2015-2016
Annual Assessment Report Template

For instructions and guidelines visit our **website**
or **contact us** for more help.

Report: BS Physics

Question 1: Program Learning Outcomes

Q1.1.
Which of the following Program Learning Outcomes (PLOs) and Sac State Baccalaureate Learning Goals (BLGs) **did you assess?** [**Check all that apply**]

- [ ] 1. Critical Thinking
- [ ] 2. Information Literacy
- [ ] 3. Written Communication
- [ ] 4. Oral Communication
- [ ] 5. Quantitative Literacy
- [ ] 6. Inquiry and Analysis
- [ ] 7. Creative Thinking
- [ ] 8. Reading
- [ ] 9. Team Work
- [ ] 10. Problem Solving
- [ ] 11. Civic Knowledge and Engagement
- [ ] 12. Intercultural Knowledge and Competency
- [ ] 13. Ethical Reasoning
- [ ] 14. Foundations and Skills for Lifelong Learning
- [ ] 15. Global Learning
- [ ] 16. Integrative and Applied Learning
- [ ] 17. Overall Competencies for GE Knowledge
- [x] 18. Overall Competencies in the Major/Discipline
- [ ] 19. Other, specify any assessed PLOs not included above:

a.
b.
c.

Q1.2.
Please provide more detailed background information about **EACH PLO** you checked above and other information such as how your specific PLOs are **explicitly** linked to the Sac State BLGs:

We assessed Physics Knowledge for our graduating (and near graduating) cohort of students in our PHYS 175 (Advanced Physics Laboratory) course. This is a course taken by all students near the end of their studies. We gave them the Major Field Test in Physics following the usual examination rules.

Q1.2.1.
Do you have rubrics for your PLOs?

- ○ 1. Yes, for all PLOs
- ○ 2. Yes, but for some PLOs
- ○ 3. No rubrics for PLOs
- ○ 4. N/A

- [x] 5. Other, specify: We are in the process of updating them based on feedback from 2014-15.

Q1.3.
Are your PLOs closely aligned with the mission of the university?

- [x] 1. Yes
- [ ] 2. No
- [ ] 3. Don't know

Q1.4.
Is your program externally accredited (other than through WASC Senior College and University Commission (WSCUC))?

- [ ] 1. Yes
- [x] 2. No (skip to **Q1.5**)
- [ ] 3. Don't know (skip to **Q1.5**)

Q1.4.1.
If the answer to Q1.4 is **yes**, are your PLOs closely aligned with the mission/goals/outcomes of the accreditation agency?

- [ ] 1. Yes
- [ ] 2. No
- [ ] 3. Don't know

Q1.5.
Did your program use the *Degree Qualification Profile* (DQP) to develop your PLO(s)?

- [ ] 1. Yes
- [x] 2. No, but I know what the DQP is
- [ ] 3. No, I don't know what the DQP is
- [ ] 4. Don't know

Q1.6.
Did you use action verbs to make each PLO measurable?

- [ ] 1. Yes
- [x] 2. No
- [ ] 3. Don't know

(**Remember**: Save your progress)

Question 2: Standard of Performance for the Selected PLO

Q2.1.
Select **ONE(1)** PLO here as an example to illustrate how you conducted assessment (be sure you *checked the correct box* for this PLO in Q1.1):

Overall Competencies in the Major/Disicpline

Q2.1.1.
Please provide more background information about the **specific PLO** you've chosen in Q2.1.

We assessed Physics Knowledge for our graduating (and near graduating) cohort of students in our PHYS 175 (Advanced Physics Laboratory) course. This is a course taken by all students near the end of their studies. We gave them the Major Field Test in Physics following the usual examination rules.

Q2.2.
Has the program developed or adopted **explicit** standards of performance for this PLO?

- [ ] 1. Yes
- [x] 2. No
- [ ] 3. Don't know

4. N/A

Q2.3.
Please **provide the rubric(s)** and **standards of performance** that you have developed for this PLO here or in the appendix.

We compared our results against similar institutions taking the Major Field Test to see how our students compare. We had a list of 44 similar instutions (including a few other CSU campuses). The test reported the following "areas":

Introductory Physics

Advanced Physics

No file attached | No file attached

Q2.4. PLO	Q2.5. Stdrd	Q2.6. Rubric	Please indicate where you have published the **PLO**, the **standard** of performance, and the **rubric** that was used to measure the PLO:
☐	☐	☐	1. In **SOME** course syllabi/assignments in the program that address the PLO
☐	☐	☐	2. In **ALL** course syllabi/assignments in the program that address the PLO
☑	☐	☐	3. In the student handbook/advising handbook
☐	☐	☐	4. In the university catalogue
☑	☐	☐	5. On the academic unit website or in newsletters
☐	☐	☐	6. In the assessment or program review reports, plans, resources, or activities
☐	☐	☐	7. In new course proposal forms in the department/college/university
☑	☐	☐	8. In the department/college/university's strategic plans and other planning documents
☐	☐	☐	9. In the department/college/university's budget plans and other resource allocation documents
☐	☐	☐	10. Other, specify:

Question 3: Data Collection Methods and Evaluation of Data Quality for the Selected PLO

Q3.1.
Was assessment data/evidence **collected** for the selected PLO?

- (●) 1. Yes
- ( ) 2. No (skip to **Q6**)
- ( ) 3. Don't know (skip to **Q6**)
- ( ) 4. N/A (skip to **Q6**)

Q3.1.1.
How many assessment tools/methods/measures **in total** did you use to assess this PLO?
1

Q3.2.
Was the data **scored/evaluated** for this PLO?

- (●) 1. Yes
- ( ) 2. No (skip to **Q6**)
- ( ) 3. Don't know (skip to **Q6**)
- ( ) 4. N/A (skip to **Q6**)

Q3.2.1.
Please describe how you collected the assessment data for the selected PLO. For example, in what course(s) or by what means were data collected:

Class of 12 majors taking "capstone" physics laboratory course in Spring 2016 were administered the Major Field Test for Physics following the standard protocols defined by ETS.

(**Remember**: Save your progress)

Question 3A: Direct Measures (key assignments, projects, portfolios, etc.)

Q3.3.
Were direct measures (key assignments, projects, portfolios, course work, student tests, etc.) used to assess this PLO?

- (●) 1. Yes
- ( ) 2. No (skip to **Q3.7**)
- ( ) 3. Don't know (skip to **Q3.7**)

Q3.3.1.
Which of the following direct measures were used? [**Check all that apply**]

- [ ] 1. Capstone project (e.g. theses, senior theses), courses, or experiences
- [ ] 2. Key assignments from required classes in the program
- [ ] 3. Key assignments from elective classes
- [x] 4. Classroom based performance assessment such as simulations, comprehensive exams, or critiques
- [ ] 5. External performance assessments such as internships or other community-based projects
- [ ] 6. E-Portfolios
- [ ] 7. Other Portfolios
- [ ] 8. Other, specify:

Q3.3.2.
Please **explain** and **attach** the direct measure you used to collect data:

Major Field Test provided by ETS.

No file attached | No file attached

Q3.4.
What tool was used to evaluate the data?

- ( ) 1. **No** rubric is used to interpret the evidence (skip to **Q3.4.4.**)
- ( ) 2. Used rubric developed/modified by the faculty who teaches the class (skip to **Q3.4.2.**)
- ( ) 3. Used rubric developed/modified by a group of faculty (skip to **Q3.4.2.**)
- ( ) 4. Used rubric pilot-tested and refined by a group of faculty (skip to **Q3.4.2.**)
- ( ) 5. The VALUE rubric(s) (skip to **Q3.4.2.**)
- ( ) 6. Modified VALUE rubric(s) (skip to **Q3.4.2.**)
- (●) 7. Used other means (Answer **Q3.4.1.**)

Q3.4.1.
If you used other means, which of the following measures was used? [**Check all that apply**]

- [ ] 1. National disciplinary exams or state/professional licensure exams (skip to **Q3.4.4.**)
- [ ] 2. General knowledge and skills measures (e.g. CLA, ETS PP, etc.) (skip to **Q3.4.4.**)
- [x] 3. Other standardized knowledge and skill exams (e.g. ETC, GRE, etc.) (skip to **Q3.4.4.**)
- [ ] 4. Other, specify: ______ (skip to **Q3.4.4.**)

Q3.4.2.
Was the **rubric** aligned directly and explicitly **with the PLO**?

- ( ) 1. Yes
- ( ) 2. No
- ( ) 3. Don't know
- (•) 4. N/A

Q3.4.3.
Was the **direct measure** (e.g. assignment, thesis, etc.) aligned directly and explicitly **with the rubric**?

- ( ) 1. Yes
- ( ) 2. No
- ( ) 3. Don't know
- (•) 4. N/A

Q3.4.4.
Was the **direct measure** (e.g. assignment, thesis, etc.) aligned directly and explicitly **with the PLO**?

- ( ) 1. Yes
- ( ) 2. No
- ( ) 3. Don't know
- (•) 4. N/A

Q3.5.
How many faculty members participated in planning the assessment data **collection** of the selected PLO?

3

Q3.5.1.
How many faculty members participated in the **evaluation** of the assessment data for the selected PLO?

0

Q3.5.2.
If the data was evaluated by multiple scorers, was there a norming process (a procedure to make sure everyone was scoring similarly)?

- ( ) 1. Yes
- ( ) 2. No
- ( ) 3. Don't know
- (•) 4. N/A

Q3.6.
How did you **select** the sample of student work (papers, projects, portfolios, etc.)?

PHYS 175 was chosen because it is a class taken in the graduation term (or penultimate term).

Q3.6.1.
How did you **decide** how many samples of student work to review?

All students in the class in Spring 2016 were given the opportunity to take the test. It was voluntary, but all did take it.

Q3.6.2.
How many students were in the class or program?

12

Q3.6.3.
How many samples of student work did you evaluated?

12

Q3.6.4.
Was the sample size of student work for the direct measure adequate?

- (•) 1. Yes
- ( ) 2. No
- ( ) 3. Don't know

(**Remember**: Save your progress)

Question 3B: Indirect Measures (surveys, focus groups, interviews, etc.)

Q3.7.
Were indirect measures used to assess the PLO?

- ( ) 1. Yes
- (•) 2. No (skip to **Q3.8**)
- ( ) 3. Don't Know (skip to **Q3.8**)

Q3.7.1.
Which of the following indirect measures were used? [**Check all that apply**]

- [ ] 1. National student surveys (e.g. NSSE)
- [ ] 2. University conducted student surveys (e.g. OIR)
- [ ] 3. College/department/program student surveys or focus groups
- [ ] 4. Alumni surveys, focus groups, or interviews
- [ ] 5. Employer surveys, focus groups, or interviews
- [ ] 6. Advisory board surveys, focus groups, or interviews

☐ 7. Other, specify:

Q3.7.1.1.
Please explain and attach the indirect measure you used to collect data:

No file attached | No file attached

Q3.7.2.
If surveys were used, how was the sample size **decided**?

Q3.7.3.
If surveys were used, how did you **select** your sample:

Q3.7.4.
If surveys were used, what was the response rate?

Question 3C: Other Measures (external benchmarking, licensing exams, standardized tests, etc.)

Q3.8.
Were external benchmarking data, such as licensing exams or standardized tests, used to assess the PLO?

- (●) 1. Yes
- ( ) 2. No (skip to **Q3.8.2**)
- ( ) 3. Don't Know (skip to **Q3.8.2**)

Q3.8.1.
Which of the following measures was used? [**Check all that apply**]

- ☐ 1. National disciplinary exams or state/professional licensure exams
- ☐ 2. General knowledge and skills measures (e.g. CLA, ETS PP, etc.)

- [x] 3. Other standardized knowledge and skill exams (e.g. ETC, GRE, etc.)
- [ ] 4. Other, specify:

Q3.8.2.
Were other measures used to assess the PLO?

- ( ) 1. Yes
- (•) 2. No (skip to **Q4.1**)
- ( ) 3. Don't know (skip to **Q4.1**)

Q3.8.3.
If other measures were used, please specify:

No file attached | No file attached

(**Remember**: Save your progress)

Question 4: Data, Findings, and Conclusions

Q4.1.
Please provide simple tables and/or graphs to summarize the assessment data, findings, and conclusions for the selected PLO for **Q2.1**:

Our 12 student scores were compared to a set of 806 students from 44 similar instituions over the past four years.

	Sample Size	Introductory Physics	Advanced Physics
Sac State	12	48 ± 5	53 ± 4
Sample Set	806	47.7 ± 0.5	49.5 ± 0.5

No file attached | No file attached

Q4.2.
Are students doing well and meeting the program standard? If not, how will the program work to improve student performance of the selected PLO?

We were generally pleased with the performance of the students. Our students may be performing slightly better than our comparison group in the Advanced Physics category, but until we get a larger sample size, we cannot say this with confidence.

No file attached | No file attached

Q4.3.
For the selected PLO, the student performance:

- ( ) 1. **Exceeded** expectation/standard
- (•) 2. **Met** expectation/standard

○ 3. **Partially** met expectation/standard
○ 4. Did not meet expectation/standard
○ 5. No expectation/standard has been specified
○ 6. Don't know

Question 4A: Alignment and Quality

Q4.4.
Did the data, including the direct measures, from all the different assessment tools/measures/methods directly align with the PLO?

◉ 1. Yes
○ 2. No
○ 3. Don't know

Q4.5.
Were **all** the assessment tools/measures/methods that were used good measures of the PLO?

◉ 1. Yes
○ 2. No
○ 3. Don't know

Question 5: Use of Assessment Data (Closing the Loop)

Q5.1.
As a result of the assessment effort and based on prior feedback from OAPA, do you anticipate *making any changes* for your program (e.g. course structure, course content, or modification of PLOs)?

○ 1. Yes
◉ 2. No (skip to **Q5.2**)
○ 3. Don't know (skip to **Q5.2**)

Q5.1.1.
Please describe *what changes* you plan to make in your program as a result of your assessment of this PLO. Include a description of how you plan to assess the impact of these changes.

Q5.1.2.
Do you have a plan to assess the *impact of the changes* that you anticipate making?

○ 1. Yes
○ 2. No
○ 3. Don't know

Q5.2.

How have the assessment data from the last annual assessment been used so far? [**Check all that apply**]	1. Very Much	2. Quite a Bit	3. Some	4. Not at All	5. N/A
1. Improving specific courses	○	○	○	○	◉
2. Modifying curriculum	○	○	○	◉	○
3. Improving advising and mentoring	○	○	○	◉	○

4. Revising learning outcomes/goals	○	○	○	●	○
5. Revising rubrics and/or expectations	○	○	○	●	○
6. Developing/updating assessment plan	○	○	○	●	○
7. Annual assessment reports	○	○	●	○	○
8. Program review	○	○	○	●	○
9. Prospective student and family information	○	○	●	○	○
10. Alumni communication	○	○	○	●	○
11. WSCUC accreditation (regional accreditation)	○	○	○	○	●
12. Program accreditation	○	○	○	○	●
13. External accountability reporting requirement	○	○	○	○	●
14. Trustee/Governing Board deliberations	○	○	○	○	●
15. Strategic planning	○	○	●	○	○
16. Institutional benchmarking	○	○	●	○	○
17. Academic policy development or modifications	○	○	○	●	○
18. Institutional improvement	○	○	○	●	○
19. Resource allocation and budgeting	○	○	○	●	○
20. New faculty hiring	○	○	○	●	○
21. Professional development for faculty and staff	○	○	○	●	○
22. Recruitment of new students	○	○	●	○	○

23. Other, specify:

Q5.2.1.
Please provide a detailed example of how you used the assessment data above:

We are still cleaning up our assessment plan. The leading member of the assessment committee was on sabbatical all of last year and we did not quite make the progess that we had hoped. We anticipate completing our full plan next AY.

(**Remember**: Save your progress)

Additional Assessment Activities

Q6.
Many academic units have collected assessment data on aspect of their program *that are not related to the PLOs* (i.e. impacts of an advising center, etc.). **If** your program/academic unit has collected data on program *elements*, please briefly report your results here:

No file attached | No file attached

Q7.
What PLO(s) do you plan to assess next year? [**Check all that apply**]

- [ ] 1. Critical Thinking

- [ ] 2. Information Literacy
- [ ] 3. Written Communication
- [ ] 4. Oral Communication
- [x] 5. Quantitative Literacy
- [ ] 6. Inquiry and Analysis
- [ ] 7. Creative Thinking
- [ ] 8. Reading
- [ ] 9. Team Work
- [ ] 10. Problem Solving
- [ ] 11. Civic Knowledge and Engagement
- [ ] 12. Intercultural Knowledge and Competency
- [ ] 13. Ethical Reasoning
- [ ] 14. Foundations and Skills for Lifelong Learning
- [ ] 15. Global Learning
- [ ] 16. Integrative and Applied Learning
- [ ] 17. Overall Competencies for GE Knowledge
- [x] 18. Overall Competencies in the Major/Discipline
- [ ] 19. Other, specify any PLOs not included above:

a.

b.

c.

Q8. Please attach any additional files here:

No file attached | No file attached | No file attached | No file attached

Q8.1.
Have you attached any files to this form? If yes, please list every attached file here:

Program Information (**Required**)

P1.
Program/Concentration Name(s): [by degree]

BS Physics

P1.1.
Program/Concentration Name(s): [by department]

Physics BS

P2.
Report Author(s):

William DeGraffenreid

P2.1.
Department Chair/Program Director:

William DeGraffenreid

P2.2.

Assessment Coordinator:

Vera Margoniner

P3.
Department/Division/Program of Academic Unit

Physics & Astronomy

P4.
College:

College of Natural Science & Mathematics

P5.
Total enrollment for Academic Unit during assessment semester (see Departmental Fact Book):

95

P6.
Program Type:

- (●) 1. Undergraduate baccalaureate major
- ( ) 2. Credential
- ( ) 3. Master's Degree
- ( ) 4. Doctorate (Ph.D./Ed.D./Ed.S./D.P.T./etc.)
- ( ) 5. Other, specify:

P7. Number of **undergraduate degree programs** the academic unit has?

4

P7.1. List all the names:

Physics, BS

Physics, BS (Applied Physics Concentration)

Physics, BA

Physics, BA (Teacher Preparation Concentration)

P7.2. How many concentrations appear on the diploma for this undergraduate program?

2

P8. Number of **master's degree programs** the academic unit has?

N/A

P8.1. List all the names:

P8.2. How many concentrations appear on the diploma for this master's program?

N/A

P9. Number of **credential programs** the academic unit has?

N/A

P9.1. List all the names:

P10. Number of **doctorate degree programs** the academic unit has?

N/A

P10.1. List all the names:

When was your **assessment plan**…	1. Before 2010-11	2. 2011-12	3. 2012-13	4. 2013-14	5. 2014-15	6. No Plan	7. Don't know
P11. developed?	○	○	○	○	◉	○	○
P11.1. last updated?	○	○	○	○	◉	○	○

P11.3.
Please attach your latest **assessment plan**:

2015 Assessment Plan DRAFT.docx
126.21 KB

P12.
Has your program developed a **curriculum map?**

- ○ 1. Yes
- ◉ 2. No
- ○ 3. Don't know

P12.1.
Please attach your latest **curriculum map**:

No file attached

P13.
Has your program indicated in the curriculum map where assessment **of student learning** occurs?

- ○ 1. Yes
- ◉ 2. No
- ○ 3. Don't know

P14.
Does your program have a capstone class?

- ◉ 1. Yes, indicate: PHYS 175; PHYS 191
- ○ 2. No

3. Don't know

P14.1.
Does your program have **any** capstone project?

1. Yes (selected)
2. No
3. Don't know

(**Remember**: Save your progress)

Department of Physics and Astronomy

Assessment Plan

June 2015(Draft)

Assessment is a long-term process that allows departments and faculty members to ensure that our students are leaving our program with useful and marketable skills to become successful members of the scientific and general community. This document is provided as an outline for process to ensure this process is done in a meaningful and efficient manner.

Mission, Background, and Goals

Mission Statement

The mission of the major programs of the Department of Physics and Astronomy is to help our baccalaureate graduates attain the knowledge, skills and attitudes that are the foundation for success in Physics and related careers. More specifically, we support three broad groups of students: those who plan to attend graduate school in Physics, Astronomy or technical disciplines such as Engineering and Computational Science, those who seek technical industrial or laboratory employment, and those who intend to pursue a career in K-12 teaching.

Department Background

We have approximately 100 majors in four degree programs. Our BS in physics provides a rigorous physics background that is designed for students interested in pursuing graduate studies in Physics or Astronomy. The BS – Applied Physics Concentration is designed to prepare students for careers in high technology or for graduate school in related fields. The BA is a traditional "liberal arts" degree that provides a solid background in Physics, yet provides flexibility in the degree for students looking for a well-rounded education. The BA – Teacher Preparation Concentration is designed for those interested in a career in secondary education. About half of our graduates move on to graduate studies in Physics or a related field (most notably Electrical Engineering).

Student Learning Outcomes

The mission of the Department is highly aligned with the Sacramento State Baccalaureate Learning Outcomes. These are described in more detail in Appendix A. Specific to the nature of our programs, there are four learning outcomes that we desire our students to be highly proficient in upon graduation. While the relative weighting of these areas may vary between our degree programs, they are in fact common to all programs. For this reason, at this point, we do not see any reason to develop different outcomes for our degree programs.

- <u>Physics Knowledge</u> – Students will develop a broad understanding of the basic principles of Physics and have a firm foundation for acquiring new knowledge and applying it in a variety of situations. We desire our students to be well schooled in the theories and laws of Physics. In addition to classroom and laboratory experiences, all students in this program are required to attend a minimum of twenty physics colloquium where they are exposed to current research subjects in Physics and Astronomy as well as occasional talks on the history of Physics. We wish the future evolution of our curriculum to keep course content and laboratories as modern as feasible with available resources.

- Analytic Reasoning – Students should develop problem solving, critical thinking, and analytical skills and be able to learn new skills as needed. This is an especially important area since quantitative "critical thinking" is badly needed in all technical pursuits and a good Physics background is extremely effective in providing this. It is no accident that people with Physics training are found in every field in which the connection between mathematics and the real world is important. We make the students explicitly aware that the development of general analytical skills is at least as high a priority as the course material itself.
- Technical Skills – Students must be exposed to a broad range of technical skills and should become proficient in most. Not too many years ago there was a fairly large distinction between theorists (working with pencil and paper) and experimentalists (in the lab with equipment and instruments). This is not as true today. A theorist may be heavily involved in developing real-world simulations and an experimentalist will likely need to have to build their work on very complex models. Our students will develop proficiency in using a wide variety of instruments, tools, and software programs. Many will demonstrate advanced technical skills by participating in one of our Certificate Programs.
- Communication Skills – Scientists must be able to share their ideas and work with others in their field. The demands of such technical writing (and speech) are generally beyond the scope of the writing requirements as defined in the University General Education program. Very complex theories and experiments must be described in unambiguous terms often peppered with large amounts of mathematics and technical jargon. Large data sets, measured or theoretically generated, must be presented clearly and succinctly in tables and graphs. Scientists must also be able to effectively share their results in other forms, such as conference presentations and poster sessions. Our students learn about all of these modes of communication and gain experiences in them through their work in classes and Senior Projects.

Assessment Strategies

As noted in Appendix B, our previous Assessment Plan was rather holistic and based on the small number of majors that we had at the time (approximately 40). From the results of our 2009-10 Program Review and the 2011-12 Learning Outcomes Report, we've determined that we need a more data-driven and sustainable plan.

We will measure the effectiveness of our Programs and the Learning Outcomes as described below.

Systematic Assessment

We have historically found great value in our graduating senior and recent-alumni surveys. We will continue to do these to gauge the student/alumni perception of our programs as well as to provide us with information about experiences that have proven particularly useful in their careers or deficiencies that have been noted. We used to do our exit interviews in person, but with the increase in the number of graduates, this is proving to be a scheduling problem. We will now do this electronically. Each graduate will be sent a survey (Appendix C) within a month of graduation. Every five years, we will perform an alumni survey (Appendix D) for graduates 4 – 8 years from graduation. The Assessment Committee will review these surveys and issues identified by the Committee will be brought to the Department's attention.

Physics Knowledge

Graduating seniors will be asked to take the Major Field Test in Physics. This comprehensive physics examination is given by departments nationwide to assess physics knowledge. Student test results are compiled by ETS and will be returned to us along with data about comparable institutions. This data will help us identify areas in our curriculum that are proving ineffective. Due to the relatively small number of students taking the examination each year (~10), we will use multiple years to identify trends. We expect that our students will perform in the upper half of comparable (public, baccalaureate) institutions.

If a particular subject area is determined to be less effective than others, we will initiate a more specific investigation into the appropriate courses in an attempt to identify why the outcomes are not being met.

Analytic Reasoning

We have developed a rubric (Appendix E) to assess the analytical skills of our students. The rubric is designed to measure the problem solving, critical thinking, and numerical analysis skills expected of our majors. In the years that we collect data for this learning outcome we will request copies of the final exams of our core physics classes: PHYS 110, 135, 150, 151. We will also request copies of the "formal" lab report for students in PHYS 175. For students in the BA programs, the 110 and 135 exams are particularly useful as they are the highest level theory classes taken by these students. For those in the BS program, 150 and 151 are the highest level. PHYS 175 serves both audiences. We expect that students in the BA program will have average scores of "intermediate" or higher and the BS students will be "advanced" or higher.

Technical Skills

We have developed rubrics (Appendix E) for assessing the technical skills of our students, one for experimental skills, the other for computational skills. Students will be assessed in appropriate classes (115, 116, 145, 162, 163, and 175) during the years when this learning outcome is selected. We expect that, on average, students will be advanced in either experimental skills or computational skills.

Communication Skills

We have developed rubrics (Appendix E) for assessing the communication skills of our students. The rubrics examine written, oral, and data presentation skills. The rubrics will be applied by faculty in their review of Senior Project written and oral reports, as well as in the final written and oral reports in 175.

Implementation Timeline

Annually

Senior Exit Interviews

Students take Major Field Test

Rotating Schedule

Analysis of Physics Knowledge, Analytical Knowledge, Technical Skills, Communication Skills on staggered rotating plan; one per year.

Recent alumni survey, every four years.

As Determined Necessary

Detailed inquiry into Physics Knowledge subject area

General alumni survey

Appendix A: Baccalaureate Learning Goals and Us

Sacramento State Baccalaureate Learning Goals for the 21st Century

Competence in the Disciplines: The ability to demonstrate the competencies and values listed below in *at least one major field of study* and to demonstrate informed understandings of other fields, drawing on the knowledge and skills of disciplines outside the major.

Knowledge of Human Cultures and the Physical and Natural World through study in the *sciences and mathematics, social sciences, humanities, histories, languages, and the arts.* Focused by engagement with big questions, contemporary and enduring.

Intellectual and Practical Skills, Including: *inquiry and analysis, critical, philosophical, and creative thinking, written and oral communication, quantitative literacy, information literacy, teamwork and problem solving,* practiced extensively, across the curriculum, in the context of progressively more challenging problems, projects, and standards for performance.

Personal and Social Responsibility, Including: *civic knowledge and engagement—local and global, intercultural knowledge and competence*, ethical reasoning and action, foundations and skills for lifelong learning* anchored through active involvement with diverse communities and real-world challenges.

Integrative Learning, Including:** *synthesis and advanced accomplishment* across general and specialized studies.

All of the above are demonstrated through the application of knowledge, skills, and responsibilities to new settings and complex problems.

Figure 1: Sacramento State Baccalaureate Learning Goals from http://goo.gl/abfQDp

Our program has a very strong overlap with the Baccalaureate Learning Goals (BLGs). Our primary learning outcome, Physics Knowledge, aligns with the first two BLGs, Competence in the Discipline and Knowledge of Human Cultures and the Physical/Natural World. Physics majors are exposed to subjects that have been fundamental in the understanding the universe and the development of the modern world. They are exposed to contemporary research that is shaping our future. The third BLG is Intellectual and Practical Skills. By the very nature of studying physics, our students gain mathematical, computer, instrumentation, and problem solving skills that are not only useful in their professional preparation, but in all aspects of their lives. We emphasize the portability of such skills as they effectively constitute our second learning outcome. Our desire to develop communication skills in graduates also aligns with the third BLG.

The fourth BLG focuses on Personal and Social Responsibility. The process of doing science has significant ethical issues which are addressed in all of our laboratory courses. Students are held to rigorous ethical standards and are taught how to process the data that they collect appropriately. Most laboratory work is also done in groups, as in the "real world," and students learn how to work with others. The final BLG is Integrative Learning. The majority of students graduating from our programs participates in an independent project, either through a Senior Project or in their advanced lab courses (PHYS 116 or 163). These projects give students the opportunity to identify a problem to study, perform an experiment, analyze the results of the experiment, and present the results. These projects tie together all of our learning outcomes and the Integrative Learning BLG.

Appendix B: Brief History of Assessment Activities

Our previous assessment plan was from January of 2008, and is based in large part on the 2001 plan. The changes in 2008 were intended to focus the plan on our academic program as a whole, and away from individual courses. This plan was used for all of our major programs. It was rather holistic and not very rubric driven; this decision was based on our very small numbers of majors that we had at the time. We put significant emphasis on Senior Exit interviews and evaluation of the Senior Project reports.

Since the development of the 2001 plan, we've made several significant changes to our programs. They are briefly summarized here.

- Created *Teacher Preparation Concentration* option for our BA degree to better prepare high school teachers.
- Created *Certificate in Scientific Instrument Development* and *Certificate in Scientific Computing and Simulation* to better prepare students for careers in academia and/or industry.
- Eliminated the languishing and unnecessary Physical Science BA degree program.
- Created PHYS 191, Senior Project, to provide a capstone experience for our students.
- Created PHYS 136 and significantly revised PHYS 156 to better prepare students for graduate studies in Physics.
- Updated PHYS 162 to reflect modern approaches to scientific computing and created PHYS 163 to teach more advanced computing techniques.
- Updated PHYS 115 and PHYS 116 to better reflect the current state of the art in electronics and instrumentation.
- Updated and standardized the PHYS 11-series curriculum to ensure adequate preparation of physics majors and students from Engineering and Chemistry that take this sequence.
- Standardized the curriculum of PHYS 106 to ensure uniform expectation of background of our students in the upper-division. We had found wide disparities in topics covered in this gateway upper-division course.

With the recent surge in the number of our majors, coupled with the desire by the campus and WASC to become more data driven, we have developed this new plan.

Appendix C: Senior Exit Survey

1. Why did you choose to major in Physics, and did your experience here fulfill your expectations that you had of your physics education?

2. What do you consider the greatest strength of our program?

3. What do you consider to be our greatest weakness?

4. What is your assessment of the Senior Project course, and did it give you a genuine experience of research and discovery?

5. Do you think the department sufficiently encourages engagement in physics related activities outside the classroom, for instance, seminars, read papers, field trips, things like that?

6. How do you feel the department has assisted you in learning programming, interfacing, and computation in general?

7. Do you think that the department does an adequate job encouraging student engagement in physics and astronomy, as the case may be, related activities through its student organization?

8. Rate three physics courses that you feel have been, or will be, most beneficial to you, and also, rate three which will be the least beneficial.

9. Was academic advising provided by the department adequate and helpful to you during your time here?

10. Did you take the GRE exam? If so, how well prepared were you for it?

11. Did our lab courses provide sufficient hands on experience?

12. Did you get enough help and guidance to obtain off campus work experience such as REUs, summer internships, and so forth?

13. How accessible and helpful did you find the faculty in the department?

Appendix D: Recent Alumni Survey

1. Internship, summer project, or senior project (P191) while @ Sac State Physics:

2. Current position/occupation:

3. Highlight your professional experience since graduation:

4. Generally, how would you rate the effectiveness of your physics education at Sacramento State?

5. How would you rate the effectiveness of our upper division laboratories?

6. How would you rate the effectiveness of our colloquium/seminar programs?

7. What would you consider as the main strength of your physics education at Sacramento State?

8. What would you consider as the main weakness of your physics education at Sacramento State?

9. What did you feel was most lacking in your physics background as you started working?

10. How would you assess the effectiveness of the Senior Project (P191)?

11. Did you have enough exposure to computer related skills while here?

12. Please comment on any other matter that you deem important.

Appendix E: Rubrics

Our rubrics for Analytic Reasoning, Technical Skills, and Communication Skills begin on the next page.

Analytic Reasoning

	Mastery	Advanced	Intermediate	Simple
	4	**3**	**2**	**1**
Comprehension of the Problem	Problem to be considered clearly understood and the student undertakes a clear strategy to solving the problem. Subtle details are clearly described and considered on how they affect the results.	Problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Problem to be considered is stated by description leaves some terms undefined, unclear, or misunderstanding that can prevent fully solving the problem.	Problem to be considered is poorly addressed. Work takes student down a path that is unsuitable for the problem.
Mathematical Skills	The student shows a mastery of the mathematical techniques needed to solve the problem.	The student shows a very sound understanding of the mathematical tools needed to solve the problems at hand. Errors may exist but are generally not a significant issue in the understanding of the problem.	The student's mathematical work shows some regular difficulties in solving problems.	Student is unable to demonstrate an understanding of the mathematical scaffolding behind the physics problems they are facing.
Connection Between Physics and Mathematics	The student demonstrates that he/she has a complete understanding of how the mathematical results connect to the physical problem being examined. Any discrepancy between the two is clearly and thoughtfully explained.	The student understands the general idea of the connection between the mathematical results and the problems under examination. There may be some incomplete connections that prevent a masterful connection between the mathematical and physical model.	Student makes limited connections between the mathematical and physical world. There may be significant mistakes in the connection and interpretations may also be incorrect.	Student makes no or completely inappropriate connections between the physical problem and the mathematical results used in solving the problems.

(Continued on next page)

(cont)	**4**	**3**	**2**	**1**
Limitations of Analysis	Student clearly defines assumptions made in the model and/or mathematical approach to solving the problem. The implications of these assumptions are clearly described and there is an attempt to show how the inclusion of these subtle effects would change the results.	Student identifies some of the issues that could affect the results of the analysis. There may be little or no attempt to explain the effect of the assumptions on the analysis	Marginal attempt to discuss the accuracy of the model and the limitations of it. A simple acknowledgement that this is a model (without its limitations) is typical for this score.	No attempt to mention any assumptions made in the physical model used to solve the problem.
Accessing Information	Accesses reliable information from a wide variety of sources.	Accesses reliable information from a small number of sources.	Knows what sources of information are reliable	Determines when information is needed.

Technical Skill – Experimental

	Mastery	**Advanced**	**Intermediate**	**Simple**
	4	**3**	**2**	**1**
Use of equipment	Broad and appropriate use of equipment. Used safely.	Generally well used. Good choice of equipment, but perhaps not best possible use.	Not using equipment to potential or inappropriate choice of equipment for job at hand. Use may put equipment in harm's way.	Inappropriate use, unsafe.
Design of experimental apparatus	Student can independently design and use a multicomponent experiment using a variety of components to make a meaningful measurement.	With minimal assistance, student can design and use a multicomponent experiment using a variety of components to make a meaningful measurement.	With moderate assistance, student can design and use a multicomponent experiment using a variety of components to make a meaningful measurement.	Student is generally unable to design and use a multicomponent experiment to make a meaningful measurement.
Use of computer in running an experiment	Student can design appropriate software and hardware to control experiment and log data.	Student can customize appropriate software and hardware to control experiment and log data.	Student can use appropriate software designed by others and hardware to control experiment and log data.	Student cannot effectively use appropriate software or hardware to control experiment or log data.

Technical Skill – Computation

	Mastery	**Advanced**	**Intermediate**	**Simple**
	4	**3**	**2**	**1**
General Level Computer Skills (i.e. word processing, spreadsheets, illustrations, etc.)	Student can use standard computer software to put together compelling documents, reports, etc.	Student uses standard computer software reasonably well. Perhaps doesn't use to full potential or makes less than ideal choices to tackle some aspects of the documents and reports.	Software is used in a marginally effective manner. The way the software is used significantly impacts readability and effectiveness of the work.	Software is used very poorly and the quality of the work is completely hindered by it (even if the physics is done correctly).
Specialized Software (i.e. LabVIEW, C++, FORTRAN, Mathematica, etc.)	Student demonstrates high level under-standing of how software tools can be effectively used in solving technical problems. The "code" is clear, easily read, and understood by others.	The software is well used by the student to solve problems but may not be as easily used by others due to insufficient documentation or poor layout of the code.	The software is used to tackle solving problems, but there are gaps in the full implementation. May also be poorly documented and structured.	The software is ill-used and makes little contribution to solving of the problems at hand. Generally poorly documented and lacking in structure.

Communication Skills – Written

	Mastery	**Advanced**	**Intermediate**	**Simple**
	4	**3**	**2**	**1**

Physics Content	Uses appropriate and relevant physics concepts in a clear and compelling fashion to display mastery of a particular subject in physics. Mathematical work is elegant and easy to follow.	Uses appropriate and relevant physics concepts in a clear and compelling fashion to display or explain sophisticated and/or complicated ideas. Mathematical work is clear and easy to follow.	Uses appropriate and relevant physics concepts to develop or explain more sophisticated ideas. Mathematical work is understandable.	Uses appropriate and relevant physics concepts to develop or explain simple ideas. Mathematical work is confused and/or confusing.
Use of written language	Uses straightforward language that skillfully communicates meaning to readers.	Uses straightforward language that generally conveys meaning to readers.	Uses language that generally conveys meaning to readers, with occasional errors.	Uses language that sometimes makes it difficult to understand meaning.
Formatting of documents	Demonstrates successful use of a wide range of physics-specific conventions in written communication.	Demonstrates consistent use of physics-specific conventions in written communication.	Follows format, organization, and style expectations for the given writing task.	Attempts to use a consistent system for organizing and presenting written information.

Communication Skills – Oral

	Mastery	**Advanced**	**Intermediate**	**Simple**
	4	**3**	**2**	**1**
Conveying of Scientific Content	Scientific concepts are presented in a compelling fashion, with strong supporting evidence.	Scientific concepts are presented in clear, understandable fashion with supporting evidence.	Scientific concepts are presented in an understandable fashion.	Scientific concepts are presented in a confusing fashion.
Organization	An organizational structure is observed consistently through-out the presentation, and its use makes the content very coherent.	An organizational structure is observed consistently throughout the presentation.	An organizational structure is observed intermittently in the presentation.	No organizational structure is observed in the presentation.
Language and Delivery	Language choice and delivery are audience appropriate, and enhance the conveying of important ideas. Presenter appears confident.	Language choice and delivery are audience appropriate and support the conveying of important ideas. Presenter appears comfortable.	Language choice and delivery are understandable by the audience and do not interfere with the conveying of important ideas. Presenter appears tentative.	Language choice and presentation are inappropriate for the audience and obscure the significance of important ideas. Presenter appears uncomfortable.

Communication Skills – Visual Representation of Data

	Mastery	**Advanced**	**Intermediate**	**Simple**
	4	**3**	**2**	**1**
Presentation of data	Presentation of data in	Presentation of data	Presentation of data	Presentation of data

	graphical, tabular, or image form enhances understandability through accuracy, elegant formal and effective labels.	in graphical, tabular, or image form is accurate, with appropriate format and labels.	in graphical, tabular, or image form is partly accurate but confusing in format, labelling, etc.	in graphical, tabular, or image form is inaccurate.