



Academic Science Fund Application Form 2012/2013

Project Name: Nematode Diversity Project – A Novel Fourth Year Undergraduate Research Course	Applicant Name & Program: Dr. Kimberley Dej (Biology and Life Sciences) Dr. Bhagwati Gupta (Biology)
Project Level: <input type="checkbox"/> Short term <input checked="" type="checkbox"/> Long term	Applicant Contact Information: dejkim@mcmaster.ca

Summary of Proposal:

The opportunity to participate in independent research in a laboratory environment is considered a capstone experience for our undergraduate specializations in the Faculty of Science. Indeed, studies show a positive learning experience as reported by students that includes increased technical skills, the ability to act independently, increased confidence, and insight into graduate opportunities and career possibilities.^{1,2} We find that students seek this opportunity in their 4th year whether it is a program requirement or not. Unfortunately, the number of such positions is limited and some students never find a 4th year thesis position. This is especially true of students in large Biology and Life Sciences programs. In addition, many students lack the confidence to secure a position in a lab. It is precisely these students who would benefit the most from this experience.

This proposal suggests a new model that would allow more students the opportunity to conduct novel, independent research. In this two-part research course, students would complete research independently, but they would support and assist each other in a peer-based, collaborative environment. Students would share their individual expertise and skills, but collect independent sets of data that would be accumulated at the end of the project for final analysis.

THE NEMATODE DIVERSITY PROJECT:

- 1) Isolation of a novel species of nematode by each student.
- 2) Independent characterization of the species by each student in a flexible lab environment.
- 3) Contribution to the scientific community of novel data in the form of a website and possible publication.

PROJECT OBJECTIVES.

- 1) Provide more students with the opportunity to complete self-directed research.
- 2) Provide an independent laboratory experience within a collaborative, peer-supported course.
- 3) Provide a new conceptual framework for undergraduate research at McMaster University that would appeal to students with diverse learning styles.

FUNDING REQUESTS:

- 1) Establishment of the basic infrastructure to run this Undergraduate Research Project for five years.
- 2) Development of a Nematode Diversity Project *iBook*. This is not a lab manual. This innovative format would include interactive quizzes and demonstrations (videos) that would assist in teaching lab skills, providing background biological information, and establishing a project time-line. Segments of the *iBook* would be made available to students on Avenue to Learn if they do not have access to an iPad.

1. Lopatto, D. (2004). Survey of Undergraduate Research Experiences (SURE): First findings. *Cell Biology Education*, 3: 270-277.

2. Seymour, E., Hunter, A.-B., Laursen, S.L., and DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88(4): 493–534.

Project Implementation Plan:

Plan of implementation: We propose dividing the research agenda into two, 3-unit courses each with an enrolment of twenty-five students. This could run Fall-Winter and Spring-Summer. Enrolment per term would be capped at 25 students. These two courses would not run on a typical 3-hour per week schedule. Students would have access to the lab 12 hours per day and would conduct the research on their own schedule, just like a thesis project.

Part 1 (Fall): An initial field component sends students outside to collect specimens of nematodes. In the lab, morphological analysis on the Nomarski microscope would be paired with molecular analysis including DNA extraction, PCR, and DNA sequencing. The students would then place their species in a phylogenetic tree. All of these elements of the project could be completed independently, but students would be encouraged to share resources and skills.

Part 2 (Winter): Students would take their isolated species from Term 1 and continue the analysis. This would include genetic crosses, life-cycle analysis, and behavioural studies. Part 2 would not require prior enrolment in Part 1, nor would students have to complete Part 2 if they began Part 1. Many students may choose to complete both since, partnered, the two courses would be equivalent to a 6-unit research project.

One of the strengths of this course design is that the students would have exposure to a large number of techniques including ecological field studies, microscopy, molecular genetic techniques, and evolutionary biological analyses. This cross-disciplinary research puts students at the forefront of current research.

While we propose a new, two-part course, the project can run immediately in Spring or Fall of 2013 under the title of Life Science or Biology research projects (e.g. Life Science 4B06, Biology 4F06)

Expected Life: The requested funding would establish the course infrastructure and allow the project to run for five years. This may allow over 200 novel species to be identified. After this time, the project could continue with Departmental and Program support as two established courses.

Both the Biology Program (R.Cameron) and the Life Sciences Program (P.Chow-Fraser) are supportive of this proposal and these courses. They are both willing to collaborate to support the needs of this course once it has become established.

Space: Currently, we have an agreement for space in the Department of Biology for a minimum of three years. Laboratory space for undergraduates is also part of the five-year Strategic plan for the Life Sciences Program and this project is a part of this plan.

Technical staff: The students will be working independently once they are comfortable with techniques in the lab. Each term, initial training and weekly technical support would come from the project leaders (K.Dej and B.Gupta) and a graduate Teaching Assistant (three years of funding requested in this proposal). In the long term, shared funding from the Life Sciences and Biology programs will support TAs in this course.

Expected impact of the proposal:

- 1) The introduction of a new structure for independent research experiences in the Faculty of Science. Novel and publishable research is conducted by a group of undergraduate students within a course.
- 2) This new structure would increase the number of research opportunities significantly. It would be possible for 25 to 50 students per year to conduct independent research. This is above the approximately 160 students that currently conduct laboratory thesis projects across the Biology and Life Sciences undergraduate programs.
- 3) The collaborative environment of this course is attractive to students who are intimidated by a thesis project. It is precisely these students who will benefit the most from conducting independent research.
- 4) This would be a model for other undergraduate research projects for large groups of undergraduate students, perhaps even at earlier times in their programs.

Budget Justification:

- 1) Funding for research resources for the Nematode Diversity undergraduate projects. This will allow the project to run for a minimum of 5 years, continued operation will be dependent upon financial support from the Department of Biology and the Life Sciences Program. Both programs are in support of this proposal.
- 2) Funding to design and implement the Nematode Diversity iBook which would be an integral part of the project implementation over the next five years.

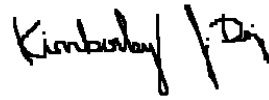
Project Budget: Total requested = \$26 507.50

PART 1: Building the Nematode Diversity Project for five years		Funds Required	Funds Requested
Technical Resources:			
	Platinum Taq polymerase (\$294/100 reactions)	882	882
	Primers for PCR	40	40
	Agarose	320	320
	DNA ladder	178	178
	dNTPs for PCR (nucleotides)	78	78
	RNAse/DNAse free water	20	20
	Sequencing	600	600
	DNA extraction buffer	60	60
	Gel extraction kit	500	500
	Plates for worms	2000	2000
	Gel electrophoresis apparatus (donated, Dr.K.Dej)	0	0
	Dissecting microscopes (borrowed, Biology Department)	0	0
	Nomarski microscope (borrowed, Dr.B.Gupta)	0	0
	Bulb for Nomarski microscope	250	250
	Software (sequence analysis-freeware)	0	0
	PCR machine (Edvotek* EdvoCycler; A resource that can be shared with Biology Teaching Labs)	2000	2000
	Misc. Equipment (tips, tubes, gloves, etc)	200	200
	Lab space (borrowed from Biology Department)	0	0
	SUBTOTAL	7128	7128
Supporting Resources:			
	One 130 hour graduate TA per year (3 years requested)	27500	16500
	Support to be arranged with Biology and Life Sciences in following years		
PART 2: Nematode Diversity iBook			
	130 hour summer student (Undergraduate)	2879.5	2879.5
	(To assist in taking the draft course protocols and writing the iBook)		
	TOTAL REQUESTED:		26507.5

Signatures

Kimberley Dej

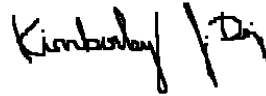
Applicant Name (Please Print)



Faculty Endorser Name (Please Print)

Kimberley Dej

Applicant Signature



Faculty Endorser Signature

(Proposal reviewed and approved by co-applicant, Dr. Bhagwati Gupta and by Dr. Robin Cameron (Associate Chair of Undergraduate Studies, Biology and Dr. Pat Chow-Fraser, Director, Life Sciences Program)

FOR ASF COMMITTEE ONLY

Fund Director Signature

Date Received