# Development of a microbial life detection system for space missions

The search for life in our solar system is among the highest priorities for space science, yet no modern instrument payload (on a rover/spacecraft) is able to definitively detect signs of life.

Prof. Lyle Whyte's lab is developing an instrument platform that could potentially be added to a rover payload that would be capable of definitive life detection. As life in our solar system is very likely to be microscopic in nature, this instrument would focus on the detection of microorganisms. To that end, the Whyte lab is testing and optimizing pre-existing, automated, and miniaturized robust instruments for life detection in our solar system.

Three different components of the platform are under development:

- An instrument capable of isolating and sequencing nucleic acids (DNA/RNA), based on the ultralight and ultraportable **MinION sequencer**. Nucleic acids are unambiguous signs of life.
- A **Microbial Activity MicroAssay (MAMA)**, which detects and characterizes living microbial communities, based on their metabolic activity.
- The **Cryo-iPlate**, a novel culturing method used to isolate microorganisms from the environment. It allows for culturing of microorganisms in their natural environment and isolation of previously inaccessible microorganisms.

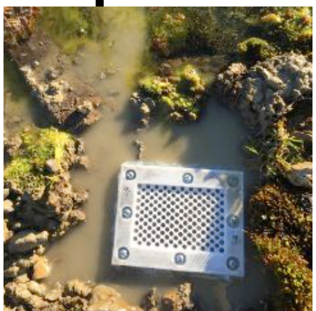
In the past year, the Whyte lab has successfully tested instruments capable of automatically extracting DNA from a variety of Arctic subzero environments similar to Mars, Enceladus, and Europa and sequencing this DNA using the MinION. The data showed diverse microbial communities containing extremophiles (microbes able to survive and thrive in extreme environments) and identified a detection limit of 100 cells/g. With the MAMA, microbial metabolic activity has also been detected with as low as a thousand yeast cells and with 4000 bacterial cells, similar to the number of cells we could find in extreme environments. Hundreds of diverse and unique Arctic bacterial strains have been cultured in situ using the Cryo-iPlate. Select novel strains are being characterized in the laboratory which will inform us on the traits required for life in extreme cryo-environments.

The Whyte lab's work over the past year has increased the robustness, sensitivity and detection limits of the instruments. Eventually, they hope to have a fully developed and optimized platform for microbial life detection system that could be robotized and integrated into future planetary exploration space missions attached to surface rovers.

**Prof. Lyle Whyte** *is a professor in the department of Natural Resource Sciences and in the McGill Space Institute. His research focuses on characterizing the microbial community and biodiversity of Canadian Arctic environments as analogues for Mars, Enceladus, and Europa.* **Dr. Isabelle Raymond-Bouchard** *is a MSI postdoctoral research fellow.* **Catherine Maggiori** *is a PhD student fellow at MSI.* **Olivia Blenner-Hassett and David Touchette** *are MSc student fellows at MSI. Their research focuses on life detection in astrobiology and characterizing the microbial community of extreme environments.*

### Why this is important

As public and private space sector activity increases, with plans for additional landers, sample caches for return to Earth, and even plans for permanent settlements on Mars, it's important that we look for the presence of native microbial life in these environments before irreversible contamination occurs.



*From top left:1) A Cryo-iPlate incubating in a pond for the isolation of novel microorganisms, in Resolute, NU; 2) a Microbial Activity MicroAssay showing metabolic activity from a cryoconite sample; 3) Dr. Isabelle Raymond-Bouchard using the MinION sequencer and the Fast Prep DNA extraction device in situ, in the Canadian high Arctic.*