

**Assessment Data Physics and Engineering
General Education: Physics and Physical Science
2019-20**

Learning Outcome:

1e. Quantitative Reasoning: Students will be able to solve problems that are quantitative in nature

Components of this outcome as defined by the department:

- Translation of words or into equations and conclusions
- Calculations and mathematical reasoning
- Reasonable and realistic view of nature

Outcome Measure:

Questions embedded in the final exam are the basis for assessment in all GE Physics and Physical Science classes.

Criteria for Success:

At least 70% of students will have an average above 2.5 on each area of the Physics and Engineering Quantitative Reasoning Rubric. These aspects of quantitative reasoning in a scientific context are as follows: (1) translating graphs and words into equations and conclusions (2) calculation and mathematical reasoning (3) reasonable view of nature.

Scale Used:

- | | |
|---|---|
| 0 | Unsatisfactory - Completely Incorrect |
| 1 | Low Satisfactory - Missed more than one key concept or step |
| 2 | Satisfactory - Missed one key concept or step |
| 3 | High Satisfactory - Made a minor error |
| 4 | Outstanding - Completely correct |

Longitudinal Data:

		Translation words or graphs into equations and conclusions	Calculations and mathematical reasoning	Reasonable and realistic view of nature
PHY141	Fall 2012	98%	100%	82%
PHY141	Fall 2013	98%	100%	75%
PHY141	Summer 2014	100%	100%	67%
PHY141	Summer 2015	100%	100%	83%
PHY141	Summer 2016	98%	90%	88%
PHY141	Summer 2017	100%	100%	100%
PHY141	Fall 2017	95%	85%	90%
PHY141	Summer 2018	100%	95%	95%
PHY141	Fall 2018	89%	84%	74%
PHY141	Summer 2019	80%	100%	85%
PHY1044	Fall 2019	68%	100%	79%
PHY1044	Summer 2020	100%	100%	100%
PHY142*	Spring 2017	70%	90%	75%
PHY142*	Summer 2017	84%	100%	68%
PHY142*	Spring 2018	90%	95%	85%
PHY142*	Summer 2018	100%	100%	100%
PHY142*	Spring 2019	95%	95%	89%
PHY142	Summer 2019	85%	85%	90%
PHY1054	Spring 2020	100%	100%	100%
PHY241	Spring 2015	100%	96%	100%
PHY241	Spring 2017	100%	100%	95%
PHY241	Spring 2018	84%	100%	89%
PHY241	Fall 2018	90%	90%	80%
PHY2044	Fall 2019	90%	100%	95%
PSC103	Fall 2014	87%	87%	77%
PSC103	Fall 2015	79%	77%	87%
PSC103	Fall 2016	95%	89%	95%
PSC105	Fall 2015	96%	92%	100%
PSC105	Spring 2016	57%	85%	86%
PSC105	Fall 2016	100%	65%	88%
PSC105	Spring 2017	90%	100%	95%
PSC105	Fall 2017	95%	95%	90%
PSC105	Spring 2018	85%	90%	90%
PSC105	Summer 2018	100%	100%	94%
PSC105	Fall 2018	94%	94%	89%
PSC105	Spring 2019	95%	95%	100%
PSC1004	Fall 2019	90%	95%	80%
PSC1004	Spring 2020	100%	95%	63%
PSC1004	Summer 2020	89%	83%	89%
PSC110	Fall 2016	95%	75%	100%
PSC110	Spring 2017	90%	95%	95%
PSC111	Fall 2017	90%	95%	95%
PSC111	Fall 2018	75%	90%	85%
PSC1014	Fall 2019	85%	85%	85%
PHY113	Fall 2018	84%	89%	89%
PHY1013	Fall 2019	89%	95%	100%

*PHY142 assessment was redesigned in the spring of 2017 and the questions were computationally significant. The first question was focused on translation of words into equations.

Note that the following changes have been made in the GE course offerings:

- PSC103 Earth Science has been eliminated as a GE class
- PSC110 Physical Science has been eliminated as a GE class
- PSC1011 Physical Science for Teachers has been added as a GE offering focused specifically on the preparation of elementary school teachers.
- PHY1013 The Physics of Sound and Music is a new GE class.

Conclusions Drawn from Data:

Overall PSC classes (Earth Science and Cosmos) tend to have a lower level of success on calculation and mathematical reasoning within a scientific context than the introductory physics classes. This is not surprising in that PHY1044, PHY1054 and PHY2044 have significant mathematical pre-requisites, and it is observed that these students are succeeding at applying these skills in a scientific context.

The PSC courses tend to emphasize the reasonable view of nature category, and the corresponding student understanding can be observed in the measures used. PHY1044, PHY1054 and PHY2044 include a considerable amount of quantitative reasoning. The measures used in these courses are not calibrated to the PSC courses, but are instead designed to identify areas of potential improvement within the context of the expected level of these courses. The measures used tended to be of a more sophisticated nature.

Changes to be Made Based on Data:

Prior to 2014-15, PSC103 did not incorporate significant aspects of calculation (the second criteria). This was increased in the last few years.

Prior to 2015-16, PSC105 did not incorporate significant use of quantitative reasoning. These skills were integrated and measured starting in 2017-18.

Note that in 2017-18, the Physical Science GE courses were reshaped to include an increased emphasis on quantitative reasoning.

Overall the students are meeting our criteria for success.

Rubric Used

Physics and Engineering Quantitative Reasoning Rubric

	Outstanding (4)	High Satisfactory (3)	Low Satisfactory (2)	Unsatisfactory (1)
Translating words or graphs into equations or conclusions	No mistakes	Few mistakes, mostly correct	Several mistakes, some understanding	Many mistakes, not interpreting information
Calculation and Math Reasoning	No mistakes	Few mistakes	Several mistakes	Many mistakes (incorrect use of data and equations)
Reasonable and realistic view of nature (sense of scale etc.)	Good understanding	Minor misunderstandings	Some clear understandings mixed with some misunderstandings	Significant misunderstandings