

A photograph of three students in green waders standing in a shallow river. They are looking at something in the water. The background is a lush green forest.

MARCH 2020

**DEPT. OF PHYSICAL AND
ENVIRONMENTAL SCIENCE**

DPEES

A photograph of two students in a dry, reddish-brown field. One student is kneeling and looking at the ground, while the other is standing nearby. The background shows a clear sky and distant hills.

DIGEST

EDITORS:

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HANIF**

**VITHUSHA
COOMARAN**



C O N T E N T S

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DEPARTMENT PROFILES

Research Faculty: Dr. Voznyy
Graduate Student: Tiange Yuan
Teaching Faculty: Dr. Hadzovic
Staff: Julie Quenneville
Undergraduate: Roomina Rashid

CHOOSING YOUR DPES PROGRAM

Environmental Science
Physics
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The Chemistry Society (CSU)

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FACULTY PROFILE

DR. VOZNYI

Ph.D. in physics of semiconductors, Chernivtsi National University, Ukraine

Learn more about Alex and the Clean Energy Lab at:

<http://cleanenergy.utoronto.ca/>

About Me:

After I had a great physics teacher in school, I knew for sure that I want to study physics at the university level. Following the advice of my older friends, I entered the Microelectronics program in the Physics Department, where I was looking for research opportunities starting from first year, but only found them in third year, in computational studies of gallium nitride (material for blue lasers). There was no industry or research funding at that time in my country, so computational research was the only option. I continued the same research into my PhD, focusing on physics of semiconductors.

After I immigrated to Canada and settled in Montreal, I worked as a programmer for a few months before I decided to try to find a position in research. I found an opportunity in Sherbrooke in the Department of Electrical Engineering but actually working on semiconductor surfaces and their applications in bio-sensing. This surface science expertise brought me next to NRC in Ottawa, where we worked on mixed polymer/nanocrystals solar cells. Here, I learned the theoretical tools for modelling the excited states and about many body electronic processes in semiconductor nanocrystals.

My nanocrystals expertise was further recognized by Ted Sargent group at ECE UToronto, who invited me for a senior research scientist position as the first computational person in the group.

There I learned about the intricacies of solar cells operation and fabrication, as well as experimental material characterization techniques, in a pursuit of better understanding the experimentalists and providing theoretical predictions that would actually contribute to the advancement of real-world materials and devices.

Over the years, the groups have grown from 10 to 100 people, and myself within it. I had a chance to mentor students and eventually lead a subgroup of nearly 20 of them, meanwhile expanding my knowledge to lasers, LEDs, catalysis, machine learning, as well as manuscript and grant writing, and managing people.

Research Summary:

Our group works on developing new materials for Li-ion batteries, hydrogen storage, CO₂ capture, and photovoltaics. We utilize atomistic simulations, machine learning, automated high-throughput materials synthesis and characterization to demonstrate proof-of-principle devices that will speed-up the transition to renewables.

What led you on this career path? What were your biggest milestones?

Each step of my career was important for gaining new knowledge and experience, even though it took much longer than expected to reach a faculty position. Getting to U of T allowed me to prove my potential: having access to resources, facilities and, great mentoring enabled me to publish a lot and establish a broad network of collaborators.

AN INTERVIEW WITH DR. VOZNYI

How would you summarize your research?

Solar panels generate too much energy during the day but cannot produce energy overnight. Without energy storage, further expansion of renewables is not economically viable. To make an impact, the price of kWh of stored energy should be reduced nearly 5-fold. Moreover, global scaling up of electrochemical energy storage requires finding new device architectures and materials that don't rely on scarce or toxic elements.

We apply computational methods and machine learning in combination with high-throughput materials synthesis, characterization and device fabrication to screen for new material compositions that will improve battery capacity and charging speed, to help the world transition to renewable energy sooner.

Most rewarding parts of your job?

Just doing research and finding out something new always excites me. My students coming to me for life advice, my peers saying that I'm their role model for persisting for many years before finding a faculty position, my collaborators who genuinely value my contributions (not those of my supervisor) all motivate me to give it my best.



Challenges in your current position?

Aiming to show my best in research, spending enough time with my students and preparing the undergraduate lectures the way I'd personally like to be taught takes quite a bit of after-hours time.

What advice would you give yourself if you can go 10 years in the past?

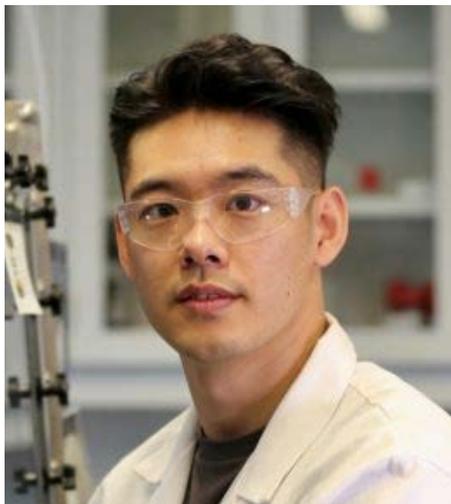
Network more! Aim higher! Think by yourself about important problems to solve and don't rely on somebody else telling you what to do.

Where do you hope your career takes you in 10 years?

A well-funded research group, making a real impact in solving the climate challenge.

A fun fact about you?

I play guitar and sing. My kids are in high school. I was seriously considering a career in web development, and getting into academia was a play of chance.



GRADUATE PROFILE

TIANGE YUAN

*PhD candidate, Clean Energy Lab (Dr. Voznyy)
University of Toronto Scarborough*

Research Summary:

- Improving lithium ion battery anode material capacity
- Reducing nitrogen gas into ammonia by electricity

What are the most rewarding parts of your graduate experience?

The first would be making novel material that was previously non-existent. Additionally, doing research that could lead us to a better society (clean energy based).

What are some challenges of your current project?

For our battery project, we are trying to optimize our material to a world-record performance.

How do you maintain a work-life balance?

For me, it is easy to work over hours. I keep some activities everyday/everyweek to make sure I can release my pressure and keep a balance between work and life. For example, workouts, board games, movies, or just simply doing groceries, and eating delicious food with my friends

Do you have any advice on graduate school and how to know if research is for you?

Talk to professors and grad students in this field. Ask them about their research, career after grad school, and importance of their research. Read some review papers about that subject matter. If you don't feel excited for the merit for the field, maybe the field is not for you. Also, try to explain to your friends the importance of the field. If you can't, it's probably not for you.

What advice would you give yourself if you can go 10 years in the past?

Enjoy the present, work hard, and don't leave any regrets. The best will come to you.

Where do you hope to be career-wise in 10 years?

I hope to work for an electrical vehicle or battery company for material development. I would also like to become a PI and lead my own group.

About Me:

I did my undergraduate at UTSC in chemistry and environmental science.

During my undergraduate co-op program, I found myself interested in chemistry and got a chance to work with Prof. Frank Wania and Prof. Myrna Simpson. I also met hundreds of excellent undergraduates through a summer internship in Germany. Their passion for research motivated and encouraged me to do research and enter graduate school.

My field is clean energy, specifically, lithium ion battery development and electrocatalysis. To reduce fossil fuels usage and CO₂ emissions, a great interest has been focused on battery materials to better utilize renewable energy sources and promote electric vehicles. Electrocatalysis, such as CO₂ reduction, is also extremely important for reducing green house gases.

FACULTY PROFILE

DR. HADZOVIC

BSc Chemical Engineering, University of Sarajevo
PhD Chemistry, University of Toronto



About Me:

I completed my undergraduate study in my hometown, at the University of Sarajevo, Bosnia and Herzegovina. The university did not have a pure chemistry program so my degree is in Chemical engineering. I graduated in 1997, two years after the war ended. My diploma thesis (something like CHMD90 here) was in inorganic chemistry, completed in part at my university and part at the Institute for analytical and inorganic chemistry, University of Graz (Austria) and Geozentrum, Vienna University (Austria).

My first position was as a teaching assistant - an entry level faculty position in our system - at University of Sarajevo. I was covering general and inorganic chemistry (stoichiometry and labs) as well as mineralogy for chemistry. I arrived in Canada at the onset of winter in 2000 (a perfect season to come to Canada for the first time). In 2001, I started my PhD at Department of Chemistry, University of Toronto under supervision of Prof. Robert Morris.

My PhD work focused on synthesis, characterization and kinetic study of ruthenium complexes used in asymmetric hydrogenation of ketones. After graduation and a two-year postdoc work with Prof. Datong Song, I started at UTSC as a sessional lecturer. I became a full-time faculty professor in 2011.

I enjoy teaching my discipline – inorganic chemistry, particularly second year. I find it very exciting about taking the students through the first steps, trying to make the topics interesting and relevant for science, society, environment, economy, history, and other perspectives. I also enjoy working with the students on their CHMD90 projects, letting them explore and understand the process in all its complexities.

What led you on this career path (research or teaching)? What were your biggest milestones?

Love for chemistry, learning and (almost) childish curiosity led me on this career path. Chemistry is a remarkable science – it has a bit of everything in itself: science, art, craft, long and beautiful history, you name it. One can find it everywhere, a true central science. This is one rare career path that allows me to stay and share and discover this wonderful world and connect it with other disciplines. I was lucky enough to have several highpoints: two teaching awards, feature in Re:Think higher education initiative, and getting to be a bedel during a UTSC convocation ceremony.

What is something interesting the department doesn't know about you?

I like carpentry – fixing old furniture and making something new of old stuff. I guess by now, many know I do not like being in front of a camera but love to be behind it. Also... well let's keep some mystery alive!

What are the most rewarding parts of your job?

There are many rewarding parts. Getting to know students, their desires for the future, helping them navigate through the material and their future profession are what makes this job particularly rewarding.

Read more about Prof Hadzovic's true merger of art and chemistry at: <https://utsc.utoronto.ca/news-events/undergraduate-experience/utsc-students-team-solve-some-mysteries-behind-celebrated-museum>



STAFF PROFILE

JULIE QUENNEVILLE

*Graduate Administrator,
Environmental Science Graduate Programs*

About Me:

I have been at the department (and U of T) since November 2005; the Master of Environmental Science (MEnvSc) Program started in January 2006 and the PhD in Environmental Science Program started in 2010. I worked in private industry prior to DPES. I have an Honours Bachelor of Business Administration from WLU.

Challenges in your job?

Things that are beyond my control as well as the pace and diversity of tasks - the MEnvSc program is incredibly fast-paced (constant and competing deadlines; many stakeholders). It can also be challenging supporting the current students, the outgoing students and prospective students simultaneously.

Most rewarding aspects of your job?

I love what I do...working with such a supportive and dynamic team/department. Amazing leaders, colleagues, faculty and students. Always interesting, always learning.

What are your specific responsibilities and requirements of your job?

Overseeing the 12-month course-based Professional MEnvSc Program and parts (funding packages and Tships) of the PhD in Environmental Science program. On a day-to-day basis, I work very closely with Gisela Bento, MEnvSc Program Assistant and Elaine Pick, Program Assistant for the PhD program (as well as the Associate Graduate Chair, Carl Mitchell and Graduate Chair, George Arhonditsis).

What is something interesting the department doesn't know about you?

I am the middle child of 7. My parents were both educators. I grew up in the country surrounded by farmland in Delhi, Ontario (Norfolk County, known for its agriculture, especially tobacco, at the time). I started working in tobacco in the summer of grade 7 - until 3rd year university - to earn enough money to put myself through university.

In my late teens/20's, I came face to face with a large animal during a job in a tobacco field. I didn't know what it was then (my tobacco farmer boss nicknamed it a "wolfoo" because I said it hopped like a kangaroo and had a tail like a wolf). All I remember was that it was stealth-like because I didn't see it until it was about 15-20 feet in front of me, loping towards me blocking me from my home, which was about a km away! Years later at the ROM with my kids I realized it was indeed a cougar that I had encountered years prior.

What are/were your biggest milestones

Graduating from university. Back-packing throughout Europe (and Iceland) post-graduation. Getting married and having 3 children (who are all grown up now), and of course, working at UTSC! Every day is an accomplishment!

What advice would you give yourself if you can go 10 years in the past?

Don't sweat the small stuff; focus on what I can control...that I will be okay....with whatever life throws my way.



UNDERGRADUATE SUCCESS STORY ROOMINA RASHID

*4th year Undergraduate
Biochemistry and Molecular Biology Double Major*

cope with the anxieties associated with being a new undergraduate.

The opportunities she has had - both inside and outside the lab, have shaped her work ethic. Altogether, Roomina's main takeaway points are to always network well and take advantage of the many resources on campus.

With the right guidance and by striking a balance between her academics and extra-curricular activities, she has honed her focus going forward in the field of Chemistry.

Roomina has been accepted into her masters program of choice. She will be pursuing chemistry and will be working with Dr. Kraatz, here at UTSC. With her current experiences and the planned completion of a master's degree under her belt, she hopes to continue making meaningful contributions in some chemistry labs around the world, and perhaps even her very own!

Congratulations Roomina! We wish you all the best in your new program!

Roomina is a fourth-year undergraduate student pursuing a double major in Biochemistry and Molecular Biology, two subjects she is deeply passionate about. Because she is fascinated by both of these subject areas, she naturally gravitated to major in both.

As an active member of the UofT student community, Roomina identifies herself as a 'lab-worm' who has had the invaluable opportunity to volunteer in Dr. Kraatz's lab. Her project consists of synthesis of peptide based hydrogels. She aims to explore these hydrogels further as an entrapment matrix for various biologically significant enzymes and she wishes to explore these compounds further for different tissue engineering applications. From the rich experiences gained, she believes in giving back to the UTSC community.

Previously, Roomina has worked as a first year peer advisor to help students



Roomina volunteering at DPES high school demonstration event



CHOOSING YOUR PROGRAM: ENVIRONMENTAL SCIENCE

DID YOU KNOW?

Besides having accreditations with the Environmental Careers Organization (ECO) of Canada and the Association of Professional Geoscientists of Ontario (APGO), environmental science programs are behind UTSC's unique Rock Walk - a collection of massive boulders showing a record our planet's complex history over the past 4.5 billion years, and reflect the geological diversity of Ontario.

SPECIALIST IN ENVIRONMENTAL BIOLOGY (14.0 credits)

**co-op option*

The study of how life on Earth responds to global environmental change in both natural and human-altered ecosystems



SPECIALIST IN ENVIRONMENTAL GEOSCIENCE (16.0 credits)

**co-op option*

The study of the geologic processes that have shaped the world's continents and oceans, and the effects of human activity on geological systems and landscapes.

SPECIALIST IN ENVIRONMENTAL PHYSICS (15.5 credits)

The study of the principles that govern how and why materials move and influence each other, as the foundation of all environmental sciences.

MAJOR IN ENVIRONMENTAL PHYSICS (8.5 credits)

The study of the wider fundamental scientific principles that underpin environmental sciences including biology, chemistry, geology, and physics, along with their application to environmental issues.



MINOR IN NATURAL SCIENCES AND ENVIRONMENTAL MANAGEMENT (4.0 credits)

The study of the origin and natural history of the Earth and environmental management, and how these fields are applied to current environmental issues



MINOR IN ENVIRONMENTAL SCIENCE (4.0 credits)

The study of the core principles of environmental sciences and their interrelatedness.

Here are some jobs our graduates hold:

- conservation biologist
- water treatment specialist
- environmental assessment analyst
- environmental specialist in engineering consulting
- environmental planner in fisheries, forestry, or mining
- environmental engineer · environmental geoscientist environmental geophysicist
- environmental remediation specialist
- climate scientist · etc, etc...

Want to further your studies? Here are some options:

- Combined BSc/ MEng program: A unique opportunity linking the study of fundamental environmental science principles, to its applications in a Masters of Chemical or Civil Engineering program.
- Graduate school (masters, PhD, technology, education...)

Environmental science is an interdisciplinary field that incorporates the study of biology, chemistry, geology, and physics, in order to address many of the world's leading challenges including climate change, biodiversity loss and conservation, food security, natural resource management, and pollution and human health. Environmental Science programs will provide you with hands-on science education and will prepare you to help solve the world's environmental challenges head on. Through a powerful combination of field and lab courses, our Environmental Science programs will thoroughly prepare you for a career in the environment in private, public, or academic sectors.



CHOOSING YOUR PROGRAM : PHYSICS

DID YOU KNOW?

Thanks to Physics & Astrophysics, UTSC campus is a home of a model solar system installation that includes ten planet markers at the exact location of each planet on July 1, 1867, the day of Canada's confederation. Markers include planet description and its position in the solar system. Each 1 mm of the model represents 10,000 km. Final marker is installed at the Eureka Research Station, Nunavut. The model spans 4,000 kilometres, and is one of the largest in the world.

SPECIALIST PROGRAM IN PHYSICS AND ASTROPHYSICS

Specialist program in physics and astrophysics program prepares students for careers in industry, government, teaching and graduate studies. It offers rigorous and in-depth training in the core areas of physics and astrophysics, making use of a strong Mathematical foundation. You will learn the principles of classical and modern physics, the foundation of astrophysics, gain computation skills and gain research experience before graduation.

SPECIALIST PROGRAM IN ENVIRONMENTAL PHYSICS

**co-op option*

This program offers a wide introduction to environmental science based on a foundation grounded in a classical physics education. You will focus on the principles of mechanics, electricity and magnetism and thermodynamics while incorporating exposure to current problems in Earth and Atmospheric Science in their broader scientific understanding. Fields explored include hydrological processes, geophysics, natural hazards, climate change and remote sensing.

SPECIALIST PROGRAM IN PHYSICAL AND MATHEMATICAL SCIENCES

Specialist Program in Physical and Mathematical Sciences provides a framework of courses in the Physical Sciences based upon a firm Mathematical foundation, relating Astronomy, Chemistry, Computer Science, Physics and Statistics. It prepares students for careers in teaching, industry, and government as well as for further studies at the graduate level.

MAJOR PROGRAM IN PHYSICAL SCIENCE

The Major Program in Physical Sciences provides a general background in the physical sciences with emphasis in the area of astronomy, physics and physical chemistry. It is intended for students who want to combine physical skills with work in other subjects, and those who do not intend to pursue graduate studies



MAJOR PROGRAM IN PHYSICS AND ASTROPHYSICS

Major in physics and astrophysics program offers a solid physics and astrophysics background with the opportunity to explore other disciplines. It gives students the flexibility in upper year physics requirements, where they can plan their own upper division courses to fit their individual objectives. Students are advised to consult an advisor when planning, and to have their program approved.

MINOR PROGRAM IN ASTRONOMY AND ASTROPHYSICS

Minor in Astronomy and Astrophysics program is intended for students who want to acquire basic knowledge in Astronomy and Astrophysics and combine it with work in other subjects. This program requires less coursework than the specialist or major program, but still require some upper year courses.



Here are some jobs our graduates hold:

- Nuclear physicist
- Astronomer
- Material Scientist
- Meteorologist
- Geophysicist
- Optical and Laser Engineer
- Energy Policy Analyst
- Industrial (automotive, space, healthcare, energy, materials, technology, IT) research scientist
- Research scientist in astronomy, physics, planetary sciences, geophysics etc.
- Data Analyst for finance

Want to further your studies? Here are some options:

- Graduate school (masters, PhD, technology, education...)
- Professional schools (technology, law, engineering...)



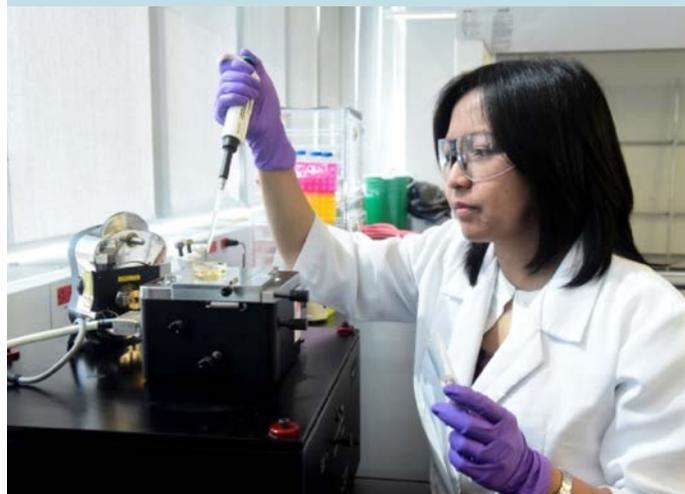
CHOOSING YOUR PROGRAM : CHEMISTRY

All programs have co-op option

DID YOU KNOW?

All of our specialist programs in chemistry have Canadian Society for Chemistry (CSC) Accreditation! Did you know? They meet the national standards of education required by the CSC, ensuring that graduating students possess skills in both the core chemical concepts and practical laboratory skills that are necessary to thrive in today's workforce. Graduates of these programs will receive a certificate stating that they have completed a nationally accredited chemistry program.

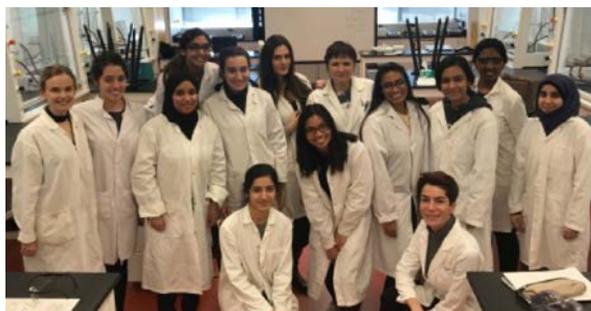
CHEMISTRY SPECIALIST (14 credits) AND MAJOR (8.5 credits)



Chemistry specialist is ideally suited for students who wish to pursue graduate studies in chemistry or a related discipline, or to work in chemistry-related industries. It offers a deep theoretical and practical learning experience in all aspects of modern chemistry. The first year of the program emphasizes learning fundamentals across various disciplines, including biology, chemistry, physics, and math. In upper years, this knowledge is applied to specialized courses focusing on the sub-disciplines of chemistry, including organic, inorganic, analytical, physical, and environmental chemistry. Students in this program will have the opportunity to contribute to the creation of scientific knowledge by participating in a directed research project in their fourth year. Chemistry major is intended for students who are interested in chemistry, but who do not wish to complete the more focused specialist program. It provides an introduction to all major chemistry sub-disciplines within chemistry, including analytical, biological, inorganic, organic, and physical chemistry. The program develops both theoretical knowledge and practical lab skills throughout their course work.

BIOCHEMISTRY MAJOR (9 credits)

The biochemistry major is intended for students who are interested in biochemistry, but who do not wish to complete the more focused specialist in biological chemistry. It is also excellent preparation for students wishing to pursue professional schools such as a medicine, pharmacy or law. The program explores the chemistry of living systems. The first two years are composed of core courses in both biology and chemistry. In later years, the disciplines are merged through courses which explore the chemistry of proteins, enzymes and metabolism.



ENVIRONMENTAL CHEMISTRY SPECIALIST (16 credits)

Graduates from this program will be well qualified for positions in government and industry as well as several graduate programs. The program provides an in depth study of chemistry, with a focus on solving environmental problems. The first year emphasizes fundamentals across various disciplines - biology, chemistry, physics, math and environmental science. Upper years develop skills in different areas of chemistry and bring specialized courses in environmental chemistry. The fourth year provides the opportunity to contribute to the creation of scientific knowledge by participating in a directed research project.



BIOLOGICAL CHEMISTRY SPECIALIST (14.5 credits)

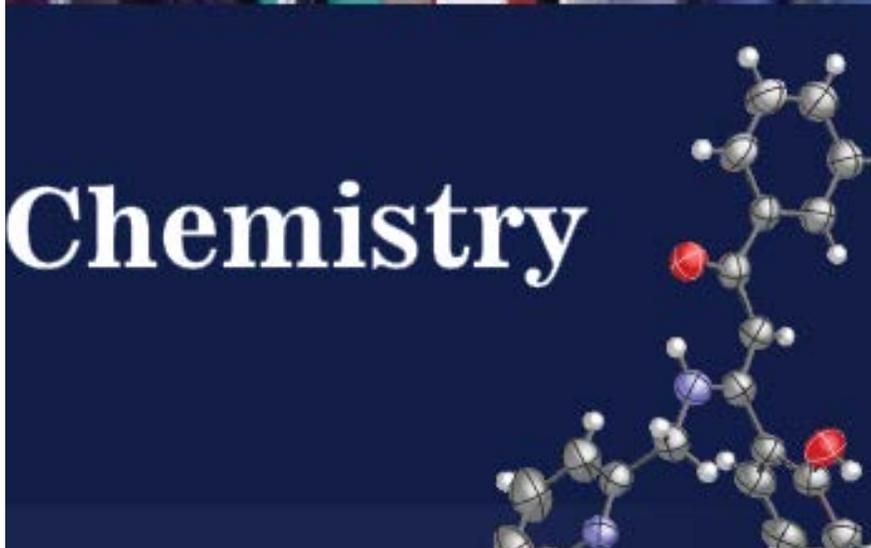
The combination of coursework and research experience makes this program ideally suited for students who wish to pursue graduate studies in biological chemistry or a related discipline, or to work in biologically chemistry-related industries. It is also excellent preparation for students wishing to pursue professional schools such as medicine, pharmacy or law. The program is intended for students who want to specialize in chemistry, and in particular, its applications to and interactions with living systems. The first year provides fundamentals across various disciplines - biology, chemistry, physics, and math. The second year brings courses in chemistry and biology, merging the two in more specialized courses later and complex chemistry of living systems (proteins, enzymes and metabolism). Students will also learn how chemistry can be used to study and manipulate these systems through courses in pharmaceutical and biological chemistry. In their fourth year, students will have the opportunity to contribute to the creation of scientific knowledge in this field by participating in a directed research.

Here are some jobs our graduates hold:

- Quality Analyst
- Scientific Affairs Liaison
- Manufacturing Sales Representative
- Drug Safety Assessor
- Government Scientific Analyst/Regulator
- Environmental Scientist in Engineering
- Product Manager Medical Supplies
- Environmental Technician in Energy Production
- Technical Marketing Associate in Chemicals
- Product development
- Environmental Assessment Analyst
- Environmental Auditor
- Development Scientist for the Federal Government
- Research Associate in Universities
- Environmental Health & Safety Coordinator
- Quality Assurance in Manufacturing
- Analytical Specialist in Engineering Consulting etc, etc...

Want to further your studies? Here are some options:

- Graduate school (masters, PhD, technology, education...)
- Professional schools (medicine, pharmacy, dentistry, law, engineering...)



D P E S P R O G R A M S S U M M A R Y

TOTAL PROGRAMS: 16

COOP PROGRAMS: 9

COMBINED DEGREE PROGRAMS: 3

CHEMISTRY PROGRAMS

Chemistry Specialist
Chemistry Major
Biochemistry Major
Biological Chemistry Specialist
Environmental Chemistry Specialist

ENVIRONMENTAL SCIENCE PROGRAMS

Environmental Biology Specialist
Environmental Geoscience Specialist
Environmental Physics Specialist
Environmental Science Major
Environmental Science Minor
Natural Sciences and Environmental
Management Minor

ENVIRONMENTAL STUDIES PROGRAMS

Environmental Studies Major

CO-OP PROGRAMS

Chemistry Specialist - Coop
Chemistry Major - Coop
Biochemistry Major - Coop
Biological Chemistry Specialist – Coop
Environmental Chemistry Specialist – Coop
Environmental Biology Specialist-Coop
Environmental Geoscience Specialist-Coop
Environmental Physics Specialist- Coop

COMBINED DEGREE PROGRAMS

HONOURS BACHELOR OF SCIENCE / MASTER
OF ENGINEERING

HONOURS BACHELOR OF SCIENCE / MASTER
OF ENVIRONMENTAL SCIENCE

HONOURS BACHELOR OF SCIENCE OR
HONOURS BACHELOR OF ARTS / MASTER OF
TEACHING

PHYSICS AND ASTROPHYSICS PROGRAMS

Physics and Astrophysics Specialist
Physics and Astrophysics Major
Physical and Mathematical Sciences
Specialist
Physical Sciences Major

RESEARCH HIGHLIGHT

From McDonald's Waste Cooking Oil to High-End 3D Printing Resin



Used cooking oil disposal is a concern at the global scale. Direct disposal from domestic households and restaurants via drains can result in serious environmental issues. Much of the cost of recycling is the transportation of used cooking oil. Hence, it may be transformative for recycling programs if high value commodities can be manufactured easily from waste cooking oil.

Recently, Professor Andre Simpson (Professor in Chemistry and Director of the Environmental NMR Center, UTSC) along with his students (Bing W, Atiqurrehman Sufi, Rajshree Gosh Biswas, Arika Hisatsune, Vincent Moxley-Paquette, Paris Ning, Ronald Soong) in collaboration with Professor Andrew Dicks (from St George) did just that. The team took waste cooking oil that was collected directly from vats in a McDonald's restaurant at the time it is normally disposed of. They then reacted the double bonds in the oils such that they cross linked to form a plastic in the presence of light. The product can be printed using a commercial 3D printer and produced high resolution prints with features down to 100 micron.

Professor Simpson explained, "molecules used in commercial 3D printing resins (i.e. long chain hydrocarbons from oil) have many features similar to fats found in nature. Indeed it is the healthy unsaturated fats that have reactive 'double bonds' that allow us to perform these specific reactions. 30 years ago when fast food chains used mainly saturated fats, this sort of chemistry would not have been possible. In this case, what is more healthy for us is also more healthy for the environment."

Further to being structurally stable, the printed models are also biodegradable in soil. As such, anything printed from the used McDonald's oil would breakdown and eventually return to the soil, thus closing the carbon loop (plants → oil → plastic → soil) while avoiding the use of fossil fuels from which conventional plastics are derived. The team hopes this approach will remove the financial barriers making it possible for all oil to be reused and recycled which may have considerable societal benefits, including reduction of waste and carbon emissions.



JOIN OUR TEAM!

We are currently hiring for:

- ▶ Webmaster
- ▶ Events Coordinator (2)
- ▶ Social Media Manager
- ▶ Graphic Designer
- ▶ Finance intern
- ▶ Physics Director
- ▶ Chemistry Director
- ▶ Envirosoci. Director

Applications can be found on our Facebook page or at myepsa.ca



Applicants are required to submit their completed application form along with their resume by e-mail with “EPSA Application Package” in the subject line to president@myepsa.ca. Applications can also be dropped off in person to the EPSA Office (EV264) in a sealed envelope.

Deadline: Friday March 27th, 2020 by 5 pm or 11:59pm (online)



CSU IS HIRING!

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DESIGNER

DIRECTOR:
FUNDING AND
PARTNERSHIP

ENVIRONMENTAL SCIENCE & CHEMISTRY



Send your resume to utsc.chem.society@gmail.com
and complete the google form prior to submission
See QR code or visit: <https://forms.gle/iW8fBP7xcmjNJ9gx7>
Deadline: March 23, 2020





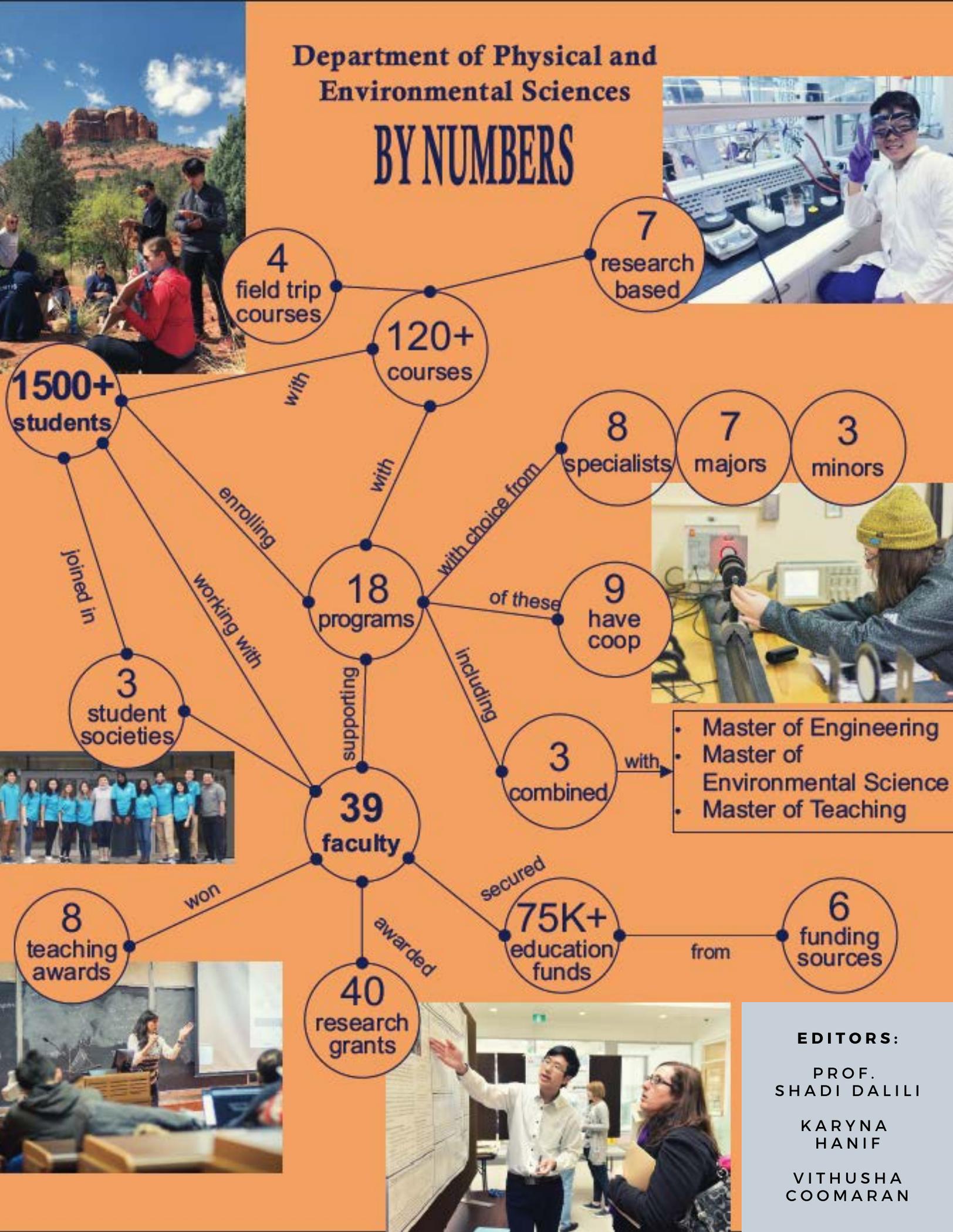
DPES DIGEST IS LOOKING FOR YOU!

Interested in assisting with the DPES newsletter?
Have any great ideas you want to come to light?
Send us your resume!

Email: karyna.hanif@mail.utoronto.ca

Department of Physical and Environmental Sciences

BY NUMBERS



- Master of Engineering
- Master of Environmental Science
- Master of Teaching

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