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MEMORANDUM

ATTENTION	Senate	**DATE**	August 15, 2022
FROM	Wade Parkhouse, Vice-President, Academic and Provost and Chair, SCUP	**PAGES**	1/1

RE: SCUP 22-21 External Review Mid-Cycle Report for Department of Earth Sciences

At its July 13th, 2022 meeting, SCUP reviewed the Mid-Cycle Report for the Department of Earth Sciences which resulted from its March 2018 external review.

The following documents are attached for the information of Senate:

- Update on the Action Plan
- Assessment of Educational Goals
- SCUTL's Feedback on the assessment of Educational Goals

C: G. Williams-Jones; M. Silverman

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SCUP 22-21

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MEMORANDUM

Attention: Catherine Dauvergne, Vice-President, Academic and Provost and Chair, SCUP

From: Wade Parkhouse, Vice-Provost and Associate Vice-President, Academic

Re: External Review Mid-Cycle Report for the Department of Earth Sciences

Date: June 29, 2022

The External Review of the Department of Earth Sciences was undertaken in March 2018. As per the Senate guidelines, the Unit is required to submit a mid-cycle report describing its progress in implementing the External Review Action Plan and the assessment of its Educational Goals. The update on the Action Plan has been reviewed by the Faculty Dean. The Senate Committee on University Teaching and Learning (SCUTL) has provided feedback to the Unit on the assessment of its Educational Goals. The recommendations from SCUTL will be incorporated into the Unit's self-study report for the next external review.

The following documents are attached for the information of SCUP:

- Update on the Action Plan
- Assessment of Educational Goals
- SCUTL's Feedback on the assessment of Educational Goals

c: Glyn William-Jones, Chair, Department of Earth Sciences
Peter Hall, Dean pro tem, Faculty of Arts and Social Sciences

SFU DEPARTMENT OF EARTH SCIENCES

Memorandum

To: **Dr. Glynn Nicholls, Director, Academic Planning and Quality Assurance**

From: Glyn Williams-Jones, Chair – Department of Earth Sciences

Re: Earth Sciences Mid-Cycle report

Date: June 29, 2022

Dear Glynn,

Please find attached the Department of Earth Sciences 2022 Mid-Cycle Report and Assessment Report of our Department's Educational Goals.

Sincerely,

Glyn Williams-Jones
Chair, Department of Earth Sciences
easc_chair@sfu.ca
778-782-3306

External Review Mid-Cycle Report for the Department of Earth Sciences June 1, 2022	
Action	**Progress Made**
1. Programming **1.1 Action to be taken**	
1.1.1 Undergraduate	
• 1.1.1.1. Develop comprehensive plan to increase undergraduate enrollment of both Majors and FTEs. The plan will be prioritized in the following manner:	As stated below, we are taking a multifaceted approach to increase Majors and FTEs in an environment wherein enrollments in Earth Science / Geology programs across North America and Europe have been in decline for > 5 years.
• 1.1.1.1.1. First-year courses will be made more appealing by better communicating the relevance of the course content to other natural and social science disciplines: course descriptions will be enhanced; some titles may be changed; and advertising will be sent to specific departments.	Course descriptions have been updated and simplified. A "marketing" initiative was launched to expand awareness of these courses, including colourful and appealing posters being displayed throughout campus, on the Department webpage, and in a digital display. A Citizen Science earthquake seismometer (Raspberry Shake) has also been installed next to the display as a means of attracting transiting students to Earth Sciences.
• 1.1.1.1.2. An additional one or two of our present breadth courses will be developed for on-line (remote) delivery. These online courses will not replace the traditional delivery of these courses, but will provide greater flexibility for students. The undergraduate committee will establish a priority list of courses for on-line development and bring these to the department for approval.	Further online offerings have been placed on hold temporarily due to the COVID crisis and an emphasis on teaching core courses (due to a reduced faculty complement), to ensure timely progression of majors/minors within the program. With increasing return to normalcy, the department will revisit the merits of developing online breadth courses.
• 1.1.1.1.3. Develop and implement a recruitment strategy for local high schools, in order to raise the profile of Earth Sciences as a career choice, emphasizing not just the relevance of an Earth Science degree in today's world (see 1.1.1.1.4) but also as the pathway to professional registration with Engineers and Geoscientists of British Columbia. A Recruitment Committee will be created and tasked with developing a communications package for high school science classes and high school advisors. This package will	A new department brochure (targeting high school audiences) and PowerPoint slide deck has been developed, in order to highlight the challenging and rewarding professional career opportunities in Earth Sciences. A similar pamphlet was developed, targeting Women in STEM and Earth Sciences. Grade 10 & 11 Science classes are the main audiences, as well as school career counselors. Graduate student-led outreach/recruiting to high schools will ramp up in Fall 2022, with the increased access to in-person interactions as COVID restrictions are lifted.

include promotional material, such as handouts, PowerPoint presentations, short videos, and social media content for in-person and digital delivery.	A preliminary marketing plan for the Department is also being developed to further prepare a consistent approach and messaging, as well as to consider the best approaches to reach different audiences (schools, SFU Science majors, *etc*.) *via* different media (*e.g*., in-person, social media, *etc*.).
• 1.1.1.1.4. Revisit with FoS Departments, with support from the Dean, how EASC 101 can be made mandatory or, at least, listed as an option for all science degrees. The rationale is to facilitate Earth Science literacy, so that science students have the knowledge to better understand critical issues surrounding climate change, natural resources, and natural hazards. EASC 101 has recently been added as a required "one of" course from a list of EASC courses in the BSc general science, joint minor program.	This has been raised again by the Department Chair and Undergraduate Curriculum Committee Chair. However, due to COVID and changes in leadership in the Faculty of Science, no progress has been made.
• 1.1.1.1.5. Continue to build interdisciplinary programme offerings. a. Discuss with School of Environmental Science about facilitating access for ENVS students to take more of our courses. There are no apparent access issues with the various required or optional courses for the Water Science Stream students, as that stream was designed specifically to remove barriers related to prerequisites and sequence of offerings. A minor issue was identified last fall with one of our courses and a Geography course being offered during the same time slot; however, this issue was rectified prior to registration, and both Geography and Earth Sciences are aware of the need to avoid overlap with the timing of the lectures/labs. We will, however, work with Environmental Science to see whether there are avenues to streamline access to more of our courses for EVSC students. b. Streamline the Joint Major with Chemistry to make it more accessible and better integrated. It is currently difficult to finish the Joint Major in less than 5 years, which may result in low student up-take.	a. Discussions with EVSC identified a few barriers, including EASC 205 and 210. These have been addressed by changing the pre-requisites. b. Joint major with Chemistry is being streamlined as part of a larger EASC undergraduate program optimization. A number of courses are no longer offered in CHEM and these will be removed from the joint-program. The UCC is tasked to address this. More broadly, we are streamlining our undergraduate program to remove potential roadblocks and increase flexibility for our students. This involved a comprehensive course mapping and educational goals assessment. Key aims are that students will be able to take more courses across the two professional streams (Geology and Environmental Geoscience). See below for more details.

• 1.1.1.2. Examine ways to increase the numbers of students taking a minor degree in Earth Sciences. We will explore this with School of Environmental Science and possibly other departments. It should be noted that most of our previous minors were Physical Geography majors who wished to register with Engineers and Geoscientists of British Columbia. However, the Department of Geography has now created a stream that allows professional registration. Since many of our courses are required for this stream, students are not able to use these for the minor. This has been the main reason for the drop in the number of minors. In addition to revising the minor degree requirements, we will also examine our existing certificate programs to see whether these can be made more attractive to students pursing majors in other disciplines.	As noted here, Physical Geography students are no longer taking the EASC minor. We are modifying the Minor requirements to provide more detail to students, so that they better understand the options and thematic areas that might be of interest to them.
• 1.1.1.3. Examine required courses in the two streams for professional registration (Geology, Environmental Geoscience) to see whether we can streamline them to allow greater flexibility for students to explore other related courses. However, a proper balance must be struck between merely meeting the course syllabus for professional registration and ensuring that the department produces well-trained Professional Geoscientists for the work force or future graduate studies research.	Following our last Department retreat (November 13-14, 2021), opportunities to optimize the existing program and enhance upper division enrollments were identified. These include making EASC 304 – Hydrogeology a required "common to all" course and consolidating the 3 existing petrology courses (301 Igneous Petrology, 302 Sedimentary Petrology, 311 Metamorphic Petrology) into 2 courses (*e.g*., Petrology 1 and 2). These petrology courses would be team taught in the Fall (Petrology 1) and Spring (Petrology 2) by 2-3 faculty. Geology Stream students would be required to take both courses while Environmental Geoscience Stream students would be required to do only Petrology 1; however, these students would nevertheless have the option to take Petrology 2 as they would have completed the prerequisite. The UCC is currently examining the merits of these possibilities.
1.1.2 Graduate	
• 1.1.2.1. Explore reducing required courses from 4 to 3 for MSc students, with the aim of decreasing completion times. This would require increasing the credit for the thesis from 18 to 21 units. This, along with increased graduate student funding, may help to reduce completion times.	This was discussed at the Department retreat on November 13-14, 2021. However, it was felt that this would not actually enhance completion rates. One change that should help is the regular (annual) offering of an Introduction to Research course.

• 1.1.2.2. Actively seek more funding for graduate students. Our efforts to strengthen our research profile (outlined elsewhere in the response) go hand-in-hand with increasing success in attracting scholarship-worthy students. We will also investigate opportunities to increase funding for all graduate students, either through the EASC TA budget or alternative sources. Alternative sources such as MITACS grants are already utilized and although temporary, other sources such as CREATE will be explored.	Individual faculty are currently leveraging external funding, including numerous Mitacs and NSERC Alliance grants. One CREATE proposal was submitted (PI at McGill) but this was unsuccessful. Other institutional initiatives are being pursued (*e.g.*, CFREF) that, should they be successful, would naturally lead to additional funding for graduate students. TA budgets are directly associated with FTEs and thus remain a potential issue while undergraduate enrollments remain low.
• 1.1.2.3. Explore the possibility of a course-based professional M.Sc.	Given the very limited faculty complement (due to unfilled departures / retirements), the Department is not in a position to consider a course-based professional M.Sc. in Earth Sciences at this time. However, very preliminary discussions have been initiated by the Department Chair, in partnership with Beedie School of Business, to investigate the possibility of a program involving delivery of asynchronous micro-credits that could lead towards a Professional MBA. The target audience would initially be working professionals in the Finance and Resource sector.
• 1.1.2.4. Regularly and systematically increase the recommended minimum graduate student stipend. This will reduce the growing gap between cost of living and student stipends, and the necessity for some students to seek outside employment. EASC indicated on the Action Plan that this goal was already completed. Minimum annual graduate salaries in EASC is $22,000 starting September 1, 2018 and will increase 2% per year after that.	This has been implemented and is now part of the Department standard with respect to graduate funding levels.
2. Research	
• Develop a strategic plan that includes: a. Identification of a narrower set of research themes for the department (3 - including natural hazards). b. Create a mission statement and a description of the Department that can aid with marketing.	a. This was completed as part of the development of a Strategic Plan (*i.e.*, Solid Earth Processes, Resources, Hazards & Surface Processes). b. Completed and now part of the Constitution and shown on the Department webpage.

c. Establish a plan to increase analytical/equipment capability to support the research programmes. Logically, this may be used to inform CFI initiatives. d. Development of a medium-term faculty hiring plan to realise the strategy (which will account for impending retirements).	c. Three successful CFI JELFs have enabled acquisition of an SEM, ITRAX X-ray core scanner, and drone-based remote imaging systems. Addition of further analytical instruments continues to be restricted by space limitations. d. A hiring plan was developed within the Strategic Plan and is being followed in efforts to campaign for faculty renewal. This situation has been exacerbated by the unexpected departure (Jan 2021) of an Assistant Professor and early retirement (Sept 2021) of an Associate Professor. We were recently given permission to hire a Lecturer (to replace retirement of a Senior lecturer in April 2022); however, at least 3-4 more faculty hires are required to enable effective delivery of our undergraduate and graduate programs.
3. Administration	
• 3.1.1 Finalize constitution.	This was completed in November 2019.
• 3.1.2 We will strive to increase communication between the Department, the Dean and VP Research.	EASC has a very good working relationship with the Dean and VP Research, with many faculty members actively involved in faculty and university initiatives.
4. Working Environment	
• 4.1.1 Ensure lecturers have suitable opportunity to take summer holidays.	This is currently being addressed through transparent planning (2-year window in accordance with the Collective Agreement) and use, where feasible, of intersession courses.
• 4.1.2 Better engage administrator and staff in decisions. If the Department approves, the administrator and some staff will be given the right to vote on relevant committees.	The department manager and some staff now have voting rights (enshrined in the updated department constitution) on relevant committees.
5. University Administration	
• 5.1.1 Through the Faculty of Science Undergraduate Curriculum Committee, continue to explore with University	The Department Chair and UCC chair continue to engage with the Faculty UCC and upper administration to express our concerns

Administration putting controls or oversight on the type(s) of courses that qualify as breadth science courses.	regarding Breadth Sciences courses. The Associate VP Learning & Teaching has recently established a committee to re-certify Breadth courses and we are hopeful that Breath-Sci issues will be addressed in the near future.
• 5.1.2. Obtain space for a common area for faculty and graduate students. Presently there is no common space and afternoon coffee is held in the foyer of the building, or outside the building when the weather is suitable.	Space continues to be an issue across the University, and with limited research and teaching spaces, common space continues to take last place. We continue to do what we can with the limited common space available and where possible, take advantage of the ready access to outdoor areas for our Social events. This is still less than ideal.

Dean's Comments on the Mid-Cycle Report

The initial action plan for EASC was ambitious, yet fulfilling the goals are essential for the long-term success of the department. This is particularly the case for increasing the numbers of majors and FTEs they attract to the program. I appreciate though, that it is been a real challenge the past few years due to COVID, and regarding general workload issues for faculty and staff. Despite these challenges, I laud the department for their efforts and progress. I note that faculty renewal is an issue for EASC with the wave of departures and retirements (Section 2 d). I have advocated for a hire in the recent Faculty Renewal Plan and hope this position is granted.

Undergraduate: Progress is excellent, particularly around high school recruitment. I hope these efforts pay off in the next few years with an increase in FTEs. I note the struggles with the Dean's office, re: 1.1.1.1.4, and will restart these discussions with EASC and ensure the incoming Dean is aware of this opportunity to facilitate Earth Science literacy among Science majors.

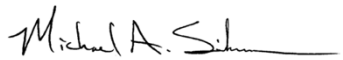
Graduate: Although a relatively small graduate program (albeit impressive considering the number of research faculty), the training opportunities are outstanding in basic and applied research. And I appreciate the extra financial burden on PIs, but it is important that graduate student stipends have been raised (1.1.2.4). This is also a trend across all the Science departments.

Research: Overall, EASC "punches well above its weight" regarding research output and profile. I appreciate their grant writing efforts and successes, and their collegial nature, e.g., shared equipment grants. As noted above, EASC is in need of faculty and without replacements their research will suffer, as will their ability to deliver undergraduate and graduate courses.

Administration: I am glad to see their constitution was completed, which is also a task for several of the other Science departments. And I hope the strong, positive relationship with the Dean's office and University continues (3.1.2).

Working environment: Both points raised here will increase the collegiality in the department and hopefully foster a more inclusive, equitable working environment.

University Administration: In relation to FTEs and the opportunity for EASC to teach Breadth-Science courses, e.g., climate change related courses, it is critical that the University assess breadth courses across campus and minimize overlap and keep quantitative offerings in Science (5.1.1). As noted, the need for common space is a challenging, and frankly, a difficult one to solve. However, the Dean's office will consider strategies to address this, for example, continuing discussions with other Faculties that occupy TASC1 where space is underutilized.

Dean's Signature  Date June 19, 2022

SFU SIMON FRASER UNIVERSITY

Mid-Cycle Assessment Plan Reporting Template

Unit: Earth Sciences
Contact Person: Glyn Williams-Jones
Date: June 1, 2022

1) Who were the members of your Educational Goals Assessment team? Please outline who has worked on the assessment.

Led by UCC Chair, James MacEachern, and EASC Department Chair, Glyn Williams-Jones. The entire academic unit was involved in the assessment of the Educational Goals. The department took part in a comprehensive discussion of Educational Goals at a 2-day retreat, held in November 2021. Prior to the retreat, the stakeholder faculty members in each of 4 thematic areas of the undergraduate program (Natural Hazards and Hydrogeology in the Environmental Geoscience Stream, and Petrology and Tectonics and Sedimentology-Stratigraphy in the Geology Stream) participated in a full appraisal of the course content of all relevant courses. The educational goals of each course were carefully assessed. The stakeholders also evaluated course content overlap and reinforcement of concepts with accompanying levels of complexity. Finally, the assessment team in each of the thematic areas presented their results to the department at the retreat, and characterized the key competencies expected of the graduating students.

2) Did your unit revise or update your Educational Goals and/or your Curriculum Map? Please outline any changes you made.

Earth Sciences is a professional program, such that graduating students can register with Engineers and Geoscientists BC (EGBC) as a Professional Geoscientist in the field of Environmental Geoscience or Geology. As such, the EASC program is aligned with the national syllabus, and has been carefully crafted and regularly revisited by the department, in response to any changes in the requirements for registration. The curriculum mapping exercise demonstrated that course contents, degrees of content overlap, expectations of ever-increasing levels of concept comprehension, and key competencies were sound.

The departmental assessment led to the documentation of Educational Goals for every course in the undergraduate program, which the department now ensures are appended to the course outlines. More importantly, the comprehensive curriculum mapping exercise evaluated the level at which each Educational Goal is presented to students, as well as the methods employed to measure its uptake (see attached file – EASC Program Map), in order to ensure that program-level EGs are met.

Six courses were then selected for monitoring to assess uptake of the goals (see section 4). Two courses (EASC 202, EASC 210) were selected from the lower division, which are common to all students in the EASC program. Two courses (EASC 306, EASC 308) were selected from the upper division, which are common to all and correspond to the field schools, in order to track uptake of practical geoscience skills. Unfortunately, the instructor of EASC 306 refused to provide the necessary data to assess Educational Goals related to that field school. Finally, one required course from each stream (EASC 304 from the Environmental Geoscience Stream and EASC 309 from the Geology Stream) was selected to assess the uptake of more advanced concepts. These latter two courses are commonly also taken by the students in the other stream.

The EG assessment also resulted in a rationalization of all course pre-requisites, with an eye to including only those absolutely necessary for successful completion of the course. These changes should enable a greater streamlining of the program and remove bottlenecks to student progression.

3) Did you change any aspects of your Assessment Plan from your Action Plan? Please outline any changes you made.

The original action plan derived out of our self-study report and our response to the departmental review in 2018. The action plan indicated that a program mapping exercise was needed to highlight educational goals and whether they were leading to the key competencies required of our graduating students. It was determined that the educational goals were being assessed in a variety of ways and that it was desirable to articulate these more clearly to the department at large (see attached file - EASC Program Map). In addition, 6 courses that cover the range of course delivery styles, scope of content, and development of practical skills were selected by the department to monitor the uptake of Educational Goals prior to the mid-cycle review.

The assessment plan (see attached file – EASC Assessment Plan) was modified slightly to include a series of stakeholder meetings in 4 thematic areas spread across the two professional streams in the department. These meetings presented the course content, its level of detail, and the proportion of course time dedicated to its delivery in order to complete the program mapping and ensure that concepts and Educational Goals were being reinforced and developed at increasing levels of refinement. The assessment plan was then presented to the Department at the November 2021 retreat for discussion and feedback. A revised action plan (see attached file – EASC Revised Action Plan) is now being implemented.

4) Please use the table below to outline the assessment you have done to date. Add or delete any rows as needed.
Courses assessed: EASC 202, 210, 304, 306, 308, 309

Educational Goal 1: Demonstrate a broad knowledge & understanding of essential Earth materials, features, processes, and history over a range of spatial and temporal scales		
Description of Assessment Method(s): **EASC 202** Exams and lab assignments **When did you collect the data?** Fall 2019 – 2021 ***N.B.*:** Two of the 3 offerings of the course in the data collection range took place during the Covid-19 pandemic when instruction was either mostly remote/on-line or some combination of limited in-person instruction and remote delivery. As a result, the assessment methods were not "standardised" over the full data range.	**Describe Key Findings, Analysis and Interpretation:** **EASC 202** In general, students have difficulty integrating concepts and information from prerequisite courses into the EASC 202 course. As a result, many students fail to see the relevance of an individual course to the overall plan or to develop those skills needed for critical thinking and problem solving. Many students choose to memorise course material to prepare for an exam and thus have difficulty dealing with test questions that are not exactly the same as the examples and demonstrations used in lecture or lab.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 202** At the start of the semester, the instructor will better articulate the importance of prerequisite/foundational information and their relevance to the educational goals of the course. In addition to this, students who self-identify as having poor background skills are suggested to attend "Science and Math Peer Tutoring". Incorporate more examples and exercises into lecture discussions and lab assignments. Hopefully, this will help students become more engaged with the course topics as they are covered, rather than attempting to synthesize a much larger volume of information immediately prior to an exam.

		Present students with various ways of looking at and solving a problem, so that they are not so perplexed by an exam question that has not been presented "exactly as the ones in lecture". This also includes suggestions on various study skills that rely less on memorization and more on understanding and integrating broader the concepts.
EASC 210 Exams and lab assignments **When did you collect the data?** Fall 2019, 2021	**EASC 210** Fall 2019 average grades: Midterm Exam (68%), Lab Exam (71%), Final Exam (69%) Fall 2021 average grades: Midterm Exam 1 (69%), Midterm Exam 2 (71%), Final Exam (64%) Not surprisingly, students do quite well with questions involving simple recall of information. Questions that require written answers in a paragraph or two yield highly variable results.	**EASC 210** There was little difference in the results over the two terms. As an overall reflection on the learning and examination processes, the instructor determined that students generally spend too little time in reading, review and study of the material. Based on recent experience with adding more experiential learning to the first-year courses, the instructor plans to follow the same avenue in EASC 210. This will include short, group-based learning activities during and at the end of lectures, and during the lab. These activities provide time to reflect upon and employ terminology and concepts just learned, and perhaps even more importantly, provide opportunities to build social connections and feelings of positivity. Students who feel more connected to the material as well as to their classmates and instructor tend to be more motivated and are more likely to achieve the education goals. As students struggle primarily with long-answer questions on exams, the instructor plans to introduce activities that provides more exposure to building that skill set and provide realistic expectations of what constitutes a high-quality answer.
EASC 304 Class average for seven lab assignments compared with class average for midterm and final exam. Only the term project is excluded. Allows understanding to be evaluated in casual learning settings versus exam settings. **When did you collect the data?** Fall 2016 – 2021	**EASC 304** Average assignment grade 83.26%, with a range of 81.4 – 86.3%. Average of midterm and final exams 59.7% with a range of 51.3 – 64.8%. The lab environment is not an exam setting. The instructor and the TA circulate to assist students with the assignments. Students often also work together on the lab assignments (although they submit	**EASC 304** The course has been taught by two instructors (Instructor 1: 2016-2019 and instructor 2: 2020-2021). Assignment grades are consistent, as there are well-established marking schemes. The exam grades are more variable with Instructor 2 having slightly lower averages (by ~5%).

	individual assignments for grading). Therefore, the lab assignment grades are high, as might be expected. The midterm and final exam grades are substantially lower and vary depending on instructor. The final exam is largely cumulative, integrating many key concepts introduced throughout the course.	Improvements include incorporation of new software for the term project.
Educational Goal 2: Use scientific method to obtain & critically evaluate scientific information		
Description of Assessment Method(s): **EASC 304** Class averages for assignments 1, 3, 4 and 7. **When did you collect the data?** Fall 2016 – 2021	**Describe Key Findings, Analysis and Interpretation:** **EASC 304** Average grade 83.4%, with a range of 82.2 – 85.7%. Very consistent grades over 6 years. At an upper division level, students are demonstrating a solid grasp of the scientific method for obtaining and critically evaluating scientific data.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 304** No improvements undertaken and none planned.
EASC 309 Lab assignments, short essay reviews of journal articles for all students. **When did you collect the data?** Fall 2019, 2021, 2022	**EASC 309** Lab assignments are designed to provide experiential application of concepts and techniques that complement and enhance understanding of the content covered in lecture. Short essays reviewing assigned journal articles were analyzed from three offerings of EASC 309 (Fall 2019, 2020, 2022). The analysis indicates that in Fall 2019, students were not making clear connections between the assignments (i.e., labs and short essays) and the role played by the scientific method. Although the assignments helped to deepen the students' knowledge and appreciation of the concepts covered in lecture, it was clear that more could be done to enhance their appreciation and ability to apply the scientific method and critically evaluate the merit of that scientific information.	**EASC 309** The instructor revised lab assignments to include questions that provide an opportunity for the students to either apply the scientific method to arrive at their answers, or to better appreciate the role played by the scientific method in developing the concepts and techniques they were learning. Short essay assignments were recast in a more structured manner that required the students to critically consider the scientific questions being asked and evaluate the merit of the data, the resulting interpretations, and the conclusions drawn from the paper. The structure of the assignments also encourages students to consider the role of the scientific method in the development of science expressed in the papers.

Educational Goal 3: Effectively describe, analyse, synthesize, document, and/or communicate scientific findings		
Description of Assessment Method(s): **EASC 304** Class average for the term project **When did you collect the data?** Fall 2016 – 2021	**Describe Key Findings, Analysis and Interpretation:** **EASC 304** Average grade 72.5%, with a range of 64.2 – 79.2%. The term project is a substantive component of the course. Students complete each of the elements of EG3 and submit a comprehensive term project report. A consistent grading scheme is used, and the project is marked by the instructor and two TAs.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 304** The site location for the term project alternates each year that the course is taught, to avoid students "passing along" old project reports. Both site locations result in similar project grades (no bias introduced). Instructors and TAs also have varied year to year (no bias). The grading scheme is appropriate – it has been developed over many years. Improvements include new software introduced in Fall 2018 for the term project, which appears not to have influenced the term project grades. No further improvements are being considered.
Educational Goal 4: Use technical, analytical and/or field skills in a broad range of applications		
Description of Assessment Method(s): **EASC 304** Class average for assignments 1, 3, 7 and the term project. These are the very technical assignments in the course. **When did you collect the data?** Fall 2016 – 2021	**Describe Key Findings, Analysis and Interpretation:** **EASC 304** Average grade 80.5%, with a range of 77.9 – 82.6%. Students have demonstrated strong technical and analytical skills in the course, including design and use of spreadsheets, graphing, problem solving, mapping / contouring, and using specialized software.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 304** As noted under EG3, new software was introduced for the term project in Fall, 2018. No additional improvements are anticipated.
EASC 306 Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.
EASC 308 Observed use of practical skills sets in the field. Students make astute observations in the field, record them in their field notes and then synthesize these into various exercises that mimic what they will do in their professional careers. Students use geophysical equipment and field-proof computer tablets with geologic data (e.g.,	**EASC 308** Students, on average, do better in field school than in their regular lecture/lab courses. They are more engaged and work together as a team. Some exercises proved to be difficult, such as air-photo-based terrain mapping, so changes were made 5 years ago, where in a prerequisite class (EASC 209W; 2017-2019) or in a one-day short	**EASC 308** Air-photo exercise is now given prior to the field school. The one-day short course employed in 2021 will be continued, as students receive information before going into the field and less lecture time is required during the actual field school; this allows students to concentrate on undertaking and completing assignments.

lidar, air-photo images) stored on them. Locations are recorded on the field tablet. **When did you collect the data?** Summer 2017 – 2021 (*N.B.*: no field school in Summer 2020 due to Covid-19 restrictions).	course (2021), students completed a pre-mapping exercise. This was marked and students were provided feedback. The final product in the field school has since improved noticeably.	

Educational Goal 5: Work independently and/or in groups, in the laboratory and/or the field		
Description of Assessment Method(s): **EASC 304** Class average for the term project. **When did you collect the data?** Fall 2016 – 2021	**Describe Key Findings, Analysis and Interpretation:** **EASC 304** Average grade 72.2%, with a range of 64.2 – 79.2%. While students can seek assistance from the TA and the instructor when completing the analysis for the term project, the interpretation and written communication are entirely independent. The average grade appropriately reflects the students' ability to work independently on a major project.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 304** No improvements have been made or are anticipated.
EASC 306 Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.
EASC 308 Observations of student interactions and practical use of skills during field-based projects. Students work in groups of 2 or 3, simulating future professional work. **When did you collect the data?** Summer 2017 – 2021 (*N.B.*: no field school in Summer 2020 due to Covid-19 restrictions).	**EASC 308** Prior to 2021, students were assigned to groups by the instructors, and these were changed during the course for each of the three modules. Some groups worked better than others, and at times there was friction, similar to real life work. Last year, due to Covid-19, students self-selected groups. These groups were more harmonious than in previous years.	**EASC 308** Moving forward we will likely continue with self-selected groups to enhance collaborative interaction and facilitate give-and-take between group members.

Educational Goal 6: Articulate the applications and importance of the Earth Sciences to society		
Description of Assessment Method(s): **EASC 210** Exams, lab assignments, class discussions. **When did you collect the data?** Impending (Fall 2022).	**Describe Key Findings, Analysis and Interpretation:** **EASC 210** The course discusses climate change as recorded in the rock record, including positive feedback loops that drive the rate of climate change. The instructor intends to add more content and discussion that brings attention to the planet's current climate trajectory. One of the most pressing concerns today is sea level rise as a result of global warming.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** **EASC 210** The instructor plans to add a lab activity that shows the effects of sea level rise locally. Using local maps students will map out what the new shoreline will look like depending on the magnitude of sea level rise. Students will see the impacts to communities (including indigenous lands), industry, infrastructure and agricultural land.
EASC 308 On-site class discussions in the field and evaluation in reports. **When did you collect the data?** Summer 2017 – 2021 (*N.B.*: no field school in Summer 2020 due to Covid-19 restrictions).	**EASC 308** Each of the three modules emphasize societal impacts of geoscience. Climate change is integral in the groundwater section. The Cowichan River has numerous users and stakeholders, and with climate change there is less water available. Students see the low river levels in August and discuss issues with stakeholders. Students describe Quaternary sediments at two gravel pits, and the operators explain how aggregate resources are vital for infrastructure construction and agriculture. Permeable sediments and rocks are discussed in the context of migration and storage of fluids such as potable water, oil and gas.	**EASC 308** No improvements are deemed necessary, and no changes are planned.

5) Please use the table below to update your assessment plan for the coming period before your next External Review. Add or delete any rows as needed.

Educational Goal 1: Demonstrate a broad knowledge & understanding of essential Earth materials, features, processes, and history over a range of spatial and temporal scales			
Description of Assessment Methods: **EASC 202** Evaluation of class averages of exams and lab assignments	**What would indicate that students had met the EG?** **EASC 202** Students will demonstrate a sufficient level of understanding of the key course concepts during lab exercises, lab discussions and exam results that would allow them to progress to the next level of the program. At a minimum, students achieving a C- grade or better will have met the EG.	**Is this direct or indirect?** **EASC 202** Direct	**When do you plan to collect data?** **EASC 202** Fall 2022 – 2025
EASC 210 Evaluation of exams and lab assignments	**EASC 210** Students will show an overall improvement in their results on the short- and long-answer questions on exams, as well as basic recall of our basis for understanding the sequential development of the Earth. At a minimum, students achieving a C- grade or better will have met the EG.	**EASC 210** Direct	**EASC 210** Fall 2022 – 2025
EASC 304 Continued evaluation of class averages for seven lab assignments compared with class averages for midterm and final exams. This allows student uptake to be evaluated in casual learning settings *versus* exam settings.	**EASC 304** EG tracking employs combinations of assignments and exams for the EG, which tests the ability of students to employ skills developed in specific assignments. Students have successfully met the EG when they are able to effectively employ these skills to other problem sets in the course assignments and exam questions. At the minimum, students achieving a C- grade or better will have met the EG.	**EASC 304** Direct	**EASC 304** Fall 2022 – 2025

Educational Goal 2: Use scientific method to obtain & critically evaluate scientific information			
Description of Assessment Methods: **EASC 304** Continued evaluation of class averages for assignments 1, 3, 4 and 7.	**What would indicate that students had met the EG?** **EASC 304** EG tracking employs combinations of lab assignments for the EG and integration of data from lecture component of the course, which tests the ability of students to employ skills developed in the previous assignments. Students have successfully met the EG when they are able to effectively employ these skills to other problem sets in the course. At the minimum, students achieving a C- grade or better will have met the EG.	**Is this direct or indirect?** **EASC 304** Direct	**When do you plan to collect data?** **EASC 304** Fall 2023 – 2025
EASC 309 Evaluation of lab assignments, short essay reviews of journal articles for all students.	**EASC 309** In the years 2021 and 2022, wherein the EASC 309 labs and short essay assignments were revamped, the students either directly applied the scientific method (labs) and/or considered the role played by the scientific method when writing short essays on assigned papers. It is clear in the students' responses in the labs and short essays that there is a better appreciation of the scientific method and the fundamental role it plays in the development of science. At the minimum, students achieving a C- grade or better will have met the EG.	**EASC 309** Direct	**EASC 309** Fall 2023 – 2025
Educational Goal 3: Effectively describe, analyse, synthesize, document, and/or communicate scientific findings			
Description of Assessment Methods: **EASC 304** Evaluation of class averages for the term project	**What would indicate that students had met the EG?** **EASC 304** EG tracking employs careful evaluation of the major term project outcomes and integration of data from lecture component of the course, which evaluates students' ability to employ developing skills. Students have met the EG when they have successfully completed the project and received a passing grade. At the minimum, students achieving a C- grade or better will have met the EG.	**Is this direct or indirect?** **EASC 304** Direct	**When do you plan to collect data?** **EASC 304** Fall 2022 – 2025

Educational Goal 4: Use technical, analytical and/or field skills in a broad range of applications			
Description of Assessment Methods: **EASC 304** Class average for assignments 1, 3, 7 and the term project.	**What would indicate that students had met the EG?** **EASC 304** EG tracking employs combinations of lab assignments and term project outcomes and integration of data from lecture component of the course, which tests the ability of students to employ skills developed in the previous assignments. Students have successfully met the EG when they are able to effectively employ these skills to other problem sets in the course. At the minimum, students achieving a C- grade or better will have met the EG.	**Is this direct or indirect?** **EASC 304** Direct	**When do you plan to collect data?** **EASC 304** Fall 2022 – 2025
EASC 306 Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.	**EASC 306** - ?	**EASC 306** Summer 2022 – 2025
EASC 308 Evaluation of students' use of practical skills sets in the field.	**EASC 308** At the minimum, students achieving a C- grade or better will have met the EG. Components of the exercises will continue to be evaluated to determine whether improvement continues.	**EASC 308** Direct	**EASC 308** Summer 2022 – 2025
Educational Goal 5: Work independently and/or in groups, in the laboratory and/or the field			
Description of Assessment Methods: **EASC 304** Evaluation of class average for the term project.	**What would indicate that students had met the EG?** **EASC 304** EG tracking employs careful evaluation of the major term project outcomes and integration of data from lecture component of the course, which evaluates students' ability to employ developing skills. Students have met the EG when they have successfully completed the project and received a passing grade. At the minimum, students achieving a C- grade or better will have met the EG.	**Is this direct or indirect?** **EASC 304** Direct	**When do you plan to collect data?** **EASC 304** Fall 2022 – 2025

EASC 306 Instructor refused to provide data.	**EASC 306** Instructor refused to provide data.	**EASC 306** - ?	**EASC 306** Summer 2022 – 2025
EASC 308 Observations of student-student interactions within field groups and their use of practical skills to solve geoscience problems.	**EASC 308** At the minimum, students achieving a C- grade or better will have met the EG. Evaluation of the practice of self-selection for the working groups to determine whether it is having the desired outcome.	**EASC 308** Direct	**EASC 308** Summer 2022 – 2025
Educational Goal 6: Articulate the applications and importance of the Earth Sciences to society			
Description of Assessment Methods:	**What would indicate that students had met the EG?**	**Is this direct or indirect?**	**When do you plan to collect the data?**
EASC 210 Evaluation of class averages in labs and exams.	**EASC 210** A discussion question on a midterm or final exam (depending on when this is added to the course schedule) will allow students to demonstrate their uptake of the Educational Goal. At the minimum, students achieving a C- grade or better will have met the EG.	**EASC 210** Direct	**EASC 210** Fall 2022 – 2025
EASC 308 Evaluation of the on-site discussions, assignment field notes and submitted field reports.	**EASC 308** Continuing to question students during interactive, field-based discussions, and evaluation of one of the Groundwater or Geophysics modules. At the minimum, students achieving a C- grade or better will have met the EG.	**EASC 308** Direct	**EASC 308** Summer 2022-2025

6) How do you plan on sharing your findings within your unit?

The findings will be shared at the next Department meeting in September 2022.

7) Assessment Timeline

Next External Review: Spring 2025

EASC Assessment Plan

The Department of Earth Science held a retreat on November 13-14, 2021, with the main focus of assessing the EASC undergraduate program via a comprehensive program mapping and EG evaluation of our courses. In preparation for this exercise, the UCC discussed a number of potential options, which required feedback from the department in order to develop a revised Action Plan moving forward. The discussion points are presented below and many of the suggestions agreed to by the department (at the retreat and subsequent department meetings) are now being implemented.

UCC Discussion Points from Nov. 13-14, 2021, Retreat

The EASC UCC identified 6 main areas of discussion:

1) Ensure that the EASC program is complete – no important areas of omission;
2) Grow our undergraduate major numbers (partly a recruitment issue);
3) Increase the interest in completing an EASC minor;
4) Ensure that the EASC program progression is optimized;
5) Increase enrollment in EASC courses, particularly those in the upper division;
6) Have EASC courses included in new developing programs at SFU.

The main topic areas in which to discuss these at the retreat are 3-fold.

1. Educational Goals, Core Competencies/Skills, and Program Mapping

The UCC has spent a fair amount of time looking at the educational goals of the courses in the program. We have a spreadsheet (circulated to all of you) that outlines the metrics used to assess uptake of these Educational Goals (EG) for every undergraduate course in the program.

1) ***Spreadsheet of Course EG*:** These generally show a logical progression of introduction, through intermediate levels of emphasis and reinforcement and ultimately advanced treatment. Feedback?
2) ***EG Evaluation Metrics*:** The spreadsheet also shows a solid underpinning of tests and lab assignments as the dominant metric for evaluation. Obviously, W courses include written material for evaluation. That said, there seems to be a clear indication that during progression from lower division to upper division, there is a concomitant increase in the number of written and oral components that are assessed in the program.
    i. Are more assessments of written and oral components needed in the lower division?
    ii. Should it be stated explicitly that communication skills are part of the competencies expected at the course and/or program level?

3) ***Program Mapping Exercise*:** The EASC majors program separates at the upper division into the Environmental Geoscience Stream and the Geology Stream. Each stream also allows concentrations into 2 informal areas of specialization:

Environmental Geoscience:
Hydrogeology and Water Science; Geo-Hazards and Environmental Applications

Geology Stream:
Petrology and Tectonics; Sedimentation and Stratigraphy

The UCC members and Dr. Diana Allen will deliver a short (5-minute summary) of their discussions with stakeholder faculty in each theme listed above. Ultimately, we need to have a written summary of the outcomes of the mapping exercise and discussions, so that they can be put into the mid-cycle review document for Senate. Key points are whether there are perceived gaps in the program, over-concentration of some subject matter, sufficient overlap between courses and/or reinforcement of concepts from course to course, as well as a logical and progressive increase in the level of detail presented as students progress through the program. While these themed areas are fairly well laid out for the Environmental Geoscience Stream students, it is not clear that the Geology Stream students are aware of the two areas of concentration.

i. The UCC requests that Educational Goals and Expected Competencies be included on all course outlines, and posted on our website.

ii. The UCC suggests that we lay out the themed concentrations for the two streams more clearly so that current and prospective students are aware of them.

4) ***Key Competencies*:** It is clear that there are expected competencies for graduates in the program and right now, those are not clearly laid out in any of materials available to the students.

i. Do faculty teaching in the main subject areas and the two streams feel confident that the expected competencies are being met by the program? The UCC is keen to have feedback from department members as to where they see competencies being met and where they may need expanding or refining.

ii. Should the key competencies expected of graduating students be clearly articulated for each of the two streams? Should they be laid out clearly in our web pages and course outlines?

2. EASC Enrollments

1. ***Student Interest vs. Recruitment*:** The department continues to struggle to attract science-based students to the EASC majors program. Is this merely an issue of recruitment, or are there aspects of the program that make us appear unattractive?

i. There is the suggestion that student interest in the geosciences has shifted fundamentally away from non-environmental issues and specifically away

from resources and resource extraction. This affects both incoming students and our EASC majors, so far as uptake of electives.

a) Is this merely a function of poor communication about possible career paths, or that there is a balance between safeguarding the environment and extraction of resources, *etc*.?

b) Is this simply a reflection of the current job market? Is this a deliberate and likely ongoing move in the interests of the current generation of students?

ii. There has been a suggestion to downplay or offer less frequently non-environmental geology stream elective courses and bolster offerings of environmental geoscience and 10X-level breadth courses, at least until student interest shifts. Others have argued that regardless of current interest that we strive to offer the widest range of courses and most balanced program possible, regardless of enrollments. Discussion?

iii. Indigenous issues are likely to become increasingly important in light of our path towards Truth and Reconciliation. It is crucial that the department actively seeks to be a part of this cultural evolution.

a) Are there ways to include indigenous content in our program (for example First Nations oral tradition, Environment Government and Stewardship, *etc*.)?

b) Can we better outline the necessity of engaging with First Nations groups, particularly with respect to issues of the effective governance of resource extraction, land access, land use, *etc*.?

c) How can we encourage First Nations students to consider undertaking an EASC major?

iv. Equity, Diversity, and Inclusiveness (EDI) is an increasingly important aspect of cultural evolution and an topic of concern for students leaving high school.

a) Are there any ways to include aspects of EDI in any of our courses?

b) Are there ways to highlight this as an aspect of the department from the perspective of student recruitment?

v. While not strictly a *curriculum issue*, another way of recruiting students to and retaining them in the majors program might be to offer required and/or optional workshops (synchronous, asynchronous and/or in person) that contribute to their professional development. For example, the department might make arrangements for workshops surrounding indigenous sensitivity (see point iii) and EDI (see point iv), as well as bullying issues, among others to our majors. Such workshops might be optional or could be required. Currently, students commonly take required workshops on plagiarism and academic integrity as part of their access to some EASC courses posted on Canvas. Students could list these on their CVs as part of their professional development and should be encouraged to do so.

Likewise, having workshops on indigenous issues and EDI listed as professional development on student CVs might be seen as both positive and progressive. From a practical perspective, offering required or optional workshops (free or heavily subsidized) on wilderness first aid, selection of career paths, course planning and program progression, *etc*., could be attractive to students considering a career in the Earth sciences. Discussion?

vi. A number of majors come to EASC by "accidentally" taking an EASC 10X course and then deciding that they like the topic. Currently, no 100-level course other than EASC 101 can be taken as part of the program requirements. Students, however, can certainly take any of those 10X courses as part of their *total* lower division units as well as serving as a breadth requirement. The text indicating that none of these 10X courses can be used as program requirements is uduly negative and may make prospective students feel that those credits are "wasted".

a) The UCC recommends removing the negative wording surrounding the non-program 100 level courses offered by the department. Discussion?

2. *EASC Upper Division Enrollments*: These are the most problematic, given the plethora of electives and the splitting of students into smaller groups for each of them. We need to revisit how to improve uptake of our upper division courses by majors. There are a number of ways that come to mind, each of which needs departmental feedback.

i. Eliminate some GEOG upper division electives in the two streams. Currently 12 units (3 courses) can be taken in Environmental Geoscience Stream from a group of 9 GEOG courses. No limit is indicated in the Geology Stream, but only 2 GEOG courses are available as electives (so effectively up to 8 units). Students who take 12 units in GEOG are effectively eliminating 4 EASC courses from their upper division training in the Environmental Geoscience Stream and 2 EASC courses in the Geology Stream.

a) The UCC has identified four GEOG courses that appear to provide content of value to our majors and which could be made available to both streams: GEOG 311 (Hydrology), GEOG 313 (River Geomorphology), GEOG 353 (Advanced Remote Sensing), and GEOG 355 (GIS II). Discussion?

ii. Another avenue to increase EASC upper division course uptake is to reduce the maximum number of courses that can be taken from GEOG as program requirements. This would be easier than reducing the total number of units, as GEOG courses are 4 credits. This will guarantee the uptake of at least one more EASC course in the two streams. One option is to reduce the total number of GEOG courses in Geology Stream to one, and the total number of GEOG courses in the Environmental Geoscience stream to either one or two. Discussion?

a) The UCC recommends that we limit the maximum number of GEOG courses taken as program electives in each stream to a total of one. This will increase EASC upper division courses by one in the Geology Stream and two in the Environmental Geoscience Stream.

iii. A suggestion has been made that there is an insufficient number of upper division EASC courses (particularly Environmental Geoscience-oriented EASC courses) offered in the fall semester, leading to students choosing to take GEOG elective courses in that semester. This is not likely impacting the Geology Stream. However, there may be potential barriers for the uptake of EASC upper division courses by Environmental Geoscience stream students in the fall semester.

a) The UCC recommends that the department strive to ensure that there is a balance between upper division offerings in the fall and spring semesters. Discussion?

iv. It is likely that one of the barriers to students taking courses in the upper division across streams is the list of prerequisites. One suggestion is to revisit the prerequisite lists and ensure that only those courses absolutely needed are listed as prerequisites, rather than providing a "preferred" list. Obviously, any course that only needs lower division prerequisites poses no barrier to students in either stream, but currently having a number of 3rd year prerequisites may very well limit student access from the other stream. This has been indicated to be one of the barriers to Environmental Geoscience students taking a number of geology-focused courses in upper division.

a) The UCC requests that all instructors revisit their prerequisites in their upper division courses, with an eye to ensuring that only essential courses are listed and with the aim of trying to facilitate uptake from the other stream.

v. One possibility for increasing enrollment into upper division EASC courses is to expand the number of "all of" or "at least # of" courses in each stream that would serve students in either stream? For example, EASC 304 (Hydrogeology), EASC 305 (Quantitative Methods for the Earth Sciences), EASC 313 (introduction to Soil and Rock Engineering, or EASC 403 (Quaternary Geology) would be of value to most Geology Stream students, regardless of career path. Likewise, EASC 301 (Igneous Petrology), EASC 302 (Sedimentary Petrology), EASC 305 (Quantitative Methods for the Earth Sciences), and EASC 309 (Global Tectonics) would be of value to Environmental Geoscience Stream students. We could make a list of 6 or so courses (3 in each stream) that rather than being designated "at least one of" might be changed to "at least two of" "at least three of" or even "all of". There are other combinations possible, of course. The elective list and total units would then be amended accordingly. In order to do this, of course, prerequisites would need to be set up that would allow easier access to

students from the other streams or that those prerequisites are also required by the other stream.

a) Discussion?

vi. Another possibility of increasing student uptake in some upper division geology courses is to introduce some environmental content into them, in order to make them more attractive to our Environmental Geoscience majors. Possibilities might be discussing the pros and cons of fracturing reservoirs, merits of CO_2 sequestration, issues of mine drainage and land remediation, or stratigraphy/subsurface mapping and impacts on geo-technical issues. There may be other aspects as well.

a) The UCC suggests that if there are ways to include aspects of environmental or societal content into courses that faculty should make an effort to do so.

3. EASC Course Offerings, Progression and Program Streamlining

1. ***Delivery of the Program with Reduced Faculty:*** It appears clear that not all retiring faculty will be replaced or not replaced in the near future. We need to discuss ways in which the program (in whatever form it ultimately takes) can be offered with a reduced faculty complement.

   i. Some upper division elective courses can be either put on an inactive list for a time, or only offered every 3 rather than every 2 years.

      a) What are the positive and negative impacts of delivering some upper division courses tri-yearly? Discussion?

   ii. It may be that we will have to consider eliminating one or more upper division courses. Discussion?

2. ***Program Streamlining*:** There are some options for facilitating progression and streamlining the program to accommodate a reduced faculty complement.

   i. EASC 206 Field School 1:

      a) It has been suggested that we remove EASC 206 from the program. Do faculty see value in continuing to offer 3 field schools, or can the content of EASC 206 be included into field trips and lab assignments of existing lower division courses?

      b) It has been suggested that EASC 206 be delivered across the entire semester with expanded content with a lecture component with both field-based and lab-based assignments. One option is to increase EASC 206 to a 3-credit course. The other is to allow it to remain a 2-credit course. Additional course content might include some of that currently provided in GEOG courses in our electives list (*e.g.*, soil science, intro to GIS, field methods for terrain analysis), and/or might introduce students to aspects of hydrogeology, *etc*. As such, an expanded EASC 206 could

introduce students to a broader range of experiential learning that would allow students to make a more informed choice as to which of the two streams they may wish to pursue. Discussion?

ii. Delivery of EASC 301, EASC 302, EASC 311 content:

a) Given that we no longer have a metamorphic petrology specialist and may not see a replacement any time soon, it has been suggested that the EASC 301 course return to an Igneous and Metamorphic Petrology course. This could then see the Geology Stream being required to take both EASC 301 and EASC 302 as program requirements, as was done in the past.

b) An alternative for dealing with the petrology content is to replace all three petrology courses (EASC 301, 302 and 311) with two courses – Petrology 1 and Petrology 2. In Petrology 1, students would take streamlined content from EASC 301 and the siliciclastic portion of EASC 302. In Petrology 2, students would take streamlined content from the carbonate part of EASC 302 and content from EASC 311. These two courses would be team taught and would be required by all Geology Stream students. We could also consider making one or both required in the Environmental Geoscience Stream as well.

c) A third alternative is to keep the system as we currently have it – 3 discrete courses, with EASC 311 only offered when there is a faculty member (or sessional) available to teach it. Discussion?

iii. EASC 305 (Quantitative Methods for the Earth Sciences) could be developed to include a range of statistical and GIS components, MatLab, Leapfrog and/or Petrel and/or GeoScout, and other programming content. This would be of relevance to surface and subsurface mapping and allow uptake for a range of other upper division courses. Broadening the content would make the course relevant to students in both streams, and might form the basis of including this as either a required upper division course or its inclusion into a "at least x of" electives list. Discussion?

iv. It is possible that the W component in our upper division courses are not ideally placed. Currently they are assigned to EASC 310W (Paleontology) and EASC 315W (Geochemistry of Natural Waters).

a) Should the W component be moved to another course or other courses? Is there an upper division course that we might identify to be required by both streams that might be also suited to W designation?

b) If we remove the W designation EASC 310, should we also remove EASC 310 from the required list for the Geology Stream? Discussion?

3. ***Field Course Content*:** There have been some questions as to the scope of the different field schools and whether the full range of geoscience field techniques are being addressed. The UCC feels that it is helpful to remind faculty as to the content being offered in each of the field schools.

    i. **EASC 206: Lectures and Field Excursions to Merritt, BC.** Introductory field course addressing field techniques (map reading, navigating, use of compass), field safety and field etiquette, description of igneous, sedimentary and metamorphic rocks, recognition of structural elements (faults, folds, joints, mineral lineation), measuring sections, taking field notes, discussing landscape evolution and geomorphology, discussion of water resources/water use, issues of natural hazards, interpretation of field data, understanding geology of southern BC.

    ii. **EASC 306: Lectures and Field Work in the Okanagan area, BC.** Intermediate-advanced field school course, focused on reinforcing rock description skills, applications of mineralogy, igneous and metamorphic petrology, sedimentology, structural geology and tectonics to field investigations, measuring of sections, and geological mapping. Students visit a copper mine as an introduction to ore deposits, and are introduced to the use of geochronology and thermochronology for understanding burial and exhumation histories and the geological evolution of southern BC. Recognition of field hazards and reinforcement of field safety protocols and field equipment use. Development of field party collaboration/management and professional conduct in the field. Student oral presentations of selected outcrops required during the course. Educational goals, competencies and metrics for evaluation are laid out clearly.

    iii. **EASC 308: Lectures and Field Work to Cowichan Lake area, Vancouver Island.** Intermediate to advanced field school course. Course broken into 3 modules, addressing environmental field applications.

        a) *Quaternary and Terrain Mapping* module has students working in small groups, reinforcing skills in sediment description, paleocurrent indicators, traverse planning, field traverses, evaluation of landscape geomorphic evolution, logging, drafting and interpreting stratigraphic sections, use of lidar data and air photos for terrain mapping, and integration of these data to understand the glacial history of the area.

        b) The *Applied Hydrogeology-Geophysics* module focuses on plotting out the groundwater table from well surveys and river locations, introduction in how pump tests and slug tests are undertaken, logging of well cuttings into a measured section, collection and interpretation of EM and magnetometer data. Module includes discussion of issues associated with regional groundwater systems, perched aquifers, and local water use in the area (e.g.,

groundwater well use, lake use by residents, river use by residents, fishing, pulp mill, *etc*.).

c) The *Applied Sedimentology* module has students working in small groups, focused on sedimentary outcrop descriptions of conglomerate, sandstone and mudstone, bed thickness measurements, identification of physical sedimentary structures, trace fossils and fossils. Students construct graphic lithologs for measured sections and provide depositional interpretations, identify facies, employ Walther's Law, and identify facies associations. Students use stratigraphic sections and a depositional model to predict facies distributions elsewhere in the Georgia Basin. Some years, students visit Sombrio Beach and undertake clast fabric analysis, quantitative assessment of these data and discuss implications of designing coastal defenses.

d) Are there aspects of the field school content that could be expanded/improved? How is the field school content going to be delivered with a reduced faculty complement as we go forward?

EASC Revised Action Plan

In light of feedback on the Assessment Plan at the Nov. 2021 retreat, further discussions within the EASC UCC and at departmental meetings in 2022, the UCC is moving forward with implementation of a number of changes to the program.

1. **Reassessment of Prerequisites within the EASC Program**
    - Faculty have been approached to re-evaluate the prerequisites assigned to their courses, particularly in the upper division, with an eye to streamlining student progression. Two course change forms have already gone forward for the upcoming calendar and several other courses are in the process of being changed.
    - The joint major with Chemistry is being streamlined as part of a larger EASC program optimization. A number of courses are no longer offered in CHEM and these will be removed from the joint-program. The UCC is tasked to address this.
2. **Adding Additional "Required" Courses in the UD of the EASC Program**
    - Stakeholder faculty are to be consulted about the merits of including courses deemed to be bottlenecks in program progression (particularly for cross-pollination between the department streams) as required courses in the upper division. This work in ongoing.
3. **Reassessing the Role of W Designations in the EASC Program**
    - The UCC is directed to consider whether there is sufficient writing components in the lower division courses and whether the W should remain on EASC 209.
    - The UCC is directed to determine whether the W designation should remain on EASC 310 and EASC 315. The UCC is to consider whether another required course would be better suited to bearing the W designation, or whether a stand-alone technical writing course should be included in the upper division as a required course.
4. **Including EG and Key Competencies on Course Outlines and EASC Web Pages**
    - The UCC is directed to ensure that faculty members clearly articulate the EG and expected competencies for each course. The department is to ensure that these are included on EASC web pages.
    - The UCC is to ensure that the expected competencies in each of the two streams that lead Professional Geoscientist registration are communicated on EASC web pages.
5. **Expanding Recruitment into the EASC Major and Minor Programs**
    - The UCC is to liaise with the Recruitment Committee to continue to explore avenues for expanding recruitment into the EASC programs. This includes, but is not limited to advertisement around the university, discussions with high-school guidance counsellors, showcasing positive environmental issues related to an education in Earth Sciences, garnering feedback regarding students' interests, *etc*.

- The UCC will modify the Minor requirements to provide greater detail to students so that they better understand the options and thematic areas available.

6. **Expanding Education and Awareness within the EASC Department**
    - The UCC is to continue to investigate the possibility of introducing non-credit "workshops" for faculty, staff, undergraduate students and graduate students in various subject areas such as EDI awareness, sensitivity surrounding Truth and Reconciliation, issues of land use and its stewardship, bullying, wilderness first aid, etc. The merits of some of this content being made asynchronously is to be explored.
7. **Re-Assess Lower Division Lecture/Lab Courses**
    - The UCC is to remove negative wording in the EASC Program associated with the non-program 100 level courses.
    - The UCC is to revisit the merits of online Breadth courses, and establish a priority list of courses for on-line development and bring these to the department for approval.
    - The UCC is to look at ways of permitting EASC majors to use one 100-level course in addition to EASC 101 as part of their program requirements.
    - The UCC is to discuss with stakeholder faculty the merits of modifying the EASC 206 field school, with an eye towards expanding its content and making it worth 3 units, modifying its delivery, or removing it from the program. The UCC is to bring a recommendation to the department, once stakeholders have been consulted.
8. **Re-Assess Non-Departmental Upper Division Courses in the Elective List**
    - The UCC is to critically assess the current non-departmental course offerings in the upper division electives list. The UCC is to make recommendations as to which courses should be retained and whether courses offered by other departments (e.g., REM) might also benefit EASC majors.
    - The UCC is directed to submit program changes that reduce the total number of units taken in each of the streams from outside the department, to ensure EG and competencies expected in the program are being met. The UCC is to ensure that only 6 units can be used as program requirements for the Environmental Geoscience Stream and 3 units can be used as program requirements in the Geology Stream.
9. **Re-Assess Departmental Upper Division Courses**
    - The UCC is to evaluate the merits of making EASC 305 (Quantitative Methods for the Earth Sciences) a required course in the upper division. The UCC is to discuss with stakeholder faculty the scope of course content and skill set development needed to make it relevant and valuable to EASC majors in both streams.
    - The department is to ensure that scheduling of upper division courses continues to provide students in either stream sufficient options for progression. Mentors and advisors are to remind students to carefully assess prerequisites for upper division courses to ensure that they are able to enrol in them.

- Faculty are encouraged to consider addition of content in their courses relevant to societal and environmental concerns. While it is recognized that this is front-and-centre in most courses in the Environmental Geoscience Stream, it is clear that many of the Geology Stream courses likewise touch on such issues.

10. Re-Assess the Teaching of Petrology in the Upper Division

- The UCC is to discuss with stakeholder faculty issues surrounding the delivery of igneous, sedimentary and metamorphic petrology. The UCC is to consider the merits of delivering streamlined content currently being taught in the three upper division petrology courses (EASC 301, EASC 302 and EASC 311) into two 3-unit courses (Petrology 1 and Petrology 2).
- The UCC is directed to communicate with the student body *via* a Townhall the possibility of this merging and get their feedback.
- The UCC is to return a recommendation to the department for discussion and a vote.

EASC Undergraduate Course Mapping

Program EGs ->	Demonstrate a broad **knowledge** & **understanding** of essential Earth materials, features, processes, and history over a range of spatial and temporal scales				Use the **scientific method** to obtain & critically evaluate scientific information				Effectively **describe**, analyse, synthesize, document, and/or **communicate** scientific findings				Use technical, analytical and/or field skills in a broad range of applications;				Work independently and/or in groups, in the laboratory and/or the field;				Articulate the applications and importance of the Earth Sciences to society			
Courses for All Majors	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures	1) EG Statement I E	2) Level I E R A	3) Direct Measures T W P L	4) Indirect Measures
101: Dynamic Earth	E	I	T,W		E	I	T,W		E	I	T,W		I	I	T,W		I	I	T,W		E	I	T, W	
201: Strat & Sed	E	E	T,L		E	E	T,W,L		E	E	T,W,L		E	I	T,L		I	I	T,L		I	I	L	
202: Intro Mineralogy	I	E	T,L		I	I	T,L		E	I	T,L		E	E	T,L		I	E	T,L		E	E	T,L	
204: Struct Geol I	E	I	T, L		E	E	T,L		E	E	T,L		E	E	T,L		E	E	T,L		E	E	T,L	
205: Intro Petrology	I	E	T,L		I	E	T,L		E	I	T,L		E	I	T,L		I	I	T,L		E	E	T,L	
206: Field Geol I	E	E	T, L		I	E	T, L		E	E	T, L		I	E	T, L		I	E	T, L		I	E	T, L	
207: Intro Applied Geophys	E	I	TL		I	I	TL		I	I	TL		E	I	TL		I	I	L		I	I	TL	
208: Intro Geochem	E	E	T,L		I	I	T,L		E	I	T,L		E	I	T,L		E	I	T,L		I	I	T,L	
209W: Enviro Geosci	E	E	T, P, L,		I	E	T, L		E	R,	W, P, L		E	E	T, P, L		E	E	L,P		E	E	T, L	
210: Evolving Earth	E	E	T, L		I	E	T, L		E	E	T, W, L		I	E	T, L		I	E	T, L		E	E	T	
306: Field Geol II	E	A	T,W, O, P		E	A	T,W, O, P		E	A	T,W, O, P		E	A	T,W, O, P		I	A	T,W, O, P		I	I	T,W, O, P	
308: Field Geol III	E	A	W,P		E	A	W,P		E	A	W,P		E	A	W,P		E	A	W,P		I	R	W,P	
301: Igneous Pet	E	R	T,L		E	R	T,L		E	R	T,L		E	R	T,L		I	R	T,L		I	I	T,L	
302: Sedimentary Pet	E	R	T,L		E	R	T,L		E	R	T,L		E	R	T,L		E	R	T,L		I	I	T,L	
309: Global Tectonics	E	R	T,L, W, O		E	R	T,L,W,O		E	R	T,L,W,O		E	R	T,L,W,O		E	R	T,L,W,O		I	E	T,L,W,O	
310W: Paleontology	I	R	T, W, L		I	R	T, W, L		E	R	T, W, L		E	R	T, W, L		E	R	T, W, L		E	R	T, W, L	
311: Metamorphic Pet	E	E	T,L		I	R	T,L		E	R	T,L		E	R	L,W		I	E	L		I	E	T,W	
305: Quantitative Methods	E	A	T,P,L		E	R	T,P,L		E	R	T,P,L		E	R	L,P		E	A	L		I	E	T,P	
307: Applied Geophysics	E	E	T,L		I	I	T,L		E	E	T,L		E	I	T,L		I	E	T,L		I	E	T,L	
312: Stratigraphy	E	R	T,W,L		E	R	T,W,L		E	R	T,W,L		E	E	L,W		E	A	L,W		I			
314: Principles Glaciology	E	I	T,W,L		I	E	T,L		I	E	T,W,O,L		E	I	T,L		I	R	T,W,O,L		E	E	T,W,O	
317: Global Geophysics	E	E	T,L		E	I	T,L		E	E	T,L		E	I	T,L		I	E	T,L		I	E	T,L	
304: Hydrogeology	E	A	T,W, L		E	A	W, L, P		E	A	P		E	A	W, L, P		I	A	P		I	R		
313: Intro Soil & Rock Eng	E	A	T,W,L		I	A	T,W,L		E	A	T,L		E	A	L,W,T		I	A	L		I	R	L,T	
315W: Geochem Nat Waters	E	R	TWL		E	R	TWL		E	E	WL		E	E	L		E	R	L		E	E	WL	
403: Quaternary Geology	E	A	T, W,O,P,		E	A	T,W,O,P,		E	A	T,W,O,P		E	A	T,W,O,P		E	R	W,P		I	R	W,O,P	
401: Mineral Deposits	E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		I			
402: Sedimentology	E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		E	A	T,W,O,P,L		I	R		
404: Stucture II	E	R	T,L,O		E	A	T,L,O		E	A	T,L,O		E	A	T,L,O		E	A	T,L,O		E	A	T,L,O	
405: Water Env & Clim Ch	E	A	W,O,L,P		E	A	W,L,P		E	A	W,O,L,P		E	A	L,P		E	A	O,L,P		E	A	W,O,L,P	
408: Reg Geol W. Can.	E	R	T,L,W,O		I	A	T,L,W,O		E	A	T,L,W,O		E	A	T,L,W,O		E	A	T,L,W,O		I	A	T,L,W,O	
410: GW Contam & Trans	E	A	T,W,O,L,P		E	A	T,W,O,L,P		E	A	T,W,O,L,P		E	A	L,P		E	A	W,O,L,P		E	A	W,O,P	
411: Terrain Analysis	E	A	T,W,O,P,L		E	A	T,W,O,L,P		E	A	T,W,O,P,L		E	A	T,W,O,P,L				W,L,P		E	A	T,W,O,P,L	
413: Resource Geotech	E	A	T,W,O,L,P		E	A	T,W,O,L,P		E	A	T,W,O,L,P		E	A	W,L,P				W,L,P		E	A	W,L	
415: GW Modelling	E	A	W,L,P		E	A	W,L,P		E	A	W,L,P		E	A	L,P		E	A	L,P		E	A	W,P	
416: Field & Lab Hydrogeol	E	A	W,P		E	A	W,L,P		E	A	W,P		E	A	W,L,P		E	A	W,P		E	A	W,L,P	
420: Petroleum Geol	E	A	T,O,P,L		E	A	P,L		E	A	T,O,P,L		E	A	T,P,L		E	A	P,L		E	A	O,P,L	
421: Volcanology	E	A	T,L		E	A	T,L		E	A	T,L		E	A	T,L		E	A	L		E	A	L	

Required both Streams

Required Geology Stream

Required Env Geoscience Stream

Electives

Courses to monitor: 202, 210, 304, 306, 308, 309

The university, your faculty, and/or your unit may have a number of broad educational goals for all their program offerings and courses, such as: Critical Analysis, Research Skills, and Critical Expression. If you don't have unit level educational goals, proceed with defining your program level educational goals in the next row.

PROGRAM LEVEL EDUCATIONAL GOALS

At the program level you can define the components of your educational goals. For examples that students should be able to "critically assess and interpret primary and secondary sources," "produce an effectively written analytical research paper based in research of primary sources," and so on.

EG STATEMENT (Column 1)

The program EG is (E) EXPLICITY or (I) IMPLICITLY stated in the course syllabus as being one of EGs for this course.

LEVEL OF CONTENT DELIVERY (Column 2)

(I) INTRODUCES- Students are not expected to be familiar with the content or skill at the collegiate or graduate level. Instruction and learning activities focus on basic knowledge, skills, and/or competencies and an entry-level complexity.

(E) EMPHASIZES- Students are expected to possess a basic knowledge and familiarity with the content or skills at the collegiate or graduate level. Instruction and learning concentrates on enhancing and strengthening knowledge, skills, and expanding complexity.

(R) REINFORCES- Students are expected to possess a strong foundation in the knowledge, skill, or competency at the collegiate or graduate level. Instructional and learning activities continue to build upon previous competencies and increased complexity.

(A) APPLIES- Students are expected to possess an advanced level of knowledge, skill, or competency at the collegiate or graduate level. Instructional and learning activities focus on the use of the content or skills in multiple contexts and at multiple levels of complexity.

DIRECT MEASURES (Column 3)

Students are asked to demonstrate their learning on the goals through tests (**T**), written work (**W**), oral presentations (**O**), and/or projects (**P**) and laboratory (**L**) are provided with formal feedback. In some cases, individual departments have tailored this legend to include discipline-specific EGs.

INDIRECT MEASURES (Column 4)

Indirect Assessment gathers perceptions of whether/how well students are achieving/have achieved a program goal. Examples of indirect assessment include alumni, employer, and student surveys, exit and focus group interviews, enrolment and retention data, and job placement data. Indirect assessment complement the data collected from direct measures and cannot stand alone as sole measures of student performance.

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MEMORANDUM

ATTENTION:	Glyn Williams-Jones, Chair, Earth Sciences
FROM:	Elizabeth Elle, Vice-Provost, Learning & Teaching (for SCUTL)
RE:	EASC Mid-cycle Educational Goals Assessment
DATE:	June 17, 2022

The Senate Committee for University Teaching and Learning has recently been charged with providing feedback to units in their mid-cycle assessment of Educational Goals. Here we note a number of positive things your department is doing, along with some suggestions for how you might leverage this process to support your departmental goals without the work becoming burdensome to faculty.

Earth Sciences has taken a collaborative approach to setting and assessing educational goals, with a combination of what looks like a strong partnership between Chair Williams-Jones and UCC Chair MacEachern, and engagement with the whole department at a retreat, with special attention paid to the different streams within the department. EASC has done the additional work to identify course-level EGs and to map the curriculum, which is an incredibly useful tool for understanding the program. In fact, the unit apparently was able to use the map to help rationalize their pre-requisites, a useful way to help students progress through the degree. Earth Sciences is to be commended for all their work thus far.

There are some areas where SCUTL recommends further thought.

- Currently, the department is using information of 6 carefully chosen courses to assess their EGs. This is a sound approach as it's based on what is done within the courses and how those courses are placed within the curriculum map. However, the main focus is to use average grades, either for whole assignments or whole courses. Unless a particular assignment or a whole course is focussed on only a single EG, however, the information gained from grades is not very useful and only weakly related to what you wish to know. Sometimes it's better to use particular questions on a test, or particular assignments (like a lab report). If your faculty are using marking rubrics, you might get rich data from those rubrics (better than the average on an assignment, which likely includes much more than the EG you are interested in). We think you can collect less, but more thoughtfully chosen data, that is better aligned with what you want to know. That would be a better use of the most limited resource, your time.
- Related to the first point, although you describe the learning activities and were very thoughtful about including this in your curriculum map (thank you!), it appears you haven't yet determined how students might demonstrate their performance on EGs through those activities (with EG 6 an exception). It may be that further stratifying the way assignments are used and more directly connecting them to your goals will be useful.

- It's clear that instructors of the courses included in the assessments are reflecting on what they are learning, and making improvements to their courses, which is great. What is less clear from your documents is whether you have taken what has been learned from the six courses and used it to reflect on the whole program, which is the intention of having program-level EGs. It would be appropriate for you to consider how you might, over the next cycle, connect what you are learning from the focal courses to the program.
- At the moment, your EGs are quite broad, and it may be helpful to make them more specific, or for fewer EGs of greatest interest define sub-goals that would be your actual focus. A few examples from our committee. You have working in groups in EG5; perhaps you might be more interested in whether they work well in groups to produce a certain kind of project or have a certain kind of skill -building experience? For EG4, on application, would it be useful to consider specific skills? Would students benefit from articulating how they employed particular skills/problem solving strategies / group thinking to undertake challenging problems/activities? If Earth Sciences wanted to narrow the focus of assessment to fewer EGs moving forward, the field schools provide important opportunities for the students to demonstrate their attainment of a range of EGs in an integrated and authentic way. It may be, for instance, helpful to assess and briefly detail ways in which students' work on the final product has improved over time.

Finally, if you could use any additional support, please reach out to the Learning Experiences Assessment and Planning group in my portfolio (email them at: leap@sfu.ca). I've added people to the team with expertise in assessment and survey analysis, and they are here to help you. And of course I'm more than happy to discuss this memo and your future endeavors with you.