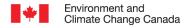# Microbial Genomics Research Opportunity

Research Challenge:

Dr. Jordyn Broadbent and **Dr. Derek Smith** at Environment and Climate Change Canada (ECCC) and **Dr. Daniel Grégoire** at Carleton University are seeking a M.Sc. student to investigate how contaminant mixtures affect microbial communities in landfills. Landfill leachates contain highly diverse communities of microbes that have adapted to live alongside potentially hazardous chemicals that are collected from modern landfills to prevent spread into the surrounding environment. How these contaminant mixtures exert toxicity and select for microbes with potential bioremediation applications hasn't been thoroughly explored in the Canadian context. This research is **funded for two years starting in Fall 2024** under the Chemicals Management Plan Research program and will be carried out collaboratively between ECCC and Carleton University. There are two main goals of this project:

 1. Characterize the microbial constituents and associated contaminants within landfill leachates using genomic sequencing and analytical chemistry to identify microbes that can act as bioindicators suitable for surveillance purposes.

2. Evaluate how bioremediation of priority contaminants in leachates with microbial consortia affects the toxicity of contaminant mixtures in non-vertebrate models (e.g., soil microbes and soil invertebrates).

This project will provide interdisciplinary skills that blend cutting-edge sequencing, analytical chemistry techniques, and bioinformatics workflows to connect environmental toxicology and microbiology data. The student will have the opportunity to apply new approach methodologies in toxicology using contaminant mixtures and model soil invertebrates and microbial systems. The student will also be tasked with organizing sampling logistics and outsourcing specific analyses, gaining essential project management skills. Data generated from this project will be used to develop cost-effective methods to monitor for contaminants and inform regulators on the chemical profiles and potential risks associated with landfill leachate.

Interested candidates are encouraged to contact Dr. Jordyn Broadbent (jordyn.broadbent@ec.gc.ca), Dr. Daniel Grégoire (DanielGregoire@cunet.carleton.ca), and Dr. Derek Smith (derek.smith2@ec.gc.ca) with a PDF of their Academic CV, transcripts (unofficial is fine), and a one page description of their research and career interests (Statement of Intent).

Research Environment:

Research activities will take place at 335 River Road, Ottawa, ON in the Science and Technology Laboratories at ECCC and in the laboratory of Dr. Daniel Grégoire in the Carleton University Department of Chemistry. The ECCC facilities are well equipped with state-of-the-art sequencing technology and quality control equipment including an Illumina NextSeq 1000, Oxford Nanopore Technologies sequencers, Agilent TapeStation 4150, Nanodrop, and Qubit fluorometer. The laboratories at Carleton University include core mass spectrometry facilities with ICP-MS, LC-MS, and GC-FID instruments in addition to lab equipment required for aerobic and anaerobic microbial cultivation and molecular biology. The student will also have access to dedicated high performance computing environments through Dr. Grégoire's lab at Carleton University to carry out bioinformatics analyses.

Research Activities:

Culturing and handling microorganisms and solutions containing microorganisms with hazardous chemicals (including potential Risk Group 2 pathogenic organisms).

Completing DNA/RNA extractions from environmental matrices, isolates, and consortia.

Quantifying and performing quality control analysis of DNA/RNA using the Agilent TapeStation, Nanodrop, and Qubit fluorometry.

Preparing libraries for Illumina and Oxford Nanopore sequencing and performing PCR/qPCR.

Conducting bioinformatic analyses on Linux-based systems.

Optimizing analytical chemistry techniques to measure contaminant concentrations.

Sourcing and ordering laboratory equipment and supplies.

Writing reports on research activities and carefully documenting work completed.

Designing presentations and posters to communicate results to academics and regulators.

Requirements:

Successful enrollment within a relevant graduate program at Carleton University ([Admissions - Department of Chemistry (carleton.ca)](https://carleton.ca). Candidates are encouraged to apply to Chemistry graduate programs with specializations in Chemical and Environmental Toxicology https://graduate.carleton.ca/cu-programs/chemical-environmental-toxicology-collaborative-masters-phd/) or Biochemistry (https://graduate.carleton.ca/cu-programs/biochemistry-collaborative-masters-phd/) to facilitate supervision by Dr. Daniel Grégoire. Exceptions can be made via the Biology Department if need be. Research activities will require the use of facilities at 335 River Road, Ottawa, ON and the Department of Chemistry at Carleton University.

Free parking and bike storage are available at ECCC. Public transportation access is available but currently has limited-service hours to the facility.

Students must be willing and able to work safely with Risk Group 2 human pathogens and hazardous chemicals in a Containment Level 2 laboratory following standard operating procedures using appropriate personal protective equipment, engineering controls, and aseptic technique. Mandatory safety training will be required, and the student must be able to demonstrate proficiency with safe work practices after training to work in the laboratory. Local risk assessments may also require up to date vaccinations for relevant pathogens due to the nature of the laboratory work.

Eligible for Reliability security status.

The student should have completed course work (or related course work) and/or have research experience in at least one of the following subject areas or related disciplines: Environmental Chemistry, Analytical Chemistry, Microbiology, Biochemistry, Molecular Biology, Genomics, or Bioinformatics.

English essential.

Assets:

Preference will be given to interested students that are Canadian Citizens or Permanent Residents.

Previous experience working in a microbiological laboratory or laboratory setting.

Experience with programming (Python, R, Perl, Java, etc.), statistics, Linux command-line (shell scripting, UNIX tools (grep, awk, sed, etc.)), or next generation sequencing analysis.

Interest in applying data science skills to manage large data sets