

Project Title: Mercury Free Microscopy

Budget Requested: \$50,000

Applicant/Project Leader: Claire Brown

Faculty/Department: Assistant Professor, Department of Physiology

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Project Team:

Faculty/Department	Email:	Daytime Phone:
Medicine/Physiology - Student - Post Doctoral Fellow	Kimberly.Young@mcgill.ca Tushare.Jinadasa@mcgill.ca	514-653-5069 514-501-8874
Medicine/MNI - Professor	Thomas.Stroh@mcgill.ca	514-398-2719
Science/Biology - Staff - Staff - Staff - Professor	Judith.Lacoste@mcgill.ca Guillaume.Lesage@mcgill.ca Elke.KusterSchock@mcgill.ca Francois.Fagotto@mcgill.ca	514-398-5914 514-398-5414 514-398-5414 514-398-6411
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I. PROJECT OVERVIEW

Project summary: The Life Science Complex Imaging Facility (Physiology), the Cell Imaging and Analysis Network (CIAN, Biology) and the Montreal Neurological Institute (MNI) microscopy core have eleven microscopes with mercury based light sources that they would like to eliminate. The facilities would like to migrate to newer sustainable, energy efficient, **mercury free** light engines. Mercury bulbs each contain about 100 mg of mercury, they run at 100-200 Watts (W), they only last for about 200 hours and the intensity of light decays over time. On the other hand, light engines are **mercury free**, run at 4 W, last for 20,000 hours, and the intensity is stable over time. Mercury light sources require about 25 times as much power as light engines, they are on constantly while they may only need to be used 50% of the time or less. In contrast, light engines are only turned on when they are in use. Therefore, each light engine would replace the equivalent of at least 150 mercury bulbs. Replacing eleven light sources would be the equivalent of 1,650 mercury bulbs or almost **a quarter of a kilogram of mercury** and would use **25 times less power**. The light output from light engines is constant and reliable over years requiring little maintenance, zero inventory, and minimal management while providing researchers with better quantitative data. We want to begin a **new campus wide initiative** for **mercury free microscopy (MFM)** that provides awareness, recycling, and elimination of mercury based light sources.

Project eligibility:

1. **Shift business as usual at McGill toward sustainability:** Almost every new fluorescence based research microscope at McGill is purchased with a mercury based light source. We will immediately start educating researchers to purchase light engine technology to avoid bringing new mercury based sources on campus. In fact, Dr. Brown recently advised Dr. Issam El Naqa from the Department of Oncology to purchase an LED based light source instead of a mercury based source for a new microscope purchase. Dr. El Naqa avoided the long term costs of replacing mercury bulbs, avoided bringing another mercury source on campus, saved money on the purchase and was able to purchase a higher end camera. As a result, he now has a more quantitative microscope. We will start an awareness campaign including working with **Procurement Services (PS)** and the **Office of Sponsored Research (OSR)** so that they can make researchers aware of mercury free solutions when purchasing new instruments.

2. **Engage the McGill Community:** The project involves core facilities that are in the Faculty of Science, Faculty of Medicine and a part of the MUHC. Users of these facilities are from departments across campus ranging from Biomedical Engineering to Oncology. The team members range from students to faculty and staff. We plan outreach to McGill administration including the OSR and PS. Dr. Brown will create at least two **PHGY396 independent study courses**, one of them collecting scientific data demonstrating the benefits of the light engine over mercury sources for long-term quantitative imaging and live cell microscopy. The second will focus on developing and delivering the educational materials for the project as well as monitoring the project outcomes. This will intimately engage undergraduate students in the project. Dr. Brown has successfully overseen three PHGY396 projects to date. Additionally, Dr. Brown will discuss the project in the context of her

PHGY560 - Light Microscopy for the Life Sciences course, reaching both graduate and undergraduate students from McGill and Concordia University. In phase 2 of the project we plan to engage an even larger part of the McGill Community.

3. Communicate why the project is being undertaken: The three facilities combined serve about 400 users from 80 to 100 laboratories across McGill and Montreal. The Imaging Facility alone has run more than 50 workshops and courses in the last 7 years. This includes the international Montreal Light Microscopy Course (MLMC) that was attended by over 200 scientists and corporate attendees in July of 2012. This large network of access to researchers using microscopy will facilitate the awareness campaign. Also, having the three core facilities move to mercury free microscopy will set an example for all researchers that is it not only possible but advantageous to move away from mercury based light sources.

We plan to have educational initiatives in awareness at many levels. We will design posters and have them prominently placed at the microscopes in the three facilities. We will run one or two larger information sessions for the McGill community over the course of the year to educate people about the hazards of mercury and the cost effective, mercury free alternatives that also result in better quality scientific data. Our facilities collectively train about 200 students and staff annually in a one-on-one format. This will be an ideal place to educate the McGill community so we will include sustainability in our training program manuals. Our workshops and courses reach scientists from around Montreal, Canada and internationally. These will be ideal places to reach out to researchers beyond the McGill community. In fact, we are running a Systems Biology Training Grant workshop on High Content Imaging December 10-12 and Dr. Baird from Lumencor Inc. will be teaching a unit on light sources. He will discuss the sustainability of light engines during his lecture. We have people from **University of Montreal** enrolled in the course, one of the speakers is from **IRCM** and corporate staff members are coming from **across Canada and the US**. These types of events combined with the **MLMC 2014**, and the Canadian Cytometry and Microscopy Symposium (**CCMA**) that Drs. Lacoste, Lesage and Brown are involved in organizing at McGill University in the spring will be ideal venues to educate McGill researchers and Canadian and international researchers.

4. Nurture learning and change in behaviour with a plan to evaluate success: Our outreach initiatives will provide learning opportunities for scientists from many different departments and at different levels in their careers. We will provide documentation to PS and the OSR to educate their staff members on mercury free microscopy. We will work with PS to find a mechanism to flag any new microscope purchases and determine if mercury free light sources are being purchased. If not we will educate the researchers purchasing the equipment about MFM. We will run an information session to train staff in PS and the OSR. We will work with Hazardous Waste Management and PS to determine if mercury bulb disposal rates and costs decrease during the course of our campaign. We will work with facilities to measure actual power consumption of mercury lamps versus light engines and determine the exact cost savings to the University for changing light sources. We will develop a section in our training manuals to ensure all facility training units include education about sustainable, mercury free light sources.

5. Commitment from project team members: Dr. Brown has been working with Lumencor Inc. for 2 1/2 years. She has directly worked with Dr. Baird on a number of educational initiatives including a workshop with the **Canadian Microscopical Society**, the **MLMC 2012** and the upcoming **High Content Imaging** workshop. Dr. Baird has been instrumental in putting this proposal together and providing detailed information on mercury content, power consumption and stability of mercury sources and light engines. His efforts have lead to an offer from Lumencor Inc. to provide a minimum 15% discount to McGill researchers who purchase their light engine. He will work with PS to develop a preferred vendor purchase price for the light engines as part of phase 2 of the project. The CIAN facility and its staff members work closely with Dr. Brown on a regular basis. They are committed to the project and will contribute \$2000 towards the budget (see attached support letter). Dr. Stroh also works very closely with Dr. Brown and Dr. Lacoste. He is very supportive of the project and his facility will contribute \$2000 towards the project (see attached support letter).

6. Positive impact: This project will result in the **elimination** of almost a **quarter of a kilogram of mercury** from use at McGill. If we expand the project in the Life Sciences Complex and beyond we could eliminate **kilograms of mercury** from being introduced into the environment from McGill. The light engines will pay for themselves over about two years because expensive mercury bulbs will not need to be replaced. This will also free up research staff from the time required to replace and align bulbs. Additional money will be saved because the light engines are **25 times more energy efficient**.

7. Phase 2: We really see this project as Phase 1 of a much larger project. With the light sources in place in our facilities we will be able to showcase the new and improved technology to our hundreds of facility users. We will push for a campus wide campaign of awareness, removal of old technology and replacement with sustainable light engines. The team members are interested in continuing with the project over the long-term. We all invest a great deal of our time educating

students and staff and see the value in educating them about MFM. We will develop and implement a MFM certification program. We will continue our educational initiatives. We will work with McGill to identify funding sources to replace mercury based light sources. We will encourage researchers to invest in these replacements, given that they quickly pay for themselves because expensive replacement bulbs are not needed and a significant amount of energy is saved. We will identify mechanisms during our awareness campaign to avoid the introduction of new mercury based systems on campus.

8. Objectives/Timeline:

Task	Dates	Time (Months)	Group Member(s) Involved - In Charge Member Bolded
1. Purchase and install eleven light engines in three core microscopy facilities across campus.	Mar-May 2013	3	Baird, Brown , Küster-Schöck, Lacoste, Lesage, Stroh
2. Measure power consumption for mercury lamps and light engines.	May-June 2013	2	Baird, Brown , McGill Facilities
3. Identify viable mercury recycling program and remove used bulbs.	Mar-Dec 2013	10	Brown, Lesage , PS
4. Develop documents for PS and the OSR explaining the benefits of MFM.	June-July 2013	2	Brown, Lesage , PS, OSR
5. Develop protocols about MFM for training manuals within the microscopy facilities.	Mar-May 2013	3	Brown , Küster-Schöck, Lacoste, Stroh
6. Develop and implement a MFM certification program.	Jan-Mar 2013	2	Baird , Brown
7. Design and implement the awareness campaign including posters, information sessions and integration of MFM into existing educational initiatives: Systems Biology Training Program workshop (Dec 10-12, 2012), CCMA Symposium (June 13-15, 2013), MLMC 2014.	Nov 2012- Dec 2013	13	Entire Project Team, Brown
8. Create and run PHGY396 independent study courses.	Jan-Dec 2013	12	Brown , Stroh
9. Develop educational programs to educate researchers and OSR and PS staff at biannual information sessions.	May-July 2013	3	Baird, Brown , Küster-Schöck, Lacoste, Lesage, Stroh
10. Develop a system to flag PS purchases that might involve mercury based lamps.	May-July 2013	3	Brown, Lesage , PS
11. Work with PS to have Lumencor, Inc. as a preferred provider of MFM light sources to McGill.	Aug-Oct 2013	3	Baird , Brown, Lesage, PS
12. Prepare for Phase 2 implementation of campus wide educational initiatives. Develop a model to fund replacements to phase out mercury light sources.	Nov 2013- Feb 2014	4	Baird, Brown , Küster-Schöck, Lacoste, Lesage, Stroh

Metrics: As mentioned above, actual power consumption reduction will be measured. We will work with PS to set up a tracking system to measure how many non-mercury based light sources are purchased at McGill each year. The number of newly certified MFM systems will be monitored. We will work with OSR to flag research proposals containing microscopes, and inform researchers about the MFM program. We will track the number and demographics of information session attendees.

9. Stakeholders:

1. **Life Sciences Complex Imaging Facility, Cell Imaging and Analysis Network (CIAN), Montreal Neurological Institute (MNI) Microscopy Core:** The facilities will transition to more sustainable MFM operations, will save on staff hours for maintenance of mercury based light sources, and will reduce operating costs because there will be no need to purchase expensive mercury bulbs.
2. **Departments of Biology and Physiology, and the MNI:** All invest considerably in the core facilities through staff salaries and overhead costs, and many faculty members pay to use the facilities for their research projects. Staff salaries will be used more efficiently (time will not be spent changing bulbs). Research projects will not be interrupted by bulb changes, avoiding lost reagents and research time in failed experiments. Data from the microscopes will be of higher quality because the solid-state light sources are much more stable and reliable over time.
3. **Lumencor Inc.:** Has invested considerable R&D dollars in creating the SolaSM, which is the only white light source in its price range that offers a viable replacement for mercury based lamps. Lumencor will specifically invest in this project by giving a minimum 15% discount on any McGill purchases.
4. **McGill University:** McGill University will break new ground by establishing the first MFM sustainability project in Canada. To our knowledge no other such initiative exists in Canada or elsewhere. The university will see a reduction in energy consumption from the switch to solid-state light engines. The university will save thousands of dollars in mercury waste removal charges and employees will not have to work with this hazardous material.

II. **PROJECT IMPLEMENTATION:** See objectives/timeline table above.

III. **Financials** Critical Date: As soon as possible.

Detailed expenses: We will purchase eleven light engines for the imaging facilities. We will create a poster and post it prominently at the microscopes in the facilities to kick start our awareness campaign. We will advertise on our facility mailing lists reaching upwards of 400 researchers in the McGill and Montreal communities who use light microscopy in their research. We will hire an intern to help with the documentation (training manuals, documents for PS, OSR), with the logistics of monitoring outcomes and the logistics of running information sessions.

Expense Description	Estimated Cost
Eleven Light Engines	\$ 63,703
Taxes (6.937% - based on discounted price)	\$ 3761
Intern (1.0 hour s/wk - 6 months - \$15/hr)	\$ 3,800
Information Sessions	\$ 3,000
Graphic Design and Printing	\$ 1,000
TOTAL EXPENSES	\$ 75,264

Detailed revenues: We are requesting \$50,000 from the sustainability fund. The Life Sciences Complex Imaging Facility will contribute \$11,774, the CIAN and MNI facilities will contribute \$2000 each towards the cost of replacing their light sources. Lumencor will give a 15% discount on the cost of the light engines for a donation of \$9,490 plus \$658 in tax savings.

Revenue Source	Amount Requested	Confirmed?
Sustainability Project fund	\$ 50,000	No
Imaging Facility	\$ 11,774	Yes
CIAN	\$ 2,000	Yes
MNI	\$ 2,000	Yes
Lumencor, Inc.	\$ 9,490	Yes
TOTAL REVENUE	\$ 75,264	

IV. **Additional information**

Dr. Brown has been the director of the Imaging Facility for 7 years, Dr. Lacoste has been in charge of microscopy in the CIAN facility for 5 years and Dr. Stroh has been running the MNI facility for 7 years. They have a combined experience of over 60 years working in microscopy. They have published in peer reviewed journals and written book chapters on microscopy related topics. The facilities have organized more than 60 courses and workshops over the last 7 years including the MLMC which runs every two years and reaches students, corporations and other core facility staff from around the world. Their extensive expertise and their extensive network of researchers and corporations in microscopy will make the awareness campaign highly targeted with a broad reach right from the beginning.



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Lumencor Quote #110	Quote Date 11/14/2012	Expiration Date 12/14/2012	Sales Person Regan Baird
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To:Claire Brown
McGill University Imaging Facility
Rm 137 Bellini Building
Montreal,Quebec
H3B 0B1
Canada

QUOTATION (all prices in USD)

Model	Part Number	Unit Price	Discount	Quantity	Product Total
SOLA SM	90-10050	4,995.00	15%	11	46,703.25
3mm LLG to Scope Collimator	82-10049	775.00	15%	11	7,246.25
Zeiss Mounting Ring	01-10395	150.00	15%	11	1,402.50
				Subtotal:	65,120.00
				Discount	-9,768.00
				Grand Total:	55,352.00

SPECIFICATION

solid-state white light light engine with excitation bandpasses designed for use with Semrock, Chroma and other popular filter sets. Includes a 2m liquid Light Guide (3mm diameter) and a Foot Switch.

Physical	
size	9 x 18 x 28cm
color	white
controls	Switch

Spectral Bandwidth
380nm-660nm white light



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Lumencor standard terms and conditions apply.

- Delivery 30 days ARO.
- Quotation is valid thru expiration date shown above. Spectral bands may be adjusted for P.O. without additional charge.
- Unless otherwise specified, this document supersedes any engineering documents, which are mailed to Lumencor after placement of your order.
- Please reference the Lumencor Quote # on your Order.

All drawings and specifications are confidential and shall not be reproduced or disclosed to third parties without written permission from Lumencor, Inc.

November 30, 2012

Dear Sustainability Committee,

I am writing to confirm that the McGill University Life Sciences Complex Imaging Facility will contribute \$11,744 towards the replacement of seven of our mercury based light sources.

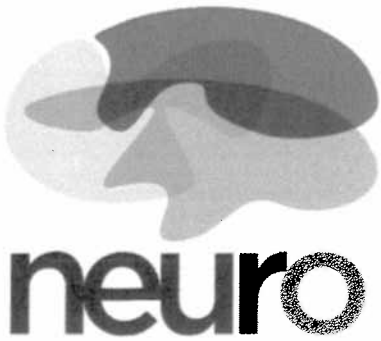
Some of this funding will also go towards educational initiatives in sustainability and discussing the Mercury Free Microscopy program at McGill and within the context of the many workshops, training sessions, courses and symposia the facility is involved with.

It is my hope this funding will help bring this important sustainability project to fruition.

Sincerely,



Claire M. Brown, PhD
Assistant Professor
Department of Physiology
McGill Imaging Facility Director



Thomas Stroh, Ph.D.

Professeur Adjoint
Département de neurologie et neurochirurgie

Assistant Professor
Department Neurology and Neurosurgery

December 3, 2012

Dr. Claire Brown
Director, Imaging Facility
Life Sciences Complex Project
Biochemistry, Department of
LIFE SCIENCES Building

Dear Claire,

As Director of the Montreal Neurological Institute Microscopy Core I am very thrilled to join your initiative to develop a Mercury Free Microscopy (MFM) program at McGill. We are willing to contribute \$2000 towards the replacement of two of our mercury based light sources through this program. We also plan to work towards becoming completely mercury free. I realize moving to mercury free systems will free up my facility staff for other important tasks rather than changing and aligning mercury bulbs. It is wonderful that we will have the added benefit of more stable light output over time ensuring that researchers will be able to have the highest quality quantitative data from our microscopes.

We plan to include a unit informing new facility users about sustainable light sources during our one-on-one training sessions. As I have done in the past I would be happy to assist with educational initiatives and to put up signage in our facility. I interact with many researchers at the MNI who use mercury based light sources and we will work to educate them on the advantages in moving to mercury free systems. Many researchers also seek my advice when purchasing new microscopes so I will advise them to buy sustainable light engine technologies and avoid bringing more mercury light sources to McGill.

I look forward to working on this project with you.

Sincerely,

Thomas Stroh, Ph.D.
Assistant Professor
Director MNI Microscopy Unit

TS/nt



Thursday, November 29, 2012

Dear Claire,

The Cell Imaging and Analysis Network (CIAN) is very excited about the sustainability project to develop Mercury Free Microscopy (MFM) at McGill. We have a number of systems that use mercury based light sources and would love to start, through this program, the process of becoming mercury free. We plan to initially replace two light sources and will contribute \$2000 to the project to do so. This will save my facility staff many hours of time that would normally be required for bulb replacement and alignment. Our researchers will also be excited to have more quantitative solid-state light sources to use in their work.

The facility is willing to include information about sustainable light sources as part of our one-on-one training programs. We will put signage throughout the facility and will be happy to participate in educational sessions throughout the year. There are many researchers in the Biology Department who use mercury based light sources in their laboratories and we will educate them on the advantages in moving to more sustainable environmentally friendly mercury free systems.

We are looking forward to working on this project with you.

Sincerely,

Guillaume Lesage, Ph.D., Administrator

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