



FOR INFORMATION

PUBLIC

OPEN SESSION

TO: UTSC Academic Affairs Committee

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PRESENTER: See Sponsor.
CONTACT INFO:

DATE: January 23, 2019 for January 30, 2019

AGENDA ITEM: 9c

ITEM IDENTIFICATION:

External Review of the Department of Physical and Environmental Sciences.

JURISDICTIONAL INFORMATION:

Under section 5.6 of the Terms of Reference of the University of Toronto Scarborough Academic Affairs Committee (UTSC AAC) provides that the Committee shall receive for information and discussion reviews of academic programs and units consistent with the protocol outlined in the University of Toronto Quality Assurance Process. The reviews are forwarded to the Committee on Academic Policy and Programs for consideration.

GOVERNANCE PATH:

1. UTSC Academic Affairs Committee [For Information] (February 11, 2019)

PREVIOUS ACTION TAKEN:

- Committee on Academic Policy and Programs (AP&P), November 1, 2018 [For Information]. The Committee was satisfied with the Dean's Administrative Response.
- Academic Board, November 22, 2018 [For Information]. The Board was satisfied with the Report from AP&P.

HIGHLIGHTS:

The *Cyclical Review Protocol* "is used to ensure University of Toronto programs meet the highest standards of academic excellence" (UTQAP, Section 5.1). The *Protocol* applies to all undergraduate and graduate degree programs offered by the University, and

the University's full complement of undergraduate and graduate degree and diploma programs are reviewed on a planned cycle. Reviews are conducted on a regular basis, and the interval between program reviews must not exceed 8 years.

The external review of academic programs requires:

- The establishment of a terms of reference;
- The selection of a review team;
- The preparation of a self study;
- A site visit;
- Receipt of a report from the external review team;
- The preparation of a summary of the review report;
- The Vice-Provost, Academic Programs' formal request for an Administrative Response;
- The Dean and Vice-Principal Academic's formal Administrative Response; and
- Preparation of a Final Assessment Report and Implementation Plan.

In accordance with the *Protocol*, an external review of the Department of Physical and Environmental Sciences (DPES) and its undergraduate programs, was conducted in the 2017-18 academic year. The review team met with a wide array of stakeholders including UTSC senior academic administrators, the Department Chair, and faculty, staff and students in the Department. As the report makes clear, the Department has made tremendous strides forward since its last review in 2009-10. The reviewers also identify a number of areas they feel could be addressed, and have made a series of recommendations regarding these areas.

To support strategic planning, the reviewers recommend developing a task force to review graduation rates and barriers to completion, as well as increasing outreach and tracking of employment outcomes of graduates. The Department believes that challenges associated with A- and B-level courses may be impeding students' progress through their programs and is investing resources to provide students with extra support through various Centres and by creating e-lab components. More broadly speaking, UTSC is analysing progression and graduation rates of students in order to gain a deeper understanding of the reasons influencing time to degree completion. In terms of reaching out to alumni, the Department is creating its own Alumni Database, and UTSC is working on improving mechanisms for tracking graduates.

To support undergraduate programs, the reviewers recommend addressing the writing requirements across all DPES programs, addressing challenges posed by calculus in introductory courses, and expanding experiential learning and research opportunities. The Department notes that it already includes a substantive writing requirement in courses at the upper-levels; nevertheless, it has recently engaged in a curriculum mapping exercise to identify all such courses, and it will be using this information to make informed decisions regarding additional requirements. The DPES is working with the Department of Computer and Mathematical Sciences and the Centre for Teaching and Learning to develop better tools to ensure adequate calculus preparation for students in their programs. The DPES already strongly supports experiential learning, however, the Dean

has recently appointed a Special Advisor on Experiential Education and established an Experiential Education fund to further support the academic units in their efforts. The DPES also strongly supports research opportunities for students, however, it will be investigating the UTSC Research Catalogue as an alternative to word-of-mouth promotion for these opportunities.

The reviewers identified a number of resource challenges around student advising, staff workloads, and equipment and space. The Department acknowledges the important of student advising, and is currently reviewing the option of creating a staff position focused on advising. Other new administrative staff, including a financial assistant, a full-time technician and co-op internship coordinator have been hired or approved, and the Department believes this will alleviate the pressure on, and boost the morale of, existing departmental staff. In terms of space and equipment, the DPES has been working with its physics and astrophysics group to identify their needs, and has allocated funds to meet these needs.

To support faculty the reviewers recommend enhancing engagement between faculty from different disciplines, as well as between tenure- and teaching-stream appointments. The DPES highlights the particular role that environmental science plays in unifying the Department, but will actively work to foster more direct collaboration between the chemistry and physics and astrophysics groups; for example, through shared teaching. The Department's teaching stream faculty have expressed that they feel strongly supported within the DPES, however, the Department will engage in round table discussions to ensure appropriate levels of communication. In addition, the Dean's Office has provided new supports for career development and progress towards promotion for teaching stream faculty and these are likely to have positive effects on morale.

The implementation timeline for departmental action is given in the Dean's Administrative Response.

FINANCIAL IMPLICATIONS:

There are no net financial implications to the campus' operating budget.

RECOMMENDATION:

Presented for information.

DOCUMENTATION PROVIDED:

1. Reviewers Report (Nov 24, 2017)
2. Provostial Summary of the External Review Report (Final)
3. Provostial Request for Administrative Response (April 20, 2018)
4. Dean's Administrative Response (October 9, 2018)

Undergraduate Program Review, Departmental of Physical & Environmental Sciences, University of Toronto, Scarborough

November 24, 2017

This document is a concatenation of observations and conclusions drawn, where possible, from the documents provided, individual or group meetings, and the extra data requested by the Review Committee. Where appropriate we have made specific references to the programs within DPES. Otherwise, the conclusions and recommendations apply to the entirety of DPES.

Generally speaking, the Review Committee was very impressed with DPES and the system that supports it. There is a strong sense of cohesion in the department and a good relationship with the Dean's Office. There are some pressure points that we address below through recommendations.

Program(s) under review:

Chemistry, BSc: Major and Co-op

Chemistry, BSc: Specialist and Co-op

Biochemistry, BSc: Major and Co-op

Biological Chemistry, BSc: Specialist and Co-op

Environmental Chemistry, BSc: Specialist and Co-Op

Physical Sciences, BSc: Major

Physical and Mathematical Sciences, BSc: Specialist

Physics and Astrophysics, BSc: Specialist, Major

Environmental Physics, BSc: Specialist and Co-op

Astronomy and Astrophysics: Minor

Environmental Science: Major and Co-op

Environmental Science: Minor

Environmental Biology, BSc: Specialist and Co-op

Environment Geoscience, BSc: Specialist and Co-op

Natural Sciences and Environmental Management: Minor

Environmental Studies: BA (Arts)

In this document, we group DPES majors/minor programs as follows: Biological Chemistry/Chemistry/Biochemistry – “CHEM”; Physics and/or Astronomy – “PAS”; Environmental Science/Environmental Geoscience/Environmental Biology – “ES”; Environmental Studies – “ESS”

1 Program(s)

Objectives:

- **The consistency of the program with the University’s mission, the University of Toronto Scarborough’s current Strategic Plan and the Department’s academic plans**

Strengths:

The CHEM, PAS, ES, and ESS programs meet UTSC strategic and academic plans in a unique way. First, it is clear that the dedicated faculty and technicians deliver a first-class undergraduate educational program in physics, chemistry, the environmental sciences, environmental studies, and natural sciences and environmental management. The availability for study in the core science fields and mathematics must be considered as an essential given UTSC’s overall aspirations. Moreover, DPES has developed research foci in chemistry, astronomy/astrophysics, and the environmental sciences that serve to differentiate it from other UT units, afford opportunities for research advances of the highest caliber, and provide special opportunities for undergraduate students. DPES should be proud of the reputation that chemistry, physics, biology, and geoscience courses have earned among undergraduate students. Morale is high and graduates are clearly successful; this speaks volumes about the quality of the instructional programs.

Weaknesses/Opportunities:

CHEM: The undergraduate numbers in the Specialist program for Chemistry and Biological Chemistry are dropping because students are migrating into the Major programs. The UTSC Co-op program serves the Biochemistry Major program well, and growth in the other CHEM-related programs may be possible. There appears to be some disconnection between DPES and the central Co-op office with respect to the appropriateness of placements, suggesting the need for better communication. There appears to be considerable stress on DPES staff. Many staff members work over lunch hour and after normal work hours to deliver on programs. The amount of extra time should be tracked to determine whether this is equivalent to another staff position. Teaching loads appear to be fair.

PAS: The linkages/resources for environmental geophysics are limited and represent one area DPES should consider strengthening, particularly by adding new Teaching Stream faculty. Bolstering environmental geophysics would fit nicely with DPES’s desire to increase

experiential learning opportunities. However, any new hiring should be coupled with instructional equipment acquisition and associated support. It appears that PAS faculty may be offering high performance computing opportunities for students, although this was not addressed in the Self Study. Given UTSC's demographic focus, this is an area that DPES might also consider for further expansion. If roadblocks to PAS instruction in high performance computer exist at UTSC, these should be addressed by the Dean(s). Disseminated instruction in high performance computing using applications directly related to a major area of study can be highly effective. The DPES Self Study noted the high rate of placement for students pursuing PAS degrees. This is consistent with the value of graduates to potential employers. DPES should begin tracking employment to start a database where trends can be evaluated.

ES: An opportunity exists for better linking the physics and geoscience programs by hiring an environmental geophysicist with expertise in geology and shallow geophysical surveying.

Admission requirements:

- **The appropriateness of admission requirements in relation to the learning outcomes of the program**

Strengths:

The admissions requirements appear appropriate given the UTSC demographic focus.

Weaknesses/Opportunities:

PAS: The common problem of poor calculus preparation for students entering first-year physics appears to be a serious issue at UTSC. The committee learned that some of the UTSC Teaching Stream faculty are providing calculus tutorials to improve the competency of entry-level students. Although laudable, these tutorials may not be an optimal use of faculty time and may not be the best approach with respect to student outcomes.

The faculty should consider establishing a mini-course (perhaps on line) as a prerequisite that focuses on the key skills needed for introductory physics. Another option is to involve UTSC Math to provide such instruction. This option might be viable at UTSC, but DPES and UTSC should also be aware that it is not been an optimal solution elsewhere. The need to meet the directed calculus skills needed for introductory physics must be balanced with the potential negative impact (e.g., increased time for degree completion) attendant with another Math course added to a UTSC PAS degree.

Curriculum and program delivery:

- **How the curriculum reflects the current state of the discipline or area of study**

Strengths:

The faculty deliver a solid education in chemistry, physics, biology, and geoscience while offering numerous opportunities to students through its the specialty programs. Students are also able to obtain experience in industry and to become better rounded through minor programs. Overall, this is an impressive mix of opportunities that maximizes use of faculty expertise.

Weaknesses/Opportunities:

The lack of a writing component in all DPES major programs is a deficiency that should be addressed. The ability of the faculty to deliver its current first-rate education in physics is tenuous because of aged equipment and the lack of sufficient storage space used for key laboratory work. The Review Committee recommends that DPES plan for, and make, a significant investment in physics laboratory instruction equipment. It also recommends that Environmental Science be provided with an equipment budget.

- **The appropriateness of the program's structure, curriculum and length to its learning outcomes and degree level expectations**

Strengths:

The curricular program is appropriate with the exception of writing.

Weaknesses/Opportunities:

As noted above, all DPES programs that we reviewed lack a comprehensive writing requirement. The practical length the all DPES programs may need careful monitoring (see comments below and Additional Comments). As noted above, a mechanism to address calculus preparation for incoming students is advisable.

- **Evidence of innovation or creativity in the content and/or delivery of the program relative to other such programs**

Strengths:

DPES has a unique structure that is very different from comparable units at other Canadian universities. There is innovation in the program in terms of the number and diversity of degree offerings. The number of programs is large in comparison to other Canadian universities, but the programs have been tailored to meet the unique demographic of the UTSC. Students commented on innovations in laboratory instruction.

Weaknesses/Opportunities:

NA

- **What opportunities are there for student learning beyond the classroom?**

Strengths/Opportunities:

Co-op opportunities are available for students in all programs, including Environmental Physics, Chemistry, Environmental Chemistry, Biological Chemistry, Biochemistry, Environmental Science, Environmental Biology, and Environmental Geoscience. DPES, together with the University Co-op office, should strive to gauge student Co-op experiences in order to further improve the program.

Weaknesses/Opportunities:

PAS and ES: Opportunities for greater experience outside the classroom appear to be limited by the lack of staff in environmental geophysics.

- **What opportunities are there for student research experience?**

Strengths:

Undergraduates told us that there are opportunities to become involved in research, and there are formal CHEM and PAS research courses.

Weaknesses/Opportunities:

Students also told us that the process of learning about research opportunities is word-of-mouth, usually communicated by graduate students. A more formal process of informing students is advised. There also appears to be capacity for greater involvement of DPES students in research (see Additional Comments).

Assessment of learning:

- **The appropriateness and effectiveness of the methods used for the evaluation of student achievement of the defined learning outcomes and degree level expectations**

Strengths:

DPES programs appear to employ standard means of evaluation in courses, aided by enthusiastic graduate students.

Weaknesses/Opportunities:

A coherent set of grading rubrics may not be used in all courses and among all graduate student lab instructors. A formal mechanism of assessment between courses (e.g. evaluating course knowledge/skills transferable to future courses) does not appear to be in place (but

this matter was not extensively explored during the visit of the committee).

Quality indicators:

- **An assessment of the programs against international comparators**

The overall DPES structure is considered unique and comparison with international universities was not discussed, other than in relation to program elements elsewhere which highlight opportunities for CHEM, PAS, and ES programs and DPES in general (see examples in Additional Comments).

- **The quality of applicants and admitted students**

Strengths:

The quality appears appropriate given the mission of UTSC and its demographic base.

Weaknesses/Opportunities:

An effort to evaluate calculus preparation is advised (see discussion above).

- **Student completion rates and time to completion**

Weaknesses/Opportunities:

The overall DPES graduation numbers supplied to the committee upon its request are as follows:

2011 cohort	4th Year of Study	5th Year of study
DPES	29.67%	42.86%
UTSC	31.37%	58.78%
2009 cohort	4th Year of Study	5th Year of Study
DPES	30.83%	38.33%
UTSC	31.93%	43.48%

Although the DPES percentages are comparable to those of UTSC overall, both sets of numbers are very low. The five-year graduation percentages are lower than the UTSC averages, but again all numbers are low.

The Review Committee arrived with an awareness of the low overall UTSC graduation numbers from supplied documents (but not the numbers for DPES), and repeatedly probed faculty, students, and staff to understand the meaning of these numbers. Factors related to the demographic base (e.g. need to maintain income) were cited, but statistics were not

readily available, suggesting the need for better tracking. Poor academic performance was not identified as a significant problem by the faculty, staff, and TAs with whom the committee met. The committee did identify a few variables that could negatively impact success and time to completion. These include the following:

- overcrowding in some courses (and the related need to employ waitlists)
- unrealistic advising loads of some faculty (it is inconceivable that nuanced advice can be given by one advisor to hundreds of students in a single semester)
- the apparent ability of students to enroll in courses without having met prerequisites (potentially leading to student failure)
- scheduling issues including the lack of availability of courses when students return from Co-op programs (see more on Co-op programs in Additional Comments).

We recommend that DPES establish an internal task group to track graduation rates, collect data, and consider best practices for improvement.

- **The quality of the educational experience and teaching**

Strengths:

The students whom the committee met were unanimous in their praise of DPES teaching and the overall education experience.

Weaknesses/Opportunities:

The Co-op program offers students many opportunities for experiential learning, but more field trips might be made available to Environmental Science and Environmental Geoscience students. Students in these programs particularly benefit from outdoor experiences related to their classroom education.

A general concern, which may be beyond the ability of UTSC to address in the short term, is insufficient undergraduate classroom space. We raise this issue because it might have a negative impact on the undergraduate educational experience.

CHEM: See above with respect to rubrics (or lack thereof) for laboratory reports.

PAS: Because of the relatively small number of PAS faculty and hence smaller numbers of graduate students, qualified graduate TAs are limited; the corollary is that some TAs may not have the required skills). DPES should closely review this issue and consider solutions, including hiring additional faculty.

- **The implications of any data (where available) concerning post-graduation employability**

The Review Committee was informed that no such data exist.

We believe that DPES or UTSC should start collecting data on post-graduate employment.

- **Availability of student funding**

Strengths:

There appears to be a range of funding opportunities available for students, and DPES students (PAS and CHEM students in particular) have been successful.

Weaknesses/Opportunities:

The total number of scholarships for research for undergraduates appears to be small and well less than the needs of the student body. DPES should explore with UTSC opportunities to commit more monies to fund additional research scholarships for its students. A concern expressed to the Review Committee is that UT Science and Technology awards are unavailable to undergraduate students. DPES might raise this issue with the university.

- **Provision of student support through orientation, advising/mentoring, student services**

Strengths:

The supervisors of study are committed to advising students. It appears that the administrative staff also make considerable contributions to informal advising. However, the latter appear to be overcommitted, and UTSC should consider whether advising, to the extent that it is done, should be part of the administrative staff job activities.

Weaknesses/Opportunities:

The number of student advisees for individual faculty advisors is in some cases unreasonable (100 to 400). DPES should undertake a comprehensive review and determine alternatives, distributing the advising load. The students with whom we met commented that DPES needs a better way of advising/informing them about research, scholarship, and Co-op opportunities. They also stated that the benefits of the Specialist degrees are not well communicated. Faculty advisors commented that many students do not understand the role the advisors have.

- **Program outreach and promotion**

The potential for DPES to promote their program in the future through interactions with successful alumni was discussed.

2 Faculty/Research

- The scope, quality and relevance of faculty research activities

Strengths:

CHEM: Chemistry faculty are conducting high-impact research that is laudable. Their research is contributing to the “research powerhouse” sentiment held by DPES and the UTSC.

PAS: The quality of PAS faculty research is outstanding and has been even further strengthened by recent key hires in astrophysics. By focusing on an area distinct from other UT units, the PAS group addresses overall UT goals and affords its students access to world-class research opportunities. The incorporation of high performance computing in some research areas was noted and should be considered an important part of future research and educational plans.

ES: Biologists and geologists in DPES collaborate extensively with other faculty members in the department, as well as with researchers elsewhere in Canada and abroad. Most of them are recognized nationally and internationally for their research.

Weaknesses/Opportunities:

A comment was made to the Review Committee that an effort needs to be made to bring the chemists and physicists together more than is currently the case. Given the brevity of our visit, we could not verify that this is indeed an issue. However, certainly there is value in close collaboration of the two faculty and teaching cohorts.

An apparent disconnection between DPES research staff and teaching staff is beginning to surface. The teaching faculty, to some degree, feel overworked and underappreciated. The research faculty appear to be unaware of this sentiment. The research faculty do respect and appreciate the teaching stream. There should be more opportunities for the two groups to talk with one another about these issues and best teaching practices.

Several faculty members expressed dissatisfaction with the level of support that UTSC provides for DPES research initiatives.

PAS: The recent apparent divestiture of geophysics from the St. George campus presents additional opportunities for the UTSC PAS group and, more generally, DPES. Hires in this area could help better bridge the geology and physics units within PAS, and better bridge PAS and other educational programs, especially in the area of environmental geophysics and

environmental science (particularly in the Teaching Stream). In terms of research, hires in solid earth geophysics, especially planetary interiors, would add to the exoplanet research performed in the department and might lead to a UTSC signature program in planetary science bridging astrophysics and earth/environmental Science. Such a program would naturally involve undergraduates.

- **The appropriateness of the level of research activity relative to national and international comparators**

Strengths:

The level of research is truly impressive and comparable to other focused international programs.

Weaknesses/Opportunities:

No weaknesses were identified. Expansion into additional areas of solid earth and environmental geophysics could further strengthen the PAS research profile.

- **Appropriateness of research activities for the undergraduate and graduate students in the Faculty**

See above.

- **Faculty complement plan**

The “faculty complement plan” was not provided. It is the Review Committee’s understanding that a new complement plan is being written (communication from Acting Vice-Principal of Research). The DPES Chair did provide the committee, on its request, a rough outline of immediate funding priorities. These include funding for an additional administrative staff member and for a technician for the extensive, and impressive, environmental science lab (TRACES). PAS instructional needs were not specifically mentioned. The opportunity to further integrate PAS activities should be considered, including hiring in the area of geophysics and addressing teaching equipment deferred maintenance.

3 Relationships

- **Strength of the morale of faculty, students and staff**

Strengths:

The morale of DPES faculty, students, and staff is extraordinary. The lack of faculty

departures is notable.

Weaknesses/Opportunities:

The faculty and staff are sometimes charged with superhuman tasks and thus the sustainability of the high morale is a concern. With respect to the PAS majors, these tasks involve repairing and maintaining outdated laboratory instructional equipment. The overall administrative staff, while showing admirable esprit de corps, are overworked, typically working over lunches and to 7 pm. The CHEM stores delivery system could be made more effective and safer by including a dedicated delivery vehicle.

- **Scope and nature of relationships with cognate academic units**

Strengths:

The structure of DPES itself ensures outstanding opportunities for interactions between Chemistry, Earth/Environmental Sciences, and Physics. Biology is a separate department, but many faculty have dual appointments and many Chemistry faculty have expertise in Biology. Hence, these relationships are extraordinary.

Weaknesses/Opportunities:

PAS: The Review Committee sensed some friction between PAS initiatives and the Math and/or computer science units at UTSC. It appears that other departments have resisted PAS initiation in instruction in computational science and calculus preparation. If these barriers to learning and/or innovation exist, they should be removed.

- **Extent to which the Department has developed or sustained fruitful partnerships with other universities and organizations in order to foster research, creative professional activities and to deliver teaching programs**

The potential for the Co-op program to develop international programs was discussed; this is at a nascent stage at UTSC.

- **Scope and nature of the Department's relationship with external government, academic and professional organizations**

These appear to be appropriate level for the DPES mission.

- **Social impact of the Department in terms of outreach and impact locally and nationally**

Strengths:

DPES has succeeded in providing opportunities for its undergraduate students. In providing opportunities for so many first generation-university students, DPES also has a national impact.

Weaknesses/Opportunities:

DPES may be missing an opportunity by not highlighting to a greater extent its societal impact in addressing its demographic base (e.g. this was not overemphasized in the DPES strategic plan).

4 Organizational and Financial Structure

- **The appropriateness and effectiveness of the Department's organizational and financial structure**

Strengths:

The inclusion of Chemistry, Earth/Environmental Science, and Physics into a single unit provides natural stimuli for collaboration.

Weaknesses/Opportunities:

In teaching, there may be three sets of highest priority items for investment, corresponding to the three general academic groupings. The need to address all three simultaneously may be challenging.

- **The appropriateness with which resource allocation, including administrative and technical staff, space and infrastructure support, has been managed**

Strengths:

DPES, through its strategic plan, appears to be striving to include input from all of its members. The administrative staff are highly motivated to serve the needs of all faculty members and students.

Weaknesses/Opportunities:

The location of PAS in a separate building is a weakness. In addition, PAS is at maximum capacity in terms of laboratory teaching space, limiting further enrollment growth. Irrespective of the inclusive nature of the strategic planning process and the existence of a departmental council to assist the Chair, some faculty seem to be unaware of the processes

used to set priorities for funding, and the Review Committee noted that priorities were not included in the Self Study. However, the DPES chair did clearly communicate priorities to the committee.

- **Opportunities for new revenue generation**

Strengths:

Anecdotal information on placement of CHEM, PAS, ES, and ESS graduates implies considerable opportunities to work with alumni on fundraising.

Weaknesses/Opportunities:

The efforts of DPES in connecting with its alumni appear limited at present (and possibly handled by Advancement, which may or may not be pursuing this opportunity). There appears to be little direct interaction between UTSC Advancement and DPES.

5 Long-range Planning Challenges

- **Consistency with the University's academic plan**

Strengths:

The Self Study nicely outlines how DPES fits into the UTSC academic plan. By offering innovative instruction and numerous undergraduate degrees, the CHEM, PAS, ES, and ESS groups are striving to address the needs of the UTSC demographic base. They are doing this while maintaining a vibrant research presence of international quality that naturally enhances the educational experience of its students.

Weaknesses/Opportunities:

A clear rationale for the continued growth of UTSC, especially in light of the growing number of international students relative to the local demographic base, is not well articulated in any of the documents provided to the Review Committee. Several DPES faculty and UTSC administrators commented on the desire to avoid “growth only for the sake of growth”, and we second that opinion; growth should be strategic and closely linked to the UTSC academic plan.

- **Appropriateness of: o Complement plan, including balance of tenure-stream and non-tenure stream faculty; o Enrolment strategy; o Student financial aid; o Development/fundraising initiatives; o Management and leadership**

We were not provided with a Complement Plan. The enrollment strategy is addressed above. Detailed financial aid data were not presented to the committee. Development is discussed above. Below, a few comments are made on DPES leadership.

The high morale in the Department clearly stems in large part from the leadership of the DPES Chair. He clearly has made an effort to carefully consider input from all in developing plans for the future.

The Review Committee, however, expressed to the Chair a concern of what it viewed as potential pressure points within a department with all people multi-tasking and potentially having unreasonable workloads. It appears to the Review Committee that the unplanned departure of one or more individuals could have a large negative impact on DPES and its ability to deliver on its educational mission. DPES may be described as “lean and mean” in tackling its mission, but sometimes an organization can be too lean and susceptible to sudden collapse. For example, several staff members described situations where it would take more than one year to fully prepare a replacement because a given position required multi-tasking at such a level that on-job experience was the only practical way of training. Should this occur in DPES, a negative effect might be to exacerbate already high time-to-graduation numbers.

The Chair expressed plans to increase support in some units (TRACES, financial administrative support), but lean staffing seems to be systemic throughout DPES. This is of such great concern that we recommend the Chair consider an overall step request to bolster support in all DPES units.

6 International Comparators

- **Assessment of the Department and the program(s) under review relative to the best in Canada/North America and internationally, including areas of strength and opportunities**

Strengths:

As commented above, the structure of DPES is unique, so direct comparisons are difficult. However, DPES ranks very highly in addressing the UTSC demographic base, something that could be emphasized more by DPES and UTSC. The DPES faculty are first rate and comparable to the best on an international basis in their respective areas of study and/or instruction.

Weaknesses:

Comparisons are again difficult (but potentially possible; we requested data but were informed they were unavailable), but the time-to-graduation numbers should be monitored with the goal of improvement. Data relative to other universities serving a similar demographic base of first-generation university students would be useful.

Additional Comments:

Undergraduate writing requirement

A major deficiency identified in the DPES undergraduate programs is the lack of a rigorous writing requirement. This came to light after discussions with undergraduates. For many, the writing experience at UTSC was limited to laboratory reports. Some students stated they would graduate without any extended writing experience. As writing is an overarching lifelong skill important for success in many endeavors, the implementation of a formal writing requirement should be considered by DPES.

There are many ways to bring this forward. Elsewhere, the undergraduate writing requirement has been decentralized and is implemented at the departmental level. DPES might consider incorporating formal writing assignments into key courses, identified as “writing courses” for each major, and making completion of one or more of these courses a requirement for the major. Importantly, writing assignments should include draft, comment, and revision stages. There are other models, but we strongly recommend that DPES initiate some training in writing in all of its major programs.

Undergraduate research

There appears to be capacity (i.e., interested students and potential advisors) to expand significantly undergraduate research experiences during summers and perhaps during the Fall and Spring semesters. Faculty noted that there are some student funding opportunities for the summer, but these appear sufficient to fund only a handful of students. It seems DPES could fill a summer “research experience for undergraduates” program for 30 students if funds were available. This might be a departmental resource issue that needs to be considered relative to other needs. The Department should consider carefully the costs and benefits of such a program (e.g., it fills experiential teaching goals, might foster further flow of students into DPES graduate programs, or might further enhance the educational experience of the UTSC student demographic base).

Future growth of PAS programs

Several comments were made about the number of PAS majors, and opinions were not entirely consistent regarding further growth. On one hand, when compared with chemistry-related majors it appears there is room for growth in physics. On the other hand, several of the teaching staff noted that it would be impossible to expand physics laboratories in the current space, something confirmed by a visit of that space by the Review Committee. In addition, future growth appears to be unwise without considerable investment in laboratory

teaching equipment. One way to stimulate growth might be to expand offerings related to computational physics, geophysics, and astrophysics.

Issue of physical separation

The PAS group is in a separate building from the other DPES faculty; this was discussed several times during the Review Committee meetings. It would of course be ideal if all faculty were co-located, as this could facilitate collaboration. Any solution to this problem might also consider space limitations on further PAS instruction and the lack of lecture space in the environmental sciences building.

Relationship with other UT units

Relationships with other UT campuses were deemphasized during meetings with the Review Committee. The documents provided (e.g. DPES Self Study) instead emphasize how DPES differs from the St. George campus to the point of somewhat detracting from the considerable accomplishments of DPES. Overall, the DPES teaching programs appear to have been spectacularly successful in providing opportunities for the UTSC demographic base and this should be the focus.

DPES Co-op programs

The completion rates of DPES Co-op students are very low and a concern (2010: 26%; 2011: 32%). While it appears that a large portion of students transfer out of the Co-op program to another DPES program, the low rate of completion nevertheless merits careful study with an eye to substantial improvement. The Co-op office related to the Review Committee that it is initiating a major data collection efforts and DPES should engage in this process. There appear to be some departments with higher success rates, although still seemingly well below optimal levels (>40%). One starting point would be to review those programs with the Co-op staff to learn if there are identifiable pathways to greater success.

Exit surveys

The lack of data on student employment was discussed throughout the Review Committee visit. DPES should consider initiating exit surveys upon graduation, and then perhaps six months to one year thereafter, to collect such data.

DPES Undergraduate Program Review

Respectfully submitted,

**David Cramb
John Clague
John Tarduno**

UTQAP Review Summary

Programs Reviewed:	<p>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</p>
Unit Reviewed:	<p>Department of Physical and Environmental Sciences (DPES), University of Toronto Scarborough (UTSC)</p>
Commissioning Officer:	<p>Vice-Principal Academic and Dean, UTSC</p>
Reviewers:	<ol style="list-style-type: none"> 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:	<p>October 17-18, 2017</p>

Previous Review

Review Date: March 29-30, 2010

Summary of Findings and Recommendations:

Undergraduate Programs

The reviewers observed the following **strengths**:

Environmental Sciences programs:

- Well-defined learning objectives for environmental science programs

The reviewers identified the following **areas of concern**:

All programs:

- Inadequate lab, teaching equipment, and technical support for chemistry and environmental science
- Students had concerns regarding the co-op, the use of stipend teachers, student advising, and the accuracy of calendar listings
- No post-graduation tracking of alumni

Environmental Sciences programs:

- Limited field and lab-based opportunities and career-related course content
- Level of math, physics and chemistry in major programs could be improved

Chemistry programs:

- Limited lab courses in physical chemistry and inorganic chemistry

Physics programs:

- Small selection of physics courses

The reviewers made the following **recommendations**:

Chemistry programs:

- Create additional lab courses in the area of biological chemistry
- Consider distribution of faculty in core courses

Faculty/Research

The reviewers observed the following **strengths**:

- Chemistry faculty are active researchers, and faculty in environmental areas are leaders in their field
- Physics faculty are involved in laboratory teaching
- Environmental science faculty have built relationships with industry and government

The reviewers identified the following **areas of concern**:

- Apparent lack of formal mentorship of junior faculty
- Six of the eleven physics faculty members are emeriti, and several other faculty members do not conduct research
- Physics faculty searches have been unsuccessful for various reasons
- Faculty complement does not meet all disciplinary teaching needs, and has led to an imbalance in research expertise

The reviewers made the following **recommendations**:

- Need for organic and biological chemistry faculty members

Administration

The reviewers identified the following **areas of concern**:

- Department seems overcommitted, especially given resources constraints
- Communication and administration challenges throughout the Department
- Academic plan does not put forward an underlying vision for the Department
- Tensions regarding physics education
- Recent efforts to expand areas of chemistry covered have met many challenges and progress has been slow
- Technical staff do not have proper office space
- Absence of operating budget for laboratories, and no base budget for the Department administrative operations
- Relationship between environmental science and Centennial College needs attention

The reviewers made the following **recommendations**:

- Consider how the existing research and teaching division of physics, environmental science, and physics could be administratively distributed to alleviate some of the administrative challenges
- Engage in comprehensive strategic planning and/or expand academic plan to address areas such as: technical and administrative support; space development; and infrastructure for teaching and research
- Consider adding subject area Associate Chairs and discipline representatives; ensure these groups meet regularly and are committed to long-term planning
- Determine the role of the physics group within the Department
- Engage with alumni, which may assist with generating new revenue sources

Current Review: Documentation and Consultation

Documentation Provided to Reviewers

1. About the University and UTSC: UTSC Strategic Plan (2014/15 – 2018/19); UTSC Academic Plan (2015-20); UTSC By the Numbers; UTSC Admissions Viewbook (2017-18).
2. About the Review: Terms of Reference; Site Visit Schedule.
3. About the Department: Unit Academic Plan; External Review Report and Administrative Response for Graduate DPES (2015-16); Unit Self Study, plus Appendices.
4. About Programs and Courses: Description of DPES programs; and description of DPES courses; Course Syllabi; Course Enrolments from 2007 to 2017.
5. Faculty CVs.

Consultation Process

The reviewers met with the following: the decanal group, including the Vice-Dean Undergraduate, Vice-Dean Graduate, Vice-Dean Faculty Affairs and Equity, Assistant Dean Academic, and Academic Programs Officer; the Vice-Principal Research (Acting); the Chair of the Department of Physical and Environmental Sciences; junior and senior members of the faculty from all areas of study; undergraduate students; graduate students; administrative staff from the Office of Arts and Science Co-op; departmental technical staff; departmental administrative staff; and library staff.

Current Review: Findings and Recommendations

1. Undergraduate Program

The reviewers observed the following **strengths**:

- Overall quality
 - Faculty and staff deliver a first-class undergraduate educational program
 - Diversity and quantity of degree offerings that meet the UTSC demographic base well
- Admissions Requirements
 - Appropriate admission requirements
- Innovation
 - Students are provided the opportunity to obtain industry experience
 - Co-op available to students in most programs
- Quality Indicators – Students
 - Student morale is high
 - Program graduates are successful
- Student Funding
 - Range of funding opportunities available to students

The reviewers identified the following **areas of concern**:

- Curriculum and Program Delivery
 - Chemistry Specialist numbers dropping (students are migrating to major programs)
 - Poor calculus preparation for first-year physics students, and faculty led tutorials may not be best approach for improving student outcomes
 - Lack of writing component in major programs
 - Overcrowding, scheduling and availability issues with some courses
 - Future growth in physics programs is compromised by limited physical resources
- Innovation
 - Students learn about research opportunities through word-of-mouth
 - Limited experiential learning opportunities for Physics and Environmental Science students due to lack of staff in Environmental Geophysics
 - Disconnect in communication between department and co-op office
- Assessment of Learning
 - Lack of coherent guide for grading to be used across courses and labs
 - Small number of Physics and Astronomy graduate students leads to smaller pool of qualified teaching assistants (TAs)
- Student Engagement, Experience & Program Support Services
 - Challenges to accessing student advisors
- Quality Indicators – Students
 - Low graduation percentages across the Department and the campus in general
 - Low completion rate for co-op students
 - Lack of rationale for enrolment growth efforts
- Student Funding
 - Total number of research scholarships is small and does not meet total need
 - There is interest from students and available advisors to support additional summer research opportunities, but there are insufficient funds to support expansion

The reviewers made the following **recommendations**:

- Curriculum and Program Delivery
 - Consider developing an introductory calculus for physics “mini-course” as a prerequisite, or explore course options that might be offered through the Department of Computer and Mathematical Sciences
 - Include writing training in all major programs

- Explore if interest in growing physics programs can be satisfied through offering additional courses in computational physics, geophysics, and astrophysics
- Innovation
 - Improve communication between Department and Co-op Office
 - Increase number of field trips for students in Environmental Science and Environmental Geoscience
 - Explore adding high performance computing opportunities
- Assessment of Learning
 - Monitor number of qualified TAs for Physics and Astrophysics and explore solutions for this issue
- Quality Indicators – Students
 - Establish an internal task force to collect data on graduation rates and begin tracking employment outcomes
 - Consider instituting an exit survey shortly after graduation
 - Monitor co-op completion
 - Ensure plans for enrolment growth are strategic and linked to the overall UTSC academic plan
- Student Funding
 - Explore opportunities to secure additional student funding
 - Consider cost/benefits of providing additional funds to support expanding summer research opportunities

2. Faculty/Research

The reviewers observed the following **strengths**:

- Overall
 - Dedicated faculty with expertise that is well deployed
- Research
 - Chemistry faculty conduct high-impact research
 - Strong research faculty in Physics and Astronomy
 - Good collaborations within Environmental Sciences faculty at the Department and with other researchers nationally and internationally

The reviewers identified the following **areas of concern**:

- Research
 - Faculty expressed dissatisfaction with level of support provided for major grant proposals
- Workload & Faculty Complement
 - Unrealistic student advising workloads
 - Teaching-stream faculty may feel “overworked and underappreciated”
 - Limited Environmental Geophysics expertise among complement

The reviewers made the following **recommendations**:

- Workload & Faculty Complement
 - Determine solutions/redistribution of student advising workload
 - Find opportunities to bringing faculty groups together to discuss issues
 - Consider adding faculty in area of Environmental Geophysics, ensuring equipment support is available for an expansions

3. Administration

The reviewers observed the following **strengths**:

- Relationships
 - Morale is high among all members of the Department
 - Ample opportunities for collaborative work among disciplines at UTSC
- Long-Range Planning & Overall Assessment
 - Chair provides good leadership and has sought consultation on development plans for the Department
- International Comparators
 - Impressive level of research activity compared to international peers

The reviewers identified the following **areas of concern**:

- Relationships
 - Unclear whether high morale can be sustained given the workloads
 - Some friction between Physics and Astronomy and some other UTSC departments
- Organizational and Financial Structure
 - Insufficient undergraduate classroom space
 - Low administrative staff numbers; stress on Department staff, many of whom work outside normal work hours
 - Staff, who are already overcommitted, are also taking on student advising work
 - Aging physics equipment and lack of storage space in laboratory work
 - It may be challenging to prioritize all three teaching areas in the Department
 - Physics and Astronomy located in a separate building which is at capacity for teaching and lab space
- Long-Range Planning & Overall Assessment
 - Limited alumni engagement and interaction between the Department and the UTSC Advancement Office

The reviewers made the following **recommendations**:

- Relationships
 - Remove any learning and innovation barriers that exist or develop due to issues between departments
- Organizational and Financial Structure
 - Address classroom shortage
 - Track staff hours to determine need for additional support; consider an overall boost to administrative support in all areas
 - Evaluate whether staff should continue providing advising support
 - Invest in physics lab and instruction equipment
 - Provide Environmental Sciences with an equipment budget
 - Consider solutions for co-locating all Department programs and addressing space limitations

Administrative response – appended

April 20, 2018

Professor William A. Gough
Vice-Principal Academic and Dean
University of Toronto Scarborough

Dear Professor Gough:

Thank you for forwarding the report of the October 17-18, 2017 External Review of the Department of Physical and Environmental Sciences and its undergraduate programs. The following programs were reviewed: Astronomy & Astrophysics: Minor; Biochemistry, BSc: Major, Co-op; Biological Chemistry, BSc: Specialist, Co-op; Chemistry, BSc: Major and Co-op; Chemistry, BSc: Specialist, Co-op; Environmental Biology, BSc: Specialist & Co-op; Environmental Chemistry, BSc: Specialist, Co-op; Environmental Geoscience, BSc: Specialist & Co-op; Environmental Physics, BSc: Specialist & Co-op; Environmental Science: Major & Co-op; Environmental Science: Minor; Environmental Studies, BA: Major; Natural Sciences & Environmental Management: Minor (effective April 1, 2017); Physical Sciences, BSc: Major; Physical & Mathematical Sciences, BSc: Specialist; and Physics & Astrophysics, BSc: Specialist, Major.

As indicated in our *Statement of Institutional Purpose*, the University of Toronto is committed “to being an internationally significant research university, with undergraduate, graduate and professional programs of excellent quality.” This quality is assessed through the periodic appraisal of programs and units, which considers how our research scholarship and programs compare to those of our international peer institutions and assesses the alignment of our programs with established degree-level expectations. The University views the reports and recommendations made by external reviewers as opportunities to celebrate successes and identify areas for quality improvement.

The reviewers commended the quality of teaching and high morale in the Department. The reviewers were impressed by the diverse set of program offerings and highlighted the strong connections to faculty expertise. Students engaged in the review praised the teaching and their overall educational experience. The reviewers also remarked on the strong research productivity of the faculty.

I am writing at this time:

1. to request your administrative response to this report, including a plan for implementing recommendations;
2. to request your feedback on a summary of the review report; and
3. to outline the next steps in the process.

1. Request for Administrative Response and Implementation Plan:

In your **administrative response**, please address the following areas raised by the reviewers and their impact on academic programs, *along with any additional areas you would like to prioritize*.

For each area you address, please provide an **Implementation Plan** that identifies actions to be accomplished in the immediate (six months), medium (one to two years) and longer (three to five years) terms, and who (Department, Dean) will take the lead in each area.

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.

Undergraduate programs

- The reviewers recommended addressing the writing requirements across all programs.
- The reviewers noted that many students entering physics and astronomy programs are challenged by the level of calculus in introductory courses.
- The reviewers encouraged expanding experiential learning opportunities for students in environmental science and environmental geoscience programs.
- The reviewers suggested a number of ways to support additional opportunities for undergraduate research.

Resources

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

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.

2. Summary

My office will provide a summary of the review of Physical and Environmental Sciences in **May 2018** for your feedback regarding tone or accuracy, and response to any information that is requested in the comments. This summary becomes part of the governance record.

3. Next Steps

Reviews of academic programs and units are presented to University governance as a matter of University policy. Under the University of Toronto Quality Assurance Process (UTQAP), the Vice-Provost, Academic Programs prepares a report on all program and unit reviews and submits these periodically to the Committee on Academic Policy and Programs (AP&P).


The review of the Department of Physical and Environmental Sciences will be considered by AP&P at its meeting on **October 31, 2018. Please plan to attend this meeting.** Your presence is important and will allow you to respond to any questions the committee may have regarding the report, and your administrative response and implementation plan. An overview of what happens at AP&P is [available on our website](#).

I would appreciate receiving your completed administrative response and plan for implementing recommendations, as well as any comments on the summary by **September 28, 2018**. This will allow my office sufficient time to prepare materials for the AP&P meeting.

After AP&P, we will work closely with you to develop a Final Assessment Report and Implementation Plan (a summary of the review's outcomes, including plans for implementing recommendations), which is posted on our [website](#) as required by the UTQAP.

Please feel free to contact me or Erin Meyers, Acting Coordinator, Academic Planning and Reviews, should you have any questions.

Sincerely,



Sioban Nelson
Vice-Provost, Academic Programs

cc.

Mark A. Schmuckler, Vice-Dean, Undergraduate, UTSC

Lesley Lewis, Assistant Dean, Academic, UTSC

Annette Knott, Academic Programs Officer, UTSC

Daniella Mallinck, Director, Academic Programs, Planning and Quality Assurance

Erin Meyers, Acting Coordinator, Academic Planning and Reviews



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.

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

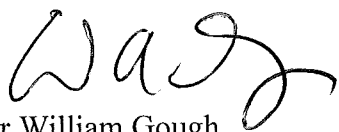
recommend that DPES create more opportunities for teaching and tenure stream faculty to talk to one another.

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)