SFU OFFICE OF THE PROVOST AND VICE-PRESIDENT ACADEMIC

vpacad@sfu.ca
www.sfu.ca/vpacademic
TEL: 778.782.3925
FAX: 778.782.5876

8888 University Drive
Burnaby, BC
Canada V5A 1S6

MEMORANDUM

ATTENTION	Senate	**DATE**	February 12, 2025
FROM	Dilson Rassier, Provost and Vice-President Academic, and Chair, SCUP	**PAGES**	1/22
RE:	External Review Mid-Cycle Report for the Department of Physics (SCUP 25-22)		

At its meeting on February 5, 2025, SCUP reviewed and approved the External Review Mid-Cycle Report for the Department of Physics that resulted from its 2021 External Review.

The following documents are attached for the information of Senate:

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

C: Levon Pogosian, Chair, Department of Physics
Angela Brooks-Wilson, Dean, Faculty of Science

SFU OFFICE OF THE PROVOST
AND VICE-PRESIDENT ACADEMIC

8888 University Drive, Burnaby, BC
Strand Hall, Room 3000
Canada V5A 1S6

TEL: 778.782.5731
FAX: 778.782.5876

vpacad@sfu.ca
www.sfu.ca/vpacademic

MEMORANDUM

ATTENTION Dilson Rassier, Chair, SCUP
DATE December 13, 2024
FROM Peter Hall, Vice-Provost and Associate Vice-President. Academic
PAGES
RE: External Review Mid-Cycle Report for the Department of Physics

The External Review of the Department of Physics was undertaken in March 2021. 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 action plan update has been reviewed by the faculty dean. The Senate Committee on University Teaching and Learning (SCUTL) has provided constructive 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:

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

c: Levon Pogosian, Chair, Department of Physics
Angela Brooks-Wilson, Dean, Faculty of Science

SFU FACULTY OF SCIENCE | DEPARTMENT OF PHYSICS

TO:	Peter Hall, Vice-Provost and Vice-President, Academic	**FROM**:	Levon Pogosian, Chair Department of Physics
RE:	Physics External Review Mid-Cycle Report	**DATE:**	November 5, 2024

Dear Peter,

Please find attached the completed External Review Mid-Cycle Report for the Department of Physics. Feel free to contact me if you have any questions.

Sincerely,

Levon Pogosian

SFU SIMON FRASER UNIVERSITY

External Review Mid-Cycle Report

Section A

To be completed by the Responsible Unit Person, e.g., Chair or Director

Unit Under Review: Department of Physics

Date of Review Site Visit: March 2 – 5, 2021

Responsible Unit Person: Levon Pogosian

Faculty Dean: Angela Brooks-Wilson

ACTION	PROGRESS MADE
1. PROGRAMMING	
1.1 **Action(s) to be taken**	
Undergraduate: A. Recruitment: We will emphasize what makes SFU Physics unique in our recruitment efforts including: Co-op, research opportunities for undergraduates, involvement in the Quantum Algorithms Institute, and our welcoming department culture. We will expand recruitment efforts to attract students from across BC and Canada. We will hold recruiting events for students in the new FIC Science stream.	We organized yearly in-person on-campus Discover Physics@SFU events for Grades 10-12. We organize visits by our current undergrads to high school to share their SFU Physics experience . We hold yearly BC teachers workshop. We have revived our Departmental Instagram account and have increased our activity on existing social media channels We have held a colloquium by the physics instructor at FIC, Peter Smith, and planning a recruitment event. We are collaborating with QAI on developing our quantum curriculum.

B. Program Review: We currently review programs on a regular basis, with the last review conducted in 2018-2019. We will continue our practice of regular reviews, aiming to achieve a major review once every external review cycle. • During the next review, we will focus our review on assessing whether the objectives of our programs may be accomplished using options currently offered within the SFU system that have less administrative overhead. • To accomplish this, we will first review the options currently offered within the SFU system. • We will review and update learning path/program information on our website for students. • We will complete work currently underway on a joint program in Physics and Computing Science. • We will conduct a survey of students and graduands to identify strengths and weaknesses of the way our programs are set up.	We conducted a thorough teaching efficiency review in 2024, and plan to do it on a yearly basis, to evaluate the purpose and the need for each of our courses. In 2024, we conducted a survey of our undergraduate graduands and leavers (students who left Physics before graduating) and learned about their experience with Physics and how we can improve our program. We will conduct a survey among current students in PHYS 201, Undergraduate Seminar. We are in the process of conducting a comprehensive update of our website
C. Co-op: Co-op is currently promoted in PHYS 201, and participation has increased since the introduction of this course in 2015. • We will ensure that students understand that working in an academic research lab can be counted as co-op and that, by doing 2- or 3-semester long appointments, it is possible to complete co-op credentials in one year. • We will conduct a survey of co-op students and graduands to help us identify areas for improvement. In particular, is SFU co-op actively helping our students to get jobs? • We will also discuss with SFU Co-op the possibility of a tiered fee scheme that may be more attractive to academic/research minded students. There are payment equity issues around co-op positions in academic labs vs industrial ones that are not being accounted for.	Co-op is encouraged at our orientation events, PHYS 201, and through the undergraduate advisor. Combining USRA and Co-op – made USRA count for Co-op. Co-op office at SFU suffered from admin staff cuts and this affects their ability to assist students in preparing strong applications.

D. Degree completion: We will investigate whether course availability is hindering completion times. We will also assess the effect of enrollment in the co-op program on completion times.	We were encouraged by the Dean to reduce our course offerings as much as possible, and eliminate low enrollement course. This introduced new challenges to completion time as not all courses would be offered every year, and students sometimes need to wait. We are working on simplifying our 2nd year curriculum, which has been identified as being too crowded. We eliminated PHYS 432, Advanced Lab, which used to be a required course, to improve completion times.
E. Data collection: • The IDEA team is collecting data to assess success, as measured by completion times, cGPA, co-op participation, etc., and compare this to a range of demographic information. • ORSEC will develop an exit survey to collect program feedback and contact info from graduands and early leavers.	The graduands and leavers survey has been conducted. Lessons learned and discussion in progress on how to make it more useful.
F. Surrey campus: We will work with the Faculty of Science to create (or promote if it already exists) a first-year Surrey cohort.	Enrolments in PHYS 102 in Surrey have declined for reasons out of our control. We had to cancel PHYS 102.
Graduate: G. TA loads: This issue was also raised in our last External Review. • Most students do not actually do two full TAs (5.17 BU each) per year, but we plan to obtain data on the distribution of TA loads amongst graduate students in the department. We will also try to cross-reference these TA loads with completion times. We will try to compare our TA loads with other schools in Canada. • One resource implication of cutting TA loads is that without additional sources of funding it would require the size of our graduate program to decrease. We will raise this issue with the Faculty of Science GPC and the Dean of Graduate Studies; one thing that emerges in these external reviews is that students in other provinces receive better support. The Province has recently been offering a special BC Graduate Scholarship, worth $15,000 to	We collected data on TA loads, and cross-reference with completion time ongoing Our GPC is actively working with the Office of Graduate Studies to find better models of graduatre funding.

entering students, which we have been using to attract top students to SFU that might otherwise have chosen to attend other universities in Canada. We are worried that this program may not continue.	
H. Graduate Course Loads: The GPC felt that our graduate course load is reasonable, but we will survey comparable Canadian universities and compare our graduate course loads with their programs. It is not clear that there is much in the way of resource implications, since we will probably still want to offer the same number of graduate courses as previously.	Done. We have reviewed our graduate course requirements, and decided to reduce the requirement for PhD by 3 units.
I. Professional Masters: We will look into the possibility of setting up a professional masters program with entrepreneurship components, or other graduate programs relating to quantum technology. If we are to set up a new program, this would likely require additional graduate courses, which would have resource implications for their development. A professional masters program would also bring in revenue that may or may not be directed to the department.	We are working with the Faculty of Science on a professional Masters program in Quantum technologies. At this stage, the proposal is developed andwe are conducting market research. Initial results are encouraging.

2. RESEARCH

2.1	Action(s) to be taken
A. The department will embark on a strategic planning exercise to determine a 10-yr plan that will provide long-term vision for the department's research and teaching programs. One of the goals of this plan will be to improve coordination and collaboration with Faculty and University research initiatives.	The 10 year strategic plan has been completed (attached) Department has 4 research themes with potential for international leadership We are taking steps to grow number of associate members We have welcomed 2 CERCs, hires on the way in 3 of 4 research themes. We will advocate for 4th in computational condensed matter.
B. The Chair will work with Senior Administration to encourage a coherent plan to leverage the establishment of the QAI at SFU's Surrey campus.	We engaged with QAI on quantum professional masters, QAU is partnering in a Mitacs grant to develop quantum curriculum.

3. ADMINISTRATION

3.1	Action(s) to be taken
A. We plan to continue to expand documentation of administrative tasks, first focusing on the department manager role, standing committees, and service roles. In a second stage, we will focus on documentation of technician roles and the recruiting/advising role.	This task is complete for the administrative/main office staff and managers. Currently, we are working on updating Job Descriptions and Standard Operating Procedures (SOPs) for teaching and research technicians.
B. We have used funds released by this cancellation to increase the Advisor/Recruiter position from 50 to 60% and will use it to offset costs for the new Operations Manager position (see Section 4.1). We are also considering part-time hires for temporary work.	Manager, Labs and Operation position was created and filled in 2022, before the hiring freeze. The department hires temporary part-time research technicians to assist with various projects as needed.

4. WORKING ENVIRONMENT

4.1	Action(s) to be taken
A. SOPs: The department will continue to share its experience in developing wiki-based SOPs and documentation with other departments and units.	Staff continue to maintain and update Standard Operating Procedures (SOPs) on Physics wiki page while looking for a new platform to host them.
B. Space: The department will work with the faculty facilities team to map out current space and develop a plan for renewal that will support our strategic goals.	Identified office space problem and found solutions Renovated the P8000 corridor and the graduate lounge The CERC lab renovations are underway
C. Vacation time for teaching faculty: Generally, all summer teaching is reserved for teaching faculty, as they are required to teach 6 courses a year. We will explore running summer courses on shorter timetables. This will require coordination with Scheduling to develop the appropriate structure. We will also encourage teaching faculty to consider a 3/3/0 workload or plan non-teaching semesters or course reductions due to course-equivalency credit during the summer.	Considering the following options - allow teaching faculty to pick the courses first - Pick lab courses that have no exams. - Considering implementing intersession teaching schedule four courses taught during the Summer term

D. IT Support: The hire of the replacement IT support person is now complete. The Department Chair will raise the issue of IT resource deployment with the Dean.	We are continuing with the IT support provided by the Faculty of Science. We are satisfied with the current level of our IT support.
E. Technician coordination: The Department is planning to hire an Operations Manager to provide a single point-of-contact for matters related to teaching and research laboratory operations. This will improve operations of the department, support staff engagement, and address Chair and MAAS workload issues.	Done.

5. OTHER: Strategic Planning

5.1	Action(s) to be taken
A. Strategic Planning: • Develop a team to support ongoing strategic planning in the department to consist of a small advisory group, led by the Chair, that will guide the department in a series of discussions or retreats and translate outcomes and insights from those discussions into action plans. • Develop a series of steps leading to a 10-year plan that would provide long-term vision for the department. • Implement these steps and draft a 10-year plan to provide long-term vision for the department. • Institute an annual process to: – review of progress towards this plan and – set near-term targets for making progress towards longer term goals. • Review and revise the 10-year plan as part of the preparation for the next external review.	This has been done. The next review and revision of the 10-year plan will be in April 2025.
B. Space: The critical nature of the Department's space issues was raised in our last External Review. The department hopes that we will see some firm commitment to renewal before the next External Review.	Space is a constant discussion item with the Dean's office. With 6 new faculty in the next 2 years, with at least 3 needing labs, it remains a challenge.

C. Start-up Budgets: The department will conduct a review of start-up budgets typical in the field.	We conducted the review and the conclusion was that we are not competitive compared to other research-intensive universities in North America.

The above action plan has been considered by the unit under review and has been discussed and agreed to by the Faculty Dean.

Unit Leader	**Date**
Name (signature) Levon Pogosian 	November 5, 2024
Title Chair, Department of Physics	

Section B

DEAN'S COMMENTS ON THE MID-CYCLE REPORT

Thank you to the Department of Physics and the Chair for a sensible, thoughtful and succinct mid-cycle report. I appreciate in particular the attention paid to undergraduate recruitment, especially through on-site events. The focus on retention is also important, and harmonizes with retention efforts at the Faculty level.

The comments on Co-op are important and pertinent; in the past Co-op has been a differentiator for SFU relative to other local universities, for the attraction of undergraduate Science students. Recent reductions of resources for Co-op make it unlikely that it will have the recruitment benefit for our programs in the future, unless changes are made.

I thank the Department for their work so far in developing a potential professional Masters in Quantum Information and Technology. I share their excitement, and look forward to the next phase of market research.

Physics has had great fortune in attracting two Canada Excellence Research Chairs, which builds further on the already very strong international reputation of the Department's research. I acknowledge that renovation of the current spaces is challenging. My office will continue to work with the Department on space issues.

Faculty Dean (signature)	Date
	November 6, 2024

SFU OFFICE OF THE VICE-PROVOST, LEARNING & TEACHING

Strand Hall 3038
8888 University Drive
Burnaby B.C. Canada V5A 1S6

TEL + 1 778 782 5433
vpastrat@sfu.ca
sfu.ca/vpacademic/our-role/support-services/learning-teaching.html

MEMORANDUM

ATTENTION: Department of Physics; SCUP; Senate
FROM: Paul Kingsbury, Associate Vice-President Learning & Teaching *pro tem* and Alice Campbell, Senior Consultant, Program Assessment, Learning Experiences Assessment and Planning
RE: Department of Physics Action Plan for Educational Goals associated with 2024/25 Mid-cycle Assessment Report
DATE: December 12, 2024

The Department of Physics has recently submitted its mid-cycle Educational Goals (EG) assessment plan to SCUTL.

We appreciate the careful and thoughtful attention the Department has paid to assessing student learning of its EGs, including consideration of which goals are already well embedded in the curriculum, and which, such as computational content, the Department is working to further embed throughout the program.

There are many commendable elements to the work you have done to date, and the work that you plan to do.

One of these is the articulation of measurable competencies within each of your EGs, and the breadth of your efforts to consider and directly measure each of your EGs through student performance. Another is the embedding of this work within the Department's curriculum committee, and the participation of many faculty in the data collection. A third is a focus on core courses, and attention to continuously improving these courses to ensure the continued excellence of your program. We appreciate your careful interpretation of what the assessment results mean within the context of your program. Within your plan for the work moving forward, you indicate that student achievement will be measured through specific measures, such as problems, experiments, and a report, assessed using a detailed rubric.

We have two suggestions as you carry on your EGs assessment work, bearing in mind that the aim of this work is to use evidence of student learning to support program improvements.

One is to re-consider using course grades as a measure of student learning of EGs. Course grades, particularly when aggregated across years, are too coarse to provide a strong measure of student learning of a given EG, and as such may not provide the fine-grained information necessary that would indicate which of the competencies are better met, and which need improvement. Because Physics has

done such careful work to identify particular competencies for each EG, we encourage the Department to focus its attention on identifying particular measures within core courses for the competencies. For example, assignments that target particular EGs, particular exam questions that target a particular EG, scores on rubric categories for assignments that target particular EGs.

We applaud the breadth of your efforts and encourage you to continue this provided it benefits the program. We also encourage you to consider focusing your efforts on those aspects of your program that you are looking to, or actively, changing, such as enriching the computational content in your program, and potentially adding more research-driven learning activities to address EG 4. This may also include the impact of simplifying the 2nd year curriculum, to ensure that these important changes don't detract from, and may enhance, student learning. Consider leveraging the EGs assessment process to gather rich data on student learning in these areas to measure the effectiveness of your program-level changes.

As you begin to carry out this work, staff in the AVPLT portfolio are well equipped to support you. We want to help ensure it is meaningful and manageable for the Department. The LEAP (Learning Experiences Assessment and Planning) team supports program and EGs assessment. Their supports include assessment design, quantitative and qualitative data collection and analysis, and support with data interpretation. The Centre for Educational Excellence can help with program revisions and course re-designs that you may be planning.

SFU SIMON FRASER UNIVERSITY

Mid-Cycle Assessment Plan Reporting Template

Unit: Physics

Contact Person: **Jeff or Levon**

Date: October 24, 2024

This template is designed to help units report on their Educational Goals Assessment for the mid-cycle reporting period. *(Textboxes will expand as you type)*

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

Jeff McGuirk, Undergrad Chair, led the creation of this report. The Educational Goals and assessment methods were creating by the Undergraduate Curriculum Committee through several years of different membership. Data collection was assisted by many Physics faculty.

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

Curriculum is continually monitored and adjusted as needed to meet the changing needs of our students; space, resource, budgetary, and personnel constraints; and in response to changes made by adjacent departments such as Math or Chemistry. No changes have been made that have negative effects on the achievement of our Educational Goals. Ongoing work on writing, statistical analysis, computation, and other skills in small, but significant ways within courses supports continuous efforts to increase achievement of Educational Goals.

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

No changes made.

4) Please use the table below to outline the assessment you have done to date. Add or delete any rows as needed.

Educational Goal 1: Graduates will be able to model complex and diverse real-world phenomena.		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Define and formulate the question or problem ○ Identify and apply the relevant physical principles from classical mechanics, electromagnetics, quantum mechanics and statistical physics, and other core areas of physics ○ Apply fundamental laws of physics such as Newton's Laws and conservation laws, and fundamental concepts such as symmetry and the appropriate choice of a physical system ○ Model in multiple ways including mathematically, conceptually, verbally, pictorially, computationally, and by simulation This educational goal is addressed in virtually every Physics course, with increasing levels of mastery as course level increases. Key assessments that exemplify this EG are synthesis-type problems that commonly comprise final exam questions. Since final exams typically carry the majority weight of course grades, course grades and DFW rates are used as a measure of achievement of this EG. **When did you collect the data?** 2020-2024	**Describe Key Findings, Analysis and Interpretation:** A selection of core courses was chosen across the levels of the program, including PHYS 211, 255, 321, 385, and 445. Using SFU's grade interpretations, a grade of C is deemed satisfactory, with higher grades exceeding expectations. All courses have mean scores around 3.0 (B). 211: 2.9 ± 1.1 255: 3.0 ± 1.0 321: 3.1 ± 1.0 385: 3.1 ± 1.0 445: 2.9 ± 1.1 With an average a full standard deviation above the "Satisfactory" level, students are largely achieving the desired level of mastery of modeling systems in these courses. We also take a closer look at the numbers of students that do not achieve satisfactory mastery, via DFW rates: 211: 9.8% 255: 16.3% 321: 7.4% 385: 7.4% 445: 10.9% Despite our best efforts, there will always be a low-level baseline of students who do engage in the course due to outside factors. This is challenging to disentangle from those that engage but still do not achieve mastery. A confounding element to the analysis and interpretation is the small number of students, which also shows large year-to-year fluctuations, ranging from a low of 12 students (445) to a high of 45 (211, 255). The COVID pandemic strongly confounds the analysis. The effect is not uniform across the data, with some courses showing anomalously high grades and low DFW rates (211, 321) while others showed much higher DFW rates (255, 445).	**What improvements have been made, or potential improvements considered, as a result of this assessment?** The consistently high achievements of the majority of students are positive signs of mastery of this educational goal. We should keep our eye on the courses showing lower grades (211, which has a reputation of being challenging, and 445 which has small numbers), but these may not represent statistically significant outcomes. Where progress might be made is to work on improving DFW rates, particularly in the lower division classes. PHYS 255 numbers are surprisingly high. This course represents the first 2nd-year course for Physics majors, and the higher DFW rates may indicate a slight mismatch between preparations of some students. Further study could elucidate whether students are underprepared, and if so from what introductory stream did they come, or if higher withdrawal rates exist in early courses indicative of a "leaky pipeline" of those leaving the program.

	Even these observations are made challenging by statistical fluctuations from small numbers.	
Educational Goal 2: Graduates will be able to solve problems and assess solutions quantitatively using mathematical and computational tools.		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Solve problems using estimation, analytical or numerical methods ○ Evaluate the quality and limitations of the solution (order of magnitude, dimensional analysis, limitations of an analytical solution, implications of the model chosen, evaluation of the modelling uncertainty) ○ Perform refinements, if appropriate This educational goal is addressed in every Physics course, with increasing levels of mastery as course level increases. Problem solving occurs in virtually every homework assignment in every course. We extract aggregate homework grades to assess this educational goal. **When did you collect the data?** 2020-2024	**Describe Key Findings, Analysis and Interpretation:** A selection of core courses was selected across the levels of the program, including PHYS 211, 255, 321, 385, and 445. As only a partial component of a course whose overall grade might be scaled, homework grades do not map directly onto the SFU grading scale of A-B-C. Nonetheless, they do represent the degree of mastery of problem-solving skills. The mean scores of all courses is around 80 ± 17. 211: 89 ± 12 255: 70 ± 22 321: 92 ± 15 385: 87 ± 16 445: 81 ± 18 The mean is generally more than one standard deviation above a what might be considered a satisfactory mastery level. We do note that PHYS 255 is significantly lower than the other core courses studied, and this is likely tied to the same issues driving DFW rates mentioned in Educational Goal 1. Additionally, we can map these numerical scores onto assumed letter grades and assign “DFW” rates to this component as well (see cautionary note below): 211: 8.0% 255: 23% 321: 7.5% 385: 3.3% 445: 12% Despite the caveats described below, these numbers are fairly consistent with DFW rates observed in course grades for the previous educational goal.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** Despite the issues mentioned in the analysis, we find that consistently high performance in homework assignments, which is where problem-solving skills are often honed and demonstrated, indicates this educational goal is largely being met. Curriculum discussions over the last several years have indicated that the computational aspect of this EG is not being fully served, as computational problems are not well represented in the sampled HW assignments. However, work is already underway to increase the computational content across our curriculum in a scaffolded way. Instructional resources have been dedicated to creating assignments that target computational skills for core courses, and practice with programming basics has been integrated into lower division lab courses. Anecdotally, instructors have observed increasing facility with computational data analysis in upper division labs as a result of this initiative. Additionally, we offer one Computational Physics course (PHYS 395). This course was not included in the analysis because it is largely treated as a breadth elective, and thus does not represent the average student experience. However, we have recently made changes to the various

	Note that high homework grades show successful mastery of this educational goal, but low homework grades do not necessarily show lack of mastery. First and foremost, homework is intended as *practice*, and struggles during practice do not imply an ultimate lack of success. Furthermore, some students fail to engage in homework assignments, though they demonstrate problem-solving satisfactory master on exams. However, engagement with homework is the most common place to practice these skills, and we should endeavor to engage all students is these activities. Again, note that the COVID pandemic and small, fluctuation numbers make data interpretation challenging.	Physics major programs such that PHYS 395 is now included as an explicit option in most of the major streams. This will increase enrollment in the course, and future assessments will include data from PHYS 395 in support of the computational component of this educational goal.
Educational Goal 3: Graduates will be able to design and perform experiments to test physical hypotheses and characterize physical phenomena.		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Plan an experimental/observational investigation taking into account the choice of instrumentation and the types, amount, and accuracy of data needed to give reproducible and accurate results ○ Demonstrate competency in basic experimental technologies (e.g. electronics, optics) ○ Apply systematic strategies and persistence in troubleshooting, using feedback from modeling and data analysis ○ Analyze data, including statistical and uncertainty analysis; distinguish between models; and present those results with appropriate tables and charts ○ Evaluate the quality and limitations of the results, and suggest and perform refinements, if appropriate	**Describe Key Findings, Analysis and Interpretation:** Analysis focused on the two most important lab courses for this educational goal, PHYS 233 and 332W. Using SFU's grade interpretations, a grade of C is deemed satisfactory, with higher grades exceeding expectations. All courses have mean scores around 3.0 (B). 233: 3.2 ± 1.1 332: 3.2 ± 0.9 With an average more a full standard deviation above the "Satisfactory" level, students are largely achieving the desired level of mastery of experimentation in these courses. The success of these courses in achieving this educational goal is likely even higher than the grades indicate, as written assignments and exams tend to pull down these grades, though they are only small components to these courses. We also look at the DFW rates: 233: 12% 332: 6.1%	**What improvements have been made, or potential improvements considered, as a result of this assessment?** We find these results to indicate good achievement of this educational goal. Additionally, an informal survey of curricula in peer institutions reveals that, though we have recently withdrawn an upper division advanced lab, SFU Physics has more lab courses than many peer programs do. Also not captured in this analysis is the learning that takes place in PHYS 432, the undergraduate thesis course. Most honors students take this course, which requires a significant amount of experimental planning, execution, and analysis. It is not possible for students to successfully complete PHYS 432 without mastering these skills sufficiently.

This educational goal is addressed primarily in Physics lab courses. Assessments in these courses primarily include successful planning and execution of experiments, coupled with written work discussing data analysis, problems, and interpretations. As the majority of marks for a lab course come from these, we use lab course grades as a metric for this educational goal. **When did you collect the data?** 2020-2024	We note that laboratory courses were particularly affected by the COVID pandemic, both during the initial semester when classes became fully remote, as well as in additional terms when labs were in-person with safety protocols. Direct assessment of some of these experimental skills is challenging. However, students cannot successfully setup and complete the complicated, multi-day experiments performed in these courses without achieving a level of mastery of the skills required in this educational goal. For this reason, we consider successful completion of the experiments as observed by instructors to indicate that nearly every student is achieving satisfactory mastery of these experimental skills.	
Educational Goal 4: Graduates will be able to critically assess the quality and reliability of resources and scientific statements.		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Assess the quality and reliability of both technical and non-technical scientific statements ○ Find the resources relevant to addressing any gaps in knowledge No data collected. **When did you collect the data?** 2020-2024	**Describe Key Findings, Analysis and Interpretation:** Assessment of this educational goal has proven to be elusive. Perhaps this goal is not addressed sufficiently in the curriculum. Certainly, students routinely find resources to address gaps in their knowledge, say when studying or working on homework, but this process is challenging to track, let alone to measure how students assess the reliability of resources they find. In PHYS 332W, students write formal reports and use outside resources to fill in the context, history, and theoretical backing to explain the results of their experiments. They are typically directed to several resources that they may use and are left to find anything else they may need on their own. We do not currently address or assess this process. Similarly, students completing an honors thesis (PHYS 432) do significant resource location, but again this is not a major component to the assessment.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** We need to think how we might assess this educational goal more directly. One component of mastery is the ability to ascertain whether technical claims, e.g. made in the media or by politicians, are scientifically sound. There is overlap in this skill and the scientific method – that is, a statement can be viewed as a hypothesis that can be checked by gathering data, typically existing studies in this context, or using first-principles arguments. This aspect is used throughout our courses, particularly in problem solving exercises and lab courses, but is not directly assessed. The second component of this goal refers to finding resources, electronic or otherwise, and verifying their reliability. This primarily enters in research-driven assignments and courses, of which we have few. We may wish to explicitly include resource-finding assignments, say in the PHYS 332W course.

Educational Goal 5: Graduates will be able to communicate and explain physical phenomena and theories.		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Communicate at different levels suitable and relevant for a wide variety of audiences (physicists, scientists, engineers, general public) ○ Communicate in a wide variety of formats (oral, visual, written) ○ Include context as needed, including related historical and philosophical background This educational goal is consistently addressed only in a small number of courses, which include two lab courses that contain significant written components (PHYS 233 & 332W) and the honors thesis course (PHYS 432), which involves writing and oral presentations. **When did you collect the data?** 2020-2024	**Describe Key Findings, Analysis and Interpretation:** Analysis focused on the capstone writing assignment in PHYS 332W, a formal report on an experiment written in the form of a scientific article. Students complete a series of semester-long scaffolded writing assignments in support of this report and educational goal, but we do not consider these "practice" elements in our analysis, as they are primarily intended as formative work with significant instructor feedback. The report also includes visual representation of data (graphs and figures) and the historical background behind phenomena under study, which are also important skills sought in this goal. The reports are scored on a comprehensive rubric. The mean score is 74 ± 15, with a so-called inferred "DFW" rate of 13% Again, the average is nearly a full standard deviation above the "Satisfactory" level, indicating students are largely achieving the desired level of mastery for this form of written communication. We do note that there is a wider range of mastery demonstrated for these skills than for those captured under other educational goals. Anecdotally, many students finding written communication to be more challenging or the scientific format to not come naturally, often more so for EAL students. Data indicates we are achieving this educational goal, though perhaps not as strongly as other key goals. Additional opportunities for writing occur in other labs and the thesis course (PHYS 432), but not to the same extent as PHYS 332W. PHYS 332W also often includes written work targeted at more general audiences, but this is not a major component to the course.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** Data suggests that we are largely achieving our goals for written communication. Though not directly indicated by the data, perhaps we could better support students who find written communication a challenge by better utilizing SFU's existing resources for writing support. We also find that there are few opportunities for formal oral communication in our curriculum. Students routinely communicate with instructors in classes, tutorials, and lab courses, where instructors routinely use Socratic questioning to encourage students to explain Physical phenomena and related topics. Students completing the thesis course (PHYS 432) give oral presentations to students in the PHYS 201 course, but any instructing on these presentations is left to individual research supervisors and is not a primary component of the thesis research. We should look for opportunities to further build students' oral communication skills in the curriculum.

Educational Goal 6: Graduates will be able to demonstrate professional/workplace skills. (Aspirational)		
Description of Assessment Method(s): Competencies sought in this educational goal: ○ Work collaboratively in diverse, interdisciplinary teams ○ Independently identify gaps in their knowledge and skills and address them, ○ Demonstrate critical professional skill, including time management, responsibility, independence, resourcefulness, integrity, and ethical behavior ○ Display awareness of career opportunities and pathways for physics graduates ○ Demonstrate awareness of standard practices for effective résumés and job interviews, as well as professional appearance and behavior **When did you collect the data?** N/a	**Describe Key Findings, Analysis and Interpretation:** We listed this educational goal as "aspirational" when creating our EGs, because we would like students to seamlessly fit into professional environments after graduation, but we did not feel that we were explicitly addressing this EG in our courses to a degree sufficient to make data collection practical and meaningful. For this reason, we have not collected any data relevant to it.	**What improvements have been made, or potential improvements considered, as a result of this assessment?** Firstly, we should reflect on whether we find these skills important enough – and lacking in students – to add more explicit instruction to the curriculum and turn this into a "non-aspirational" Goal, keep the aspirational label, or remove it entirely. Despite not collecting data, we do address this educational goal in several direct and indirect ways. Students work collaboratively in lab courses and tutorials. For instance, collaboration is somewhat scaffolded by assigning students fixed collaboration roles in PHYS 132 & 133, explaining their duties, and then letting students independently navigate those roles in group work undertaken in future lab courses. However, this skill is not assessed. We also address career preparation in PHYS 201, with alumni talks and other discussions that promote awareness of co-op, research, and career opportunities. PHYS 201 also includes CV writing exercise, which are assessed on a completion basis. Lastly, time management, responsibility, and independence are general life skills that we hope all students master during their university degrees through completion of a rigorous set of required courses.

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:			

Description of Assessment Methods: Final exams and course grades	**What would indicate that students had met the EG?** Successful completion of synthesis-type problems that commonly comprise final exams or homework, especially in upper division classes.	**Is this direct or indirect?** Direct	**When do you plan to collect the data?** Continuously, as needed
Educational Goal 2:			
Description of Assessment Methods: Homework grades and completion of homework assignments	**What would indicate that students had met the EG?** Successful completion of homework assignment problems, virtually all of which require problem-solving skills.	**Is this direct or indirect?** Direct	**When do you plan to collect the data?** Continuously, as needed
Educational Goal 3:			
Description of Assessment Methods: Successful planning, execution, and analysis of laboratory experiments	**What would indicate that students had met the EG?** Successful completion of lab experiments as measured by course grades in key laboratory courses.	**Is this direct or indirect?** Indirect	**When do you plan to collect the data?** Continuously, as needed
Educational Goal 4:			
Description of Assessment Methods: As described above, more thought is required into assessing this Goal, which is essentially the development of content-specific critical thinking skills and is challenging to measure.	**What would indicate that students had met the EG?** N/a	**Is this direct or indirect?** N/a	**When do you plan to collect the data?** Continuously, as needed
Educational Goal 5:			
Description of Assessment Methods: Written work in laboratory courses	**What would indicate that students had met the EG?** Successful completion of a formal report in a scientific format, as assessed using a detailed rubric.	**Is this direct or indirect?** Direct	**When do you plan to collect the data?** Continuously, as needed

Educational Goal 6:			
Description of Assessment Methods: See discussion above. This educational goal is challenging to assess and not completely addressed explicitly in our curriculum, and thus it has been listed as “aspirational.” Thought will be required to determine if we wish to change any of these factors.	**What would indicate that students had met the EG?** N/a	**Is this direct or indirect?** N/a	**When do you plan to collect the data?** N/a

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

The Undergraduate Curriculum Committee (UGCC) meets regularly to discuss all things related to undergraduate curriculum, including the assessment of educational goals. Minutes are available to all Physics faculty. Findings of the UGCC are shared with the Physics Department at department meetings as needed, as well as in strategic planning documents.

7) Assessment Timeline

Next External Review: