

# '396' Undergraduate Research Project Application Form

Office for Undergraduate Research in Science  
[www.mcgill.ca/science/ours/](http://www.mcgill.ca/science/ours/)  
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Form version 200603

## Instructions for students

- *All fields are required, unless indicated otherwise.*
- Download and print this form. Complete Section 3 and sign.
- See “How students can apply” instructions in Section 2.10.
- Your supervisor or department will tell you if you are selected for this project. If so, you will receive a code to register for a ‘396’ course on MINERVA.

## 1 Supervisor Information

**Name:** Prof. Boswell Wing  
**Email:** boswell.wing@mcgill.ca  
**Phone:** 514-398-6772  
**Website:**  
**Department or Unit:** Earth and Planetary Sciences  
**Course number:** EPSC396

## 2 Project Information

### 2.1 Term:

Fall 2008

### 2.2 Project start & end dates:

September 16 - December 2, 2008

### 2.3 Project title:

*In silico* isotopic tracking of the metabolic evolution in the sulfate-reducing microbe *D. vulgaris*

## 2.4 Project description:

The history of oxygen in Earth's atmosphere can be read in the variation of sulfur isotope ratios in ancient rocks. Variations in these isotopic tracers are taken to reflect differences in the global vigor of sulfate-reducing microbes. These differences, in turn, are taken to reflect variability in oceanic sulfate abundances. The final step in the deductive sequence links oceanic sulfate levels to weathering rates of sulfide minerals through a direct proportional relationship mediated by atmospheric oxygen. Despite the importance of this chain of logic to current thinking on the history of atmospheric oxygen levels, the critical link that ties it all together - the isotopic effect associated with microbial sulfate reduction - remains empirically validated but mechanistically obscure. This research project aims to make clear the specific metabolic controls on isotopic fractionation during microbial sulfate reduction, with the broader goal of revealing the co-evolution of microbial sulfate reduction and Earth's surface environment.

The specific objectives of this research project will be to: (1) use MATLAB to reproduce a recently published *in silico* model of the genomically-constrained core metabolism of the sulfate-reducing microbe *Desulfovibrio vulgaris*; (2) modify the model to include the thermodynamic fractionation of sulfur isotopes at key metabolic steps; and (3) explore the range of net sulfur isotope fractionations produced by biologically-relevant variations in the control parameters for the *D. vulgaris* metabolism.

## 2.5 Prerequisites:

1 term completed at McGill + CGPA  $\geq 3.0$ ; or permission of instructor. If applying from the biological sciences, a strong desire to quantify biogeochemical processes. If applying from the physical sciences, a strong interest in the nuts-and-bolts of the history of life. MATLAB experience would be helpful.

## 2.6 Grading scheme:

50% of final grade based on participation in lab meetings and 1-on-1 meetings with advisor;  
50% of final grade based on final report.

## 2.7 Other:

The published model we will be using as a basis for this project is reported here:

[www.nature.com/msb/journal/v3/n1/synopsis/msb4100131.html](http://www.nature.com/msb/journal/v3/n1/synopsis/msb4100131.html).

(Note: access is limited to the mcgill.ca domain).

## 2.8 Status:

This project is:

Open to applicants

Already taken; no more positions available this term

Taken, but contact me for other possible projects this term

## 2.9 Ethics, safety, & training:

Which of the following, if any, is involved?

- Animal subjects
- Human subjects
- Biohazardous substances
- Radioactive materials
- Handling chemicals
- Using lasers

*For undergraduate students, ethics and safety compliance is the supervisor's responsibility.*

## 2.10 How students can apply:

Send me an email indicating your interest. We can set up a meeting to discuss the project.

## 3 Student Information. (1) Print legibly and sign. (2) See 'How students can apply' in Section 2.10.

Name:

McGill ID:

Email (first.last@mail.mcgill.ca):

Phone:

Program (e.g., B.Sc. Maj. Chem. Minor  
Biology):

Level: (circle one) U0 / U1 / U2 / U3

*I have not applied for another 396 course this  
term.* Student signature:

Date:

## 4 Approvals. (1) Print names and sign. (2) Notify Office for Undergraduate Research in Science. (3) Give student code to register for course on MINERVA.

Supervisor:

Date:

*I certify that this project conforms to depart-  
mental requirements for 396 courses.* Unit

Chair, Director, or designate:

Date: