLOGY
faculty of SCIENCE
discover the unknown + invent the future

Available Undergrad Research Award (URA) Supervisors

MICROBIOMES AND MICROBIAL ECOLOGY

Name: Matthew Bakker

Contact Information: Matthew.Bakker@umanitoba.ca

Website: https://matt-bakker.github.io/index.html

Description of Research: Research in the Bakker lab is centered on the fungal plant pathogen *Fusarium graminearum*. Our aim is a more effective control of fusarium head blight, a disease that impacts wheat, barley and oat crops. We find ecologically-motivated questions to be particularly fun. Some current projects include studies of phosphatases (how does *Fusarium* get the phosphorus it needs?) and ferulic acid esterase (how does the degradation of plant cell walls during pathogen attack feedback to impact pathogen success?), studies of hydrophobin proteins produced by *Fusarium* (how does *Fusarium* activity during malting impact beer quality?), and studies of how other microbes interact with a toxic metabolite that is produced by *Fusarium*.

HOST-MICROBE INTERACTIONS

Name: A. Karen Brassinga
Contact Information: Ann.Brassinga@umanitoba.ca
Website: http://jodavies919.wixsite.com/brassingalab

Description of Research: Our research focuses on understanding the mechanisms used by bacteria to adapt and survive in diverse environments. Our particular focus is on the water-borne bacterium *Legionella pneumophila*; a parasite of freshwater protozoa featuring a unique intracellular biphasic lifecycle that alternates between replicative forms and cyst forms. Normally intended for prolonged survival between protozoan hosts, cyst forms can also cause a pneumonia termed Legionnaires' disease in susceptible humans. To carry out our investigations, we use diverse range of molecular and microscopic techniques to identify genetic components essential for survival of *L. pneumophila* in water and in the host cell.

MOLECULAR APPROACHES TO CONTROL BACTERIAL GROWTH

Name: Silvia Cardona
Contact Information: Silvia.Cardona@umanitoba.ca
Website: www.cardonalab.org

Description of Research: Our research long-term goal is to understand the molecular mechanisms that control microbial growth in diverse environments, such as in infection sites and biotechnological

processes. To that end, our lab builds genomic and synthetic biology tools with a focus on essential genes. We apply these tools to the discovery of antimicrobials, the synthesis and degradation of bioplastics, and methods for pathogen detection. We develop some of these applications in *Burkholderia*, a group of Gram-negative bacteria that have extraordinary biotechnological potential but also cause opportunistic infections.

MITOCHONDRIAL MEMBRANE PROTEINS

Name: Deborah Court
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Description of Research: Our research focuses on mitochondrial membrane proteins. We are investigating the interactions of the voltage-gated anion-selective channel (VDAC) with hexokinases in fungal mitochondria, and the structure and organization of VDAC in membrane-mimetics such as detergents. We are also investigating the potential role of mitochondrial transporters in protecting mitochondrial translation from the effects of certain antibiotics. We use a range of methods including biophysical analysis of purified membrane proteins, expression of mitochondrial proteins in *E. coli,* and genetic and cell biology approaches in yeast and *Neurospora*.

FUNGAL EVOLUTION & GENOMICS

Name: Aleeza Gerstein
Contact Information: Aleeza.Gerstein@umanitoba.ca
Website: http://microstatslab.ca

Description of Research: Research in the MicroStats lab applies evolutionary principles to broadly understand the factors that influence how and why fungal populations to evolve, particularly in the context of antimicrobial resistance and recurrent infection from human fungal pathogens. We work with different species of human fungal pathogens as well as the eukaryotic genetic model organism *Saccharomyces cerevisiae*. We collaborate with clinical microbiologists and clinicians in Winnipeg to characterize local isolates to identify when and why different relatedness patterns are observed in different infection contexts and among different species. Our studies typically combine elements of empirical lab work (isolate characterization, drug response phenotyping, experimental evolution) with bioinformatics (analysis of whole genome sequencing data) and statistical analysis (powered by the R Programming Language – no prior experience necessary!).

MICROBIAL EVOLUTION & GENOMICS

Name: Georg Hausner
Contact Information: Georg.Hausner@umanitoba.ca
Website: http://geohaus.wixsite.com/curriculum-vitae-r

Description of Research: Our research characterizes fungal mitochondrial genomes. Fungi are important organisms that have large mitochondrial genomes (compared to metazoans). We study the molecular evolution of mitochondrial mobile introns within the fungi: The focus is on the characterization of mitochondrial genomes of plant pathogens, with an emphasis on the molecular evolution and biology of group-I and group-II introns (ribozymes). This includes the

characterization of intron encoded proteins such as homing endonucleases (HEases). HEases are DNA cutting enzymes that have applications in biotechnology. In addition we work on aspects of fungal taxonomy using various molecular tools and we collect fungi from the environment as potential sources for novel enzymes and antimicrobial compounds (the latter is in collaboration with Dr. Kumar's research group).

ANTIMICROBIAL RESISTANCE

Name: Ayush Kumar
Contact Information: Ayush.Kumar@umanitoba.ca
Website: www.ayushkumarlab.com

Description of Research: We study the mechanisms of multidrug resistance in Gram-negative pathogens *Acinetobacter baumannii* and *Pseudomonas aeruginosa*. Both these organisms are classified as 'critical' by the World Health Organization due to their resistance to almost all classes of antibiotics. Specifically, we are studying multidrug efflux pumps in *A. baumannii* and *P. aeruginosa* that belong to the Resistance-Nodulation-Division (RND) family. We are interested in establishing RND pumps' substrate profiles, deciphering their regulatory pathways, understanding their biochemical mechanisms, and investigating their role in the antibiotic resistance as well as virulence of bacteria.
Further, we are also studying the prevalence of bacteria and antibiotic resistance genes in drinking water samples from First Nation communities in Manitoba.

MOLECULAR BIOLOGY OF VIRAL AND BACTERIAL VIRULENCE MECHANISMS

Name: Brian Mark
Contact Information: brian.mark@umanitoba.ca
Website: **http://home.cc.umanitoba.ca/~bmark/Welcome.html**

Description of Research: The Mark laboratory explores the molecular mechanisms that bacteria use to defend themselves from antibiotics, and how viruses evade host immune responses by corrupting the cellular ubiquitin system. Findings from his group are revealing weaknesses in bacteria and viruses that can be exploited as new therapeutic targets to treat infectious disease. For more information please visit the Mark Lab website at: http://home.cc.umanitoba.ca/~bmark/Welcome.html

BACTERIAL COMMUNICATION AND PROTEIN SECRETION

Name: Gerd Prehna
Contact Information: gerd.prehna@umanitoba.ca
Website: https://home.cc.umanitoba.ca/~prehnag/

Description of Research: We study how bacteria communicate with their hosts, how they communicate with each other, and how they communicate with other micro-organisms. Currently, our lab studies the molecular mechanisms of protein secretion and inter-bacterial communication in pathogenic bacteria such as *Salmonella* (food poisoning, typhoid fever) and *Streptococcus* (strep. Throat, flesh eating disease). We use a diverse range of biochemical and biophysical techniques, including X-ray crystallography and NMR spectroscopy, to determine the function of the bacterial proteins that form secretion systems, serve as toxins, and operate as receptors for signaling events.

MICROBIAL PHYSIOLOGY AND ECOLOGY FOR THE BIOECONOMY

Name: Richard Sparling
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Website: https://home.cc.umanitoba.ca/~sparling/R%20Sparling%20website/Home.html

Description of Research: 1. Understanding the molecular physiology of bioethanol production in the lignocellulolytic waste degrading Clostridium thermocellum, alone and in designed small consortia. 2. Green-House effect mitigation from landfills through the conversion of fugitive methane emissions to CO_2 and the potential generation of bioproducts from thermophilic methanotrophic bacteria.

Other research-focused faculty members may be available; please see the Department of Microbiology website for further information.