UNIVERSITY OF TORONTO

University of Toronto Quality Assurance Process (UTQAP)
Cyclical Review: Final Assessment Report and Implementation Plan

Programs Reviewed:	Astronomy & Astrophysics: Minor (Sciences) Biochemistry, B.Sc. (Hons.): Major, Co-op Biological Chemistry, B.Sc. (Hons.): Specialist, Co-op Chemistry, B.Sc. (Hons.): Specialist, Co-op, Major, Co-op Environmental Biology, B.Sc. (Hons.): Specialist, Co-op Environmental Chemistry, B.Sc. (Hons.): Specialist, Co-op Environmental Geoscience, B.Sc. (Hons.): Specialist, Co-op Environmental Physics, B.Sc. (Hons.): Specialist, Co-op Environmental Science, B.Sc. (Hons.): Major, Co-op, Minor Environmental Studies, B.A. (Hons.): Major Natural Sciences & Environmental Management: Minor (Sciences) (effective April 1, 2017) Physical Sciences, B.Sc. (Hons.): Major Physical & Mathematical Sciences, B.Sc. (Hons.): Specialist Physics & Astrophysics, B.Sc. (Hons.): Specialist, Major
Unit Reviewed:	Department of Physical and Environmental Sciences (DPES), University of Toronto Scarborough (UTSC)
Commissioning Officer:	Vice-Principal Academic and Dean, UTSC
Reviewers (Name, Affiliation):	1. Professor John Clague, Department of Earth Sciences, Simon Fraser University

	2. Professor David Cramb, Department of Chemistry, University of Calgary 3. Professor John Tarduno, Department of Earth and Environmental Sciences, University of Rochester
Date of review visit:	October 17 – 18, 2017
Date reported to AP&P:	November 1, 2018

Unless otherwise noted, all bulleted comments apply to all programs reviewed.

1 Outcome

The Committee on Academic Policy and Programs (AP&P) concluded that the Decanal response adequately addressed the review recommendations.

2 Significant Program Strengths

- Faculty and staff deliver a first-class undergraduate educational program
- Students obtain experience in industry, with co-op available for students in most programs
- Innovative diversity of degree offerings
- Range of funding opportunities available to students
- Outstanding faculty research
- Strong faculty collaborations within the department and across Canada
- Extraordinarily high morale

3 Opportunities for Program Enhancement

The reviewers recommended that the following be considered:

- Developing a task force to review graduation rates and barriers to completion, as well as increasing outreach and tracking employment outcomes of graduates
- Addressing the writing requirements across all programs
- Addressing student challenges with calculus in introductory courses
- Expanding experiential learning opportunities for students in environmental science and environmental geoscience programs
- Supporting additional opportunities for undergraduate research
- Exploring opportunities for improvements in student advising
- Addressing challenges around staff workloads, equipment and space to provide better support to students and programs
- Exploring ways to enhance engagement between faculty from different disciplines and appointment categories within the department

UNIVERSITY OF TORONTO SCARBOROUGH

OFFICE OF THE VICE-PRINCIPAL ACADEMIC & DEAN

October 9, 2018

Professor Susan McCahan
Vice-Provost, Academic Programs
Office of the Vice-President and Provost
Simcoe Hall
University of Toronto

Dear Susan,

Administrative Response:
External Review of the Department of Physical and Environmental Sciences

Thank you for the letter of April 20, 2018 requesting my administrative response to the external review of the Department of Physical and Environmental Sciences. I appreciate the seriousness with which the reviewers approached the external review process, and I am grateful for the careful consideration they have given to the Department and its undergraduate programs. I note with pride the tremendous strides forward the Department has made since its 2009-10 external review, and want to affirm my great pleasure at the very positive report submitted by the review team. I believe their recommendations will be helpful in taking the DPES to the next level.

The external review report was sent to the Chair of the Department and shared widely among faculty, staff and students. The decanal group, including myself, the Vice-Dean Undergraduate, the Vice-Dean Faculty Affairs and Equity, Assistant Dean, Academic, and Academic Programs Officer met with the Chair and Undergraduate Associate Chair on June 27, 2018 to discuss the external review, and the recommendations from the review report; I am pleased with the depth of the discussion that took place. We are taking the recommendations of the reviewers seriously and already have begun to act upon them.

Let me address the specific points raised in the letter:

Planning:

- The reviewers recommended developing a task force to review graduation rates, barriers to completion, as well as increasing outreach and tracking of employment outcomes of graduates.

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The reviewers state the view that DPES graduation rates, while comparable to overall UTSC numbers, are low. They recommend that time-to-completion numbers be monitored with the goal of improvement, and an internal task force be established to track graduation rates, collect data, and consider best practices. The reviewers also note that DPES's efforts in connecting with its alumni appear limited, and recommend the Department begin collecting data on student employment by initiating exit surveys upon graduation.

At the departmental level, the DPES believes that challenges associated with A- and B-level courses may be impeding students' progress through their programs. To improve matters, DPES is investing significant resources to support its Physics and Chemistry Aid Centers. The main goal of these Centres is to provide students with extra support in their studies as well as to create a positive and inclusive space for discussion and interaction among students, teaching assistants (TAs) and faculty. Another on-going effort aims to create e-lab components for all the A-level courses in Environmental Sciences. The preliminary deliverables are very encouraging. Effective in the 2018-2019 academic year, DPES will be hiring additional TAs with a strong grounding in first and second year courses to ensure students are fully supported. These learning opportunities will provide leadership, nurture organizational and teamwork skills, and facilitate peer-led learning in DPES programs.

At the campus level, UTSC has been paying closer attention to the intake, progression and graduation rates of students. With regard to progression rates, we acknowledge that UTSC students typically progress towards degree completion at a relatively slow rate, which is, perhaps, to be expected on a campus where a large proportion of students are also working. Using a data-driven approach, the Dean's Office has been working towards gaining a deeper understanding of the reasons influencing time to degree completion. While this analysis applies to the campus as a whole, the data can be filtered by program and may prove useful to the DPES in approaching the question for its own students.

With regard to the reviewers' concerns about connecting with alumni, at the departmental level the DPES has created their own Alumni Database primarily consisting of alumni of the highly successful Professional Master's Program in Environmental Sciences, as well as recent graduates from the Specialist and Major programs in Chemistry, Environmental Science, and Physics. The Department will continue to make this list more comprehensive. Since January 2018, DPES has also created a monthly newsletter, which has been distributed to all recent graduates, and highlights a number of interesting activities, faculty/student/alumni recognitions, and other departmental events. At the campus level we recognize the need to develop stronger ties with our alumni. UTSC is working on improving mechanisms for tracking our graduates, monitoring their success, and building long-lasting relationships.

Undergraduate programs:

- The reviewers recommended addressing the writing requirements across all programs.

The reviewers express some concern regarding a perceived lack of a comprehensive writing requirement in all DPES programs, and recommend the Department consider incorporating formal writing assignments into key courses formally identified as "writing" courses.

The Department notes that formal writing is central to all three disciplines. Specifically, there are substantive writing components in B-level and upper-level courses in chemistry and environmental science, as well as in upper-level courses in physics. In these courses students develop technical reading skills spanning the range from scientific divulgation pieces, through introductory textbooks, and ending in peer-reviewed scientific papers. They learn to appreciate the differences in these written forms and to critically evaluate the reliability of the content presented. Required reports teach students how to properly communicate in written form. This written communication is embedded in many courses that allow students to complete reports in topics beyond the course content – a practice strongly encouraged throughout the DPES programs. Intermediate and advanced labs allow students to explore question-framing using experimental methods and subsequently to write their reports. Students are also taught search and assessment techniques typically in the courses requiring reports, often with support from the Library and the Writing Centre. Lastly, the one-on-one mentoring provided in the directed reading/research courses offers an excellent opportunity to develop question-framing and learn about the tools useful in answering these fundamental research questions. DPES has established awards to recognize students who produce publishable research papers arising from their directed reading or research courses.

However, bearing in mind the reviewers' concerns, the DPES is currently engaged in a curriculum mapping exercise that will be completed by the end of October 2018. Upon the completion of this endeavor, the Department will be able to identify, with certainty, all the courses that include comprehensive writing components, and will be in a position to make better informed decisions regarding additional requirements.

- The reviewers noted that many students entering physics and astronomy programs are challenged by the level of calculus in introductory courses.

Within the context of their review of the physics and astrophysics program, the reviewers state that, similarly to other universities, UTSC has a problem with unsatisfactory calculus preparation for students taking first-year physics courses. The reviewers acknowledge the calculus tutorials mounted by teaching stream faculty in the Department as one mechanism to improve the students' competencies, and recommend the physics and astrophysics faculty consider establishing a mini course focused on the key skills students will need.

The DPES has developed its own online tutorial modules to support the development of basic physics (see: https://www.utsc.utoronto.ca/physsci/online-modules), and their Teaching & Curriculum Committee is currently developing an on-line course focused on the key mathematical techniques and computational skills students need for the first-year physics courses. The working plan is for this introductory course to be in place for the academic year 2019-2020. At the campus level, the Centre for Teaching and Learning

and the Department of Computer and Mathematical Sciences have created a set of online videos and activities to help students backfill gaps in the key skills required for success in calculus (see: https://utsc.utoronto.ca/mslc/online-resources).

- The reviewers encouraged expanding experiential learning opportunities for students in environmental science and environmental geoscience programs.

The reviewers acknowledge that Co-op programs offer students many opportunities for experiential learning; however, they recommend more field trips be made available to students in environmental science and environmental geoscience.

In addition to its Co-op programs, the main mode for delivering experiential learning in the DPES is through field-based laboratories and courses. In environmental science and environmental geoscience, this takes a number of forms including multiple one- and two-day field trips that illustrate points taught in the classroom, for example: (1) site visits to local geological sites; (2) visiting contaminated sites; (3) site visits to ravine systems; (4) stream flow measurement and stream load characterization in local waterways along with flume experiments; (5) site visits to the coast of Lake; (6) field courses such as the limnological field course in the Algonquin Park; and (7) substantial 10-day field camps in locations as diverse as Costa Rica, the Rockies, the American southwest, and Iceland. The DPES has also invested significant resources to establish a new Field Techniques course, which focuses on fundamental field concepts and methodologies. The course allows students to explore and experiment with a variety of quantitative and qualitative methods for collecting environmental data. The DPES Teaching and Curriculum committee will be looking at new ways to include experiential learning components into departmental courses and activities throughout the 2018-19 academic year.

More generally, UTSC actively promotes experiential education along three lines: first, program-based including co-op, co-op internships and field placements; second, course-based including service-learning and lab/research intensive courses; and third, co-curricular activities including speaker series. With funding from the Provost's Office, the Dean's Office recently appointed a Special Advisor to the Dean on Experiential Education who has been conducting a systematic measurement of experiential education opportunities within each of our academic units (the DPES participated at an Experiential Learning workshop organized by the Special Advisor in June 2018). UTSC has also established an Experiential Education fund to support departmental initiatives to integrate experiential education into curricula in new ways, and we have hired two Coordinators for Integrated Learning Experiences who will play a lead role in developing and managing relations with external partners who are able to provide high-quality integrated learning experiences for our students.

- The reviewers suggested a number of ways to support additional opportunities for undergraduate research.

The reviewers acknowledge the comprehensive range of opportunities available to undergraduate students to become involved in research, including formal research

courses in chemistry and physics. However, they express some concern that these opportunities are typically communicated by word-of-mouth and recommend a more formal process be developed to inform students. They also express concern regarding the total number of scholarships for research, suggesting they are below the needs of the student population in the Department. They recommend the DPES explore options for additional resources and funding which could be used to support scholarships and a summer Research Experience for Undergraduates program.

The DPES has a strong record of engaging students in research and cultivating a productive research culture within its undergraduate student population. The Department offers undergraduate research opportunities in all three disciplines, and it has established several awards to recognize outstanding research from upper-year undergraduate students. It should be acknowledged that several publications in refereed scientific journals have resulted from student efforts, and many students have gone on to do graduate studies.

To address the concern regarding a reliance on word-of-mouth communication for apprising students about research opportunities, we note that the Office of the Vice-Principal Research (OVPR) has developed the UTSC Research Catalogue which serves as a one-stop-shop for providing information about research opportunities to all undergraduate students, and some academic units – for example, Biological Sciences and Psychology – have made good use of the Research Catalogue to reach out to students. The DPES will connect with these academic units and the OVPR to determine whether the Research Catalogue can be used to more effectively communicate available research opportunities to students.

To address the reviewers' recommendations regarding more funding to support scholarships, the Department has implemented a new database that compiles all the available funding opportunities and research internships associated with municipalities and conservation authorities in Ontario. This information has regularly been distributed to the graduate students, and it will now be provided to senior undergraduate students effective with the 2018-2019 academic year.

Resources:

- The reviewers observed a number of challenges in student advising and recommended exploring opportunities for improvements in this area.

The reviewers express concern regarding the volume of student advising responsibilities of some faculty, and recommend the DPES undertake a comprehensive review of student advising to determine alternatives.

The Department acknowledges they have favoured a model in which student advising is primarily the responsibility of faculty serving as program supervisors, but they are now reviewing other models. In particular, the Department will explore the option of creating a new administrative staff student advising position as soon as possible.

In addition, the Dean's Office recognizes the important role of advising to support student success, and has been engaging in finding ways to better integrate academic programs with supports that are available on campus, including the Centre for Teaching and Learning, Library, Registrar's Office, and Academic Advising & Career Centre. The Academic Advising Round Table (AART) and the Student Success Caucus (SSC), whose membership is drawn from these units, are important mechanisms for coordination of support activities and initiatives undertaken by them and by academic units, and they also provide a forum for sharing best practices for student support.

- The reviewers noted a number of challenges around staff workloads, equipment and space that could be addressed to provide better support to students and programs.

The Department notes that new administrative staff have been brought on board in the last six months, including a new financial assistant that will significantly alleviate the pressure on the current DPES financial team. Two further positions have recently been approved: a full-time technician for the TRACES facility and a new co-op internship coordinator. With the on-going growth in the Department's faculty complement, increased research operations and program offerings, these two positions will address the deficit of administrative and technical support. In addition, several staff and technician job descriptions recently were revised to more accurately reflect current duties; the Department anticipates these changes will boost morale among administrative staff in the DPES, and they will continue to monitor the situation.

With regard to both space and equipment, the Department acknowledges that, overall, it is in a privileged position relative to other academic units at UTSC. Nevertheless, it has been working with the physics and astrophysics group to identify their space and equipment needs, and it has allocated approximately $70K to purchase new instruments that will allow for the redesign of the lab components of all major courses in Physics and Astrophysics.

Faculty:

- The reviewers recommended the Department explore ways to enhance engagement between faculty from different disciplines (e.g., chemistry and physics) as well as between different categories of appointment.

The review team was told that greater effort is needed in the Department to bring together the chemists and physicists more often than is currently the case. The review team's stated goal in highlighting this comment is to emphasize the importance of collaboration among the three overarching disciplines in the DPES: chemistry, environmental science/environmental studies, and physics and astrophysics.

In addition, the review team note an apparent disconnection between the teaching and tenure stream faculty in the DPES; specifically, the reviewers say that some teaching stream faculty indicate they feel overworked and underappreciated, yet tenure stream faculty express only respect and appreciation for their colleagues. The reviewers

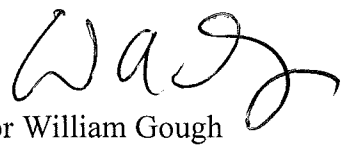
recommend that DPES create more opportunities for teaching and tenure stream faculty to talk to one another.

With regard to the issue of collaboration between the chemists and physicists, the Department points to the unifying role environmental science plays within the DPES, and notes there is already strong collaboration between the chemists and environmental scientists, as well as between the physicists and environmental scientists. The impressive growth of the Specialist programs in Environmental Chemistry and Environmental Physics, which draw upon the expertise of faculty members from the corresponding disciplines, provides compelling evidence that this strategy has been successful. Nevertheless, departmental leadership acknowledges the importance of fostering more direct collaboration between the chemistry and physics and astrophysics groups. Towards that end, teaching assignments recently were shuffled to accommodate a request from a faculty member in the Chemistry group, with expertise in quantum mechanics, to be responsible for a course offered through the Physics and Astrophysics program. As part of the Curriculum mapping exercise, the Department is also exploring opportunities for joint teaching enhancement grants that will consolidate the integration of elements from chemistry and physics into course offerings.

The reviewers note that some teaching stream faculty feel under-appreciated. However, the Department shows strong support for the success of teaching stream faculty in several ways. For example, the majority of the DPES teaching stream faculty have been nominated by the Department for (and received) campus- or university-wide teaching awards. As another example, the Department actively involves teaching stream faculty in decision making, with several teaching-stream faculty members having assumed significant academic leadership roles (Associate Chair Undergraduate, Discipline Representatives). Following receipt of this review, during conversations between teaching stream faculty leaders in the DPES and the Office of the Dean, these faculty asserted that they generally feel supported and respected by their colleagues (which echoes comments from the tenure stream faculty interviewed by the external reviewers). Since the basis for the comments noted in the review is currently unclear, we will pursue this issue in two ways: round table discussions with teaching stream faculty; and, facilitated discussions among Chairs regarding evaluation of, and communication with, teaching stream faculty (the latter to occur during the annual Chairs & Director's retreat at UTSC this September).

More generally, the Office of the Dean has, in the past year, provided new supports for career development and progress towards promotion for teaching stream faculty across the campus, and this is likely to have positive effects on morale. This includes a new Professional/Pedagogical Development Support Fund (commenced April 2018), a Professional Development Grant (roll out by September 2018), and an Indigenous Course Development grant (commenced February 2018).

Regards,



Professor William Gough
Vice-Principal Academic and Dean

Action	Implementation Timeline	Lead
The DPES will invest resources to support its Physics and Chemistry Aid Centres.	Immediate (6 months)	DPES Chair and/or designates
The DPES will hire additional TAs to provide additional support to students in A- and B-level courses.	Immediate (6 months)	DPES Chair and/or designates
Upon request from the DPES, the Dean's Office will share data related to completion rates – filtered specifically for the Department.	Immediate (6 months)	DPES Chair and/or designates
The DPES Curriculum Mapping working groups will complete their work, and identify all courses that include a comprehensive writing requirement.	Immediate (6 months)	DPES Chair and/or designate(s)
The DPES will reach out to the OVPR and the Departments of Biological Sciences and Psychology regarding the Research Catalogue. They will determine the most effective way to make better use of this tool.	Immediate (6 months)	DPES Chair and/or designate(s)
The DPES will distribute its database of information about available research funding and research internships to senior undergraduate students,	Immediate (6 months)	DPES Chair and/or designate(s)

effective with the 2018-19 academic year.		
The DPES will review and address the space and equipment needs of the physics and astrophysics group.	Immediate (6 months)	DPES Chair and/or designate(s)
The V-D Faculty will conduct round-table discussions with teaching stream faculty.	Immediate (6 months)	Vice-Dean Faculty Affairs and Equity
The V-D Faculty will support facilitated discussions among Chairs regarding evaluation of and communication with teaching stream faculty.	Immediate (6 months)	Vice Dean Faculty Affairs & Equity
The DPES will create an online course focused on the mathematical skills they need for first-year physics courses.	Immediate to Medium (6 months to 2 years)	DPES Chair and/or designate(s)
The DPES Teaching and Curriculum committee will look at new ways to add experiential learning components into departmental courses and activities.	Immediate to Medium (6 months to 2 years)	DPES Chair and/or designate(s)
The Dean's Office will continue to engage with the various advising groups on the UTSC campus to better coordinate advising activities and share best practices.	Immediate/Medium/Long (6 months to five years)	VP Academic and Dean and/or designate(s)
The DPES will make their recently created Alumni Database more comprehensive.	Medium (1 to 2 years)	DPES Chair and/or designates
The DPES will review its current approach to student advising, as well other available models. The student advising model will be adjusted based on the	Medium (1 to 2 years)	DPES Chair and/or designate(s)

results of the review.		
The DPES will explore opportunities for joint teaching enhancement grants that will consolidate elements from chemistry and physics into course offerings.	Medium (1 to 2 years)	DPES Chair and/or designate(s)
The Dean's Office will facilitate consultation with UTSC leadership regarding improving mechanisms for tracking graduates.	Long (3 to 5 years)	VP Academic and Dean and/or designate(s)

5 Executive Summary

The reviewers identified the programs' strengths as faculty and staff who deliver a first-class undergraduate educational program; students who obtain experience in industry, with co-op available for students in most programs; the innovative diversity of degree offerings; range of funding opportunities available to students; outstanding faculty research; strong faculty collaborations within the department and across Canada; and extraordinarily high morale. The reviewers recommended that the following issues be addressed: developing a task force to review graduation rates and barriers to completion, as well as increasing outreach and tracking employment outcomes of graduates; addressing the writing requirements across all programs; addressing student challenges with calculus in introductory courses; expanding experiential learning opportunities for students in Environmental Science and Environmental Geoscience programs; supporting additional opportunities for undergraduate research; exploring opportunities for improvements in student advising; addressing challenges around staff workloads, equipment and space; and exploring ways to enhance engagement between faculty from different disciplines and appointment categories within the department. The Dean's Administrative Response describes the Campus, unit and programs' responses to the reviewers' recommendations, including an implementation plan for any changes necessary as a result. The Committee on Academic Policy and Programs (AP&P) concluded that the Decanal response adequately addressed the review recommendations.