We're recruiting B.Sc. and Ph.D. students to work on microbial metal cycling in e-waste

Posted by Dr. Daniel S. Grégoire, Chemistry Department, Institute of Biochemistry
This is a template adapted from Dr. Paul Carini's newsletter *Uncultured*

Please see instructions at the end of this document for details on how to apply

What you need to know

You will lead your own research project that examines how microbes control the fate of valuable rare earth elements or iron in habitats containing e-waste. This research is funded by an NSERC Discovery Grant awarded to Dr. Grégoire and is carried out in partnership with the e-waste recycling sector.

Your work will expand the known biodiversity of microbes living in contaminated habitats and identify novel pathways that can be used for sustainable waste reclamation. You will use a combination of meta-omic (*i.e.,* whole community DNA) and geochemical analyses to develop models for microbial metal cycling in e-waste. You will design enrichment experiments to establish stable microbial consortia that can be used to reclaim valuable metals from e-waste.

You will work with Dr. Daniel Grégoire, who will use a "learning-by-doing" approach to teach you different skills needed for your research. You will play an integral role in organizing field campaigns, generating sequencing data, and optimizing analytical methods to work with challenging samples. Once you are comfortable, you'll be encouraged to take more ownership over your research. We're open to hearing your creative ideas!

Background on the projects

As the demand for consumer electronics has increased, so has the environmental footprint associated with their manufacturing and disposal. Managing e-waste is challenging because it is a contamination source that also contains valuable metals such as rare earth elements that could be recycled. The global growth of e-waste has also created a new environment for microbes that can directly interact with metals. To date, how microbes control the chemistry of metals in e-waste is poorly understood.

Daniel Grégoire
Department of Chemistry
Assistant Professor

Steacie building room 419
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada

T (613)-520-2600 ext 3883
danielgregoire@cunet.carleton.ca
www.carleton.ca/envbiotech

We're recruiting for two projects: one on **rare earth elements**, and the other, **iron**.

Rare earth elements (REE) are critical raw materials that are essential to the clean technology sector. Using biological platforms with REE-dependent metabolism has emerged as a sustainable strategy for recovering REEs from electronic waste streams but most work on REE-biology has focused on soil and plant-associated ecosystems. Our current mechanistic understanding of REE metabolism is limited to lab studies on a few model organisms isolated from such habitats. In contrast, biological REE cycling pathways in habitats contaminated with e-waste remain poorly characterized

Iron is an essential component of alloys used in consumer electronics and iron concentrations in e-waste are comparable to those in mine tailings. E-waste is also rich in stainless steel, which can support microbially-induced corrosion. Whereas mine tailings have served as model systems to characterize microbial iron redox cycling, the microbes that control iron's fate in e-waste have not been described.

What you will be doing

There is no one skillset that will define who we hire for these projects because our lab is interdisciplinary by nature. Your research will require you to characterize how microbes affect the fate of metals directly and indirectly through their metabolic activities. We're looking for someone with broad experience in **environmental microbiology, ecotoxicology, geochemistry, or bioinformatics.**

You might be an expert in bioinformatics who has worked with sequencing data sets, or you might have in depth knowledge metal redox chemistry. You may also be skilled in microbial cultivation and biochemical analyses to characterize microbial metabolisms. We encourage you to apply if you have experience in any of these areas and we will help fill in the gaps once you're on the project.

In our lab, you can expect to grow your skills in analytical chemistry for metals (*e.g.,* colorimetric methods and ICP-MS), environmental sampling, microbial physiology, molecular biology, and connecting environmental data sets to sequencing data using computational workflows. We will work with you to build your skills in experimental design, project management, and science communication. You can expect to be part of an inclusive group that will support your growth and help with troubleshooting. Your initial onboarding will involve reading literature help you plan your research, giving you time to get used to balancing research with your academic commitments. We will work on an individual development plan to ensure your training aligns with your career goals. We want you to access diverse career paths inside and outside of academia.

Daniel Grégoire
Department of Chemistry
Assistant Professor

Steacie building room 419
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada

T (613)-520-2600 ext 3883
danielgregoire@cunet.carleton.ca
www.carleton.ca/envbiotech

Specific skills we are interested in

We are looking for people that are excited about combining meta-omics and geochemistry to better understand how microbes contribute to metal cycling in the environment. You'll have an interest in using cutting-edge bioinformatics tools to characterize microbial communities and develop reproducible workflows to tackle large sequencing datasets. You're interested in optimizing molecular biology methods to extract DNA from challenging samples. You're keen to develop knowledge of geochemistry to connect biotic and abiotic processes that control metal cycling. You will be able to communicate your research through written documents and presentations.

We're looking for someone with good project management skills that can help build the lab. We value someone who is a self-starter, autonomous, and can commit to a decision while clearly outlining their logic. We want to work with someone who understands the importance of troubleshooting and documenting solutions to transfer knowledge to others. We recognize that mistakes will be made along the way, but we see these mistakes as an essential part of your learning.

We hope you will pay this forward because you'll play a key role in training students as the lab grows. We want people who see value in incorporating feedback into their work. This is a two-way street, and you can expect that your voice will be heard. We will strive to provide you with professional development opportunities and attending conferences that will help you meet your career goals.

Where you will work

You will be working in Ottawa, which is a fantastic city in which to do research and pursue your education. You will be in a city where you can easily connect with people working in the private biotech industry or the government contributing to policy. Ottawa has several means of public transport (bus and train) and bike paths that make it easy to get to campus from most places in the city. Carleton Chemistry's Department and Institute of Biochemistry are interdisciplinary environments that equip students for diverse career paths after they graduate. If you'd like to learn more about what we have going on in the lab, go to https://carleton.ca/envbiotech/.

Daniel Grégoire
Department of Chemistry
Assistant Professor

Steacie building room 419
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada

T (613)-520-2600 ext 3883
danielgregoire@cunet.carleton.ca
www.carleton.ca/envbiotech

Job logistics and pay

The Environmental Biogeochemistry and Biotechnology lab is located on Carleton University's campus in room 432 in the Steacie Building. The work for this position will necessitate field work at sites containing e-waste. You will also have to work in a large lab space that will be shared with members of other research groups. You'll be supervised by a combination of in-person and remote supervision.

Pay for undergraduates applying through the I-CUREUS or NSERC USRA program will be in line with those program requirements. Undergraduates applying through the Honours thesis program will receive academic credit towards the completion of their program. Pay for graduate students will be in line with Carleton's Chemistry Department norms. Information on benefits for graduate students can be found here: https://gsacarleton.ca/healthplan/. We will do our best to help you apply for any scholarships that will help you succeed during your time with us.

We want you to have a sustainable relationship with your work and will help you strike a good work-life balance. **Graduate students** are expected to work in the lab 20-24 hours a week while balancing their academic duties. **Honours students** are expected to work between 12-16 hours a week and we recognize that your course load is a priority. Undergraduates working through the **I-CUREUS** program will work 150 hours over an internship that can last 8 months. Undergraduates working through the **NSERC USRA** program are expected to work 40 hours a week over a 16-week period.

Diversity matters to us. We strongly encourage candidates of all different backgrounds and identities to apply. Equity, diversity, and inclusion are crucial to supporting innovation in academia by bringing people with diverse lived experiences together. This means that we want a diverse team that includes people from different backgrounds, experiences, and identities. If you identify as being part of a marginalized community, you are welcome here! We will put the work into providing you with an inclusive and supportive environment to do your research.

Please submit an application that speaks directly to this position

Please prepare an application that consists of your CV and a statement outlining your research experience and interests. This statement should be succinct and highlight why you are a good fit for the lab. All applications can be emailed to danielgregoire@cunet.carleton.ca. We will be evaluating applications on a rolling basis until we find the right candidates. Ph.D. students would ideally start in **September 2025**. Undergraduate students can start in **January, May, or September 2025**.

Daniel Grégoire
Department of Chemistry
Assistant Professor

Steacie building room 419
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada

T (613)-520-2600 ext 3883
danielgregoire@cunet.carleton.ca
www.carleton.ca/envbiotech

Once we have your application, you will hear from us in two weeks about advancement to the interview stage. We expect one interview that will be an hour and a half long to take place remotely or in person (your choice). We will send questions in advance so there are no surprises. These questions will focus on your professional experience, problem-solving ability, and communication skills.

For graduate students, if we decide to work together, you must be formally accepted into one of the Ph.D. programs in Chemistry at Carleton before you can start in the lab: https://graduate.carleton.ca/cu-programs/chemistry-phd/. After you are accepted into your Ph.D. program, we will work with the Department of Chemistry to draft a formal offer and send it you. We will aim for this letter to be sent shortly before the start of the Fall 2025 semester.

Daniel Grégoire
Department of Chemistry
Assistant Professor

Steacie building room 419
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada

T (613)-520-2600 ext 3883
danielgregoire@cunet.carleton.ca
www.carleton.ca/envbiotech