HOST-MICROBE INTERACTIONS

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Description of Research: Our research focuses on understanding the mechanisms used by bacteria to adapt and survive in diverse environments. Current targets of investigation in our group are the environmental bacteria *Legionella pneumophila* and *Serratia marcescens*. *L. pneumophila* is a parasite of freshwater protozoa and has 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. *S. marcescens* is also an opportunistic human pathogen known for multidrug resistance gained through modulation of its bacterial physiology and horizontal gene transfer. To carry out our investigations, we use a diverse range of molecular biology approaches.

MOLECULAR BIOLOGY OF VIRAL AND BACTERIAL VIRULENCE MECHANISMS

Name: Brian Mark
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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
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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.

ANTIMICROBIAL RESISTANCE

Name: Ayush Kumar
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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 APPROACHES TO CONTROL BACTERIAL GROWTH

Name: Silvia Cardona
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Description of Research: The Cardona lab is interested in the molecular mechanisms that regulate bacterial growth with the long-term goal of controlling bacteria in infection conditions or during biotechnological applications. One project involves genomic exploration of essential process in bacteria with the goal of predicting antibiotic activity of novel small molecules and identifying their mechanism of action. A second project is related to the use of CRISPR interference for exploring bacterial metabolic pathways relevant to bioremediation.

MITOCHONDRIAL MEMBRANE PROTEINS

Name: Deborah Court
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Description of Research: Our research focuses on the understanding of structure and function of the voltage-gated anion-selective channel (VDAC) in fungal mitochondria. We are investigating the structure and organization of VDAC in membrane-mimetics such as detergents, using a variety of biophysical methods. We are also probing the roles of this membrane protein in the function and regulation of mitochondrial and cellular activities, using proteomic and genetic approaches.
MICROBIAL EVOLUTION & GENOMICS

Name: Georg Hausner
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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).

Name: Aleeza Gerstein
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Description of Research: Our research seeks to understand the genotypic and phenotypic basis of stress resistance in fungal microbes. Unlike bacteria, which frequently acquire plasmid-mediated beneficial genes and alleles, fungal microbes primarily adapt through a range of genomic mutations (e.g., single nucleotide changes, insertions, deletions) and karyotypic mutations (i.e., changes in ploidy, the number of chromosome sets, and aneuploidy, copy number change in one or several chromosomes. We work with both the eukaryotic genetic model organism Saccharomyces cerevisiae as well as human fungal pathogen species. We are particularly interested in determining the factors that constrain and promote diversity in the context of drug resistance. We couple microbial experimental evolution with next generation sequencing and statistical techniques (e.g., genome wide association studies) to "peer under the hood of evolution" and directly probe the factors that influence the rate and genetic basis of adaptation.

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