

'396' Undergraduate Research Project Application Form

Office for Undergraduate Research in Science
www.mcgill.ca/science/ours/
victor.chisholm@mcgill.ca
Dawson Hall, Room 211
tel 514-398-5964, fax 514-398-8102
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: Nilima Nigam and Svetlana Komarova
Email: nigam@math.mcgill.ca
Phone: 514-398-3804
Website: <http://www.math.mcgill.ca/~nigam/>

Department or Unit: Mathematics and Statistics
Course number: MATH 396

2 Project Information

2.1 Term:

Summer 2006

2.2 Project start & end dates:

May 1- August 30, 2006

2.3 Project title:

Osteoclasts: a mathematical and biological investigation into oscillatory growth dynamics.

2.4 Project description:

Osteoclasts are cells which are crucial in the growth, maintenance and repair of bones. They are typically formed when precursor cells (called monocytes) fuse together. Monocytes are also able to proliferate. These processes can be enhanced via biochemical agents. It is not clear how, and to what degree, the populations of monocytes and osteoclasts affect each other, and what roles these agents play.

Recent experiments suggest that in cell culture, osteoclast populations show strikingly oscillatory behaviour, rebounding after the population reaches near-zero levels. This phenomenon needs to be explained, and has important implications in the study of bone tissues and diseases. As part of this study, the student will investigate the cell processes mathematically and biologically. On the mathematical front, models involving monocyte and osteoclast populations will be developed, and will include appropriate nonlinear or feedback mechanisms to explain observed behaviour and include the effect of the biochemical agents. These models will then be analytically studied to understand other possible dynamics which could occur. The analysis will be enhanced by careful numerical experiments.

Simultaneously, the student will conduct experiments involving monocytes in culture, varying parameters such as initial concentration of monocytes, nutrients, etc. The goal is to study the effect of these parameters on osteoclast populations. Daily recordings of osteoclast levels will be crucial.

The project is completely interdisciplinary. The mathematical models will be built based on observations and refined accordingly. The models and computations, in turn, will suggest other experiments to be conducted on the monocytes and osteoclasts, with the overall goal of understanding the growth and subsequent dynamics of osteoclast cells.

2.5 Prerequisites:

1 term completed at McGill + CGPA ≥ 3.0 ; or permission of instructor.

2.6 Grading scheme:

Weekly meetings and oral progress reports: 15%
Experiments and recording of biological data: 15 %
Numerical experiments and documentation: 15%
Final report: 55%

2.7 Other:

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:

This project is already taken.

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

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: Nilima Nigam

Date:

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

Chair, Director, or designate

Date: