Program Learning Outcomes for Physics & Astronomy, UH Hilo

B.A. Physics

Upon completion of a B.A. in Physics at UH Hilo, graduates will be able to:

1. demonstrate fluency in the scientific enterprise (e.g., experimental design and technique, clear communication, attention to potential biases)
2. demonstrate awareness of possible career paths available to the undergraduate physics major
3. understand physical processes in the surrounding world
4. formulate scientific problems in mathematical terms and apply analytical and numerical methods towards their solutions
5. demonstrate understanding of the core foundation of physics including classical mechanics, electromagnetism, modern physics, optics, thermodynamics, and quantum mechanics

Assessments of the PLOs are made as follows:

1. Assessment Rubric (p 3), applied to capstone PHYS495B presentation
2. Indirectly via faculty-student interactions, student on- and off-campus employment, post-baccalaureate plan, and alumni surveys (every 4 yr)
3. Assessment Rubric (p 3), applied to capstone PHYS495B presentation
4. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 2)
5. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 2)

The Course Matrix on the next page correlates the level of each specific program learning outcome (PLO) to each course required by B.A. Physics. The key for the table is as follows: I - introduction; D - development; M - mastery; NA - not applicable.

Course Matrix

PLO:	1	2	3	4	5
Course:	Demonstrate fluency in the scientific enterprise (e.g., experimental design and technique,...	Demonstrate awareness of possible career paths available to the undergraduate physics major	Understand physical processes in the surrounding world	Formulate scientific problems in mathematical terms and apply analytical...	Demonstrate understanding of the core foundation of physics including...
PHYS170+L	I	NA	I	I	I
PHYS272+L	I	NA	I	I	I
PHYS260+L	D	NA	NA	D	I
PHYS274	NA	NA	D	D	D
PHYS341	NA	NA	D	D	D
PHYS331	NA	I	I	D	D,M
PHYS330	NA	NA	M	M	M
PHYS371	NA	NA	M	M	M
PHYS430	NA	NA	M	M	M
PHYS495A	D	I	I	NA	NA
PHYS495B	D	I	D	NA	NA
UD PHYS elec. (6 cr)	D,M	I	D,M	D,M	D,M
MATH241	NA	NA	NA	I	NA
MATH242	NA	NA	NA	I	NA
MATH243	NA	NA	NA	D	NA
MATH244	NA	NA	NA	D	NA
MATH300	NA	NA	NA	D	NA
MATH311	NA	NA	NA	D	NA
CS150 or CS172	NA	I	NA	I	NA
Nat. Sci. elec. (9 cr)	I	I	I	I	I

Assessment Rubric for PLOs 1 & 3: PHYS495B Presentation

PLO 1: Demonstrate fluency in the scientific enterprise (e.g., experimental design and technique, clear communication, attention to potential biases)
PLO 3: Understand physical processes in the surrounding world

Dimension of PLO	**Level 1: Beginner** (what it looks like when student is novice/rudimentary w.r.t. outcome)	**Level 2: Intermediate** (what it looks like when student needs to work more w.r.t. outcome)	**Level 3: Competent** (what it looks like when student is proficient w.r.t. outcome)	**Level 4: Advanced** (what it looks like when student is advanced w.r.t. or has mastered outcome)
PLO 1: Overall covers basics of scientific process: big-picture science objective, use of data or theoretical foundation, immediate conclusions, and future work	Major element of scientific process unaddressed	All elements of scientific process addressed, generally weakly	All elements of scientific process addressed, with varying quality	All elements of scientific process well addressed
PLO 1&3: Science objective is well motivated for a broad science-literate audience	Science objective is not clearly provided	Science objective is clearly provided but too technical or too generically/simply for a broad science-literate audience	Science objective is well motivated for a broad science-literate audience	Science objective is well motivated, with specific attention to the broader science-literate audience as well as the (few) experts in the audience
PLO 1: Science objective is investigable, given technical and physical constraints and resources	Science objective effectively not investigable, given technical and physical constraints and resources	Science objective mostly investigable given technical and physical constraints and resources	Science objective investigable, given technical and physical constraints and resources, though constraints and resources not directly addressed	Science objective investigable and the technical and physical constraints and resources are clearly addressed
PLO 1: Experiment or theoretical work clearly addresses the science objective (loosely, “tests a hypothesis”)	Experiment or theoretical work does not address the presented science objective	Experiment or theoretical work mostly addresses the science objective	Experiment or theoretical work indirectly addresses the science objective	Experiment or theoretical work clearly addresses the science objective
PLO 1&3: Uncertainties and assumptions are addressed in context of robustness of conclusions	Does not address sources of uncertainties	Identifies sources of uncertainties	Identifies sources of uncertainties and indicates how they might affect conclusions	Identifies sources of uncertainties and quantifies how they affect conclusions
PLO 1: Conclusions directly based on data or theoretical framework	Conclusions not based on data or theoretical framework	Conclusions indirectly based on data or theoretical framework	Conclusions directly based on data or theoretical framework	Conclusions directly based on data *and* theoretical framework

B.S. Astronomy

Upon completion of a B.S. in Astronomy at UH Hilo, graduates will be able to:

1. demonstrate fluency in the scientific enterprise (e.g., experimental design and technique, clear communication, attention to potential biases)
2. demonstrate awareness of possible career paths available to the undergraduate astronomy major
3. apply basic physical principles from a broad range of topics in physics to astronomical situations
4. formulate scientific problems in mathematical terms and apply analytical and numerical methods towards their solutions
5. demonstrate understanding of the core foundation of astronomy including taxonomy and formation and evolution of planets, stars, galaxies, and the Universe
6. design observing projects with research telescopes (specifically demonstrating understanding of observing techniques and astronomical instrumentation) and/or projects drawing upon data in the literature and in archives
7. recognize and understand the interdisciplinary aspects of astronomy as it pertains to e.g., geology/planetary science, chemistry, and computer science
8. appreciate the significance of Maunakea in Hawaiian culture and its impact in world-wide astronomy

Assessments of the PLOs are made as follows:

1. Assessment Rubric (p 7), applied to capstone ASTR495B presentation
2. Indirectly via faculty-student interactions, student on- and off-campus employment, post-baccalaureate plan, and alumni surveys (every 4 yr)
3. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 6)
4. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 6)
5. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 6)
6. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 6) and Assessment Rubric (p 7), applied to capstone ASTR495B presentation
7. summative assessments (e.g., tests) embedded in the applicable courses (see Course Matrix below, p 6) and specific motivation for related course requirements
8. Indirectly via faculty-student interactions; HWST/KHWS course requirement specifically addresses the cultural significance aspect

The Course Matrix on the next page correlates the level of each specific program learning outcome (PLO) to each course required by B.A. Physics. The key for the table is as follows: I - introduction; D - development; M - mastery; NA - not applicable.

Course Matrix

PLO:	1	2	3	4	5	6	7	8
Course:	Demonstrate fluency in the scientific enterprise (e.g., experimental design and technique,...	Demonstrate awareness of possible career paths available to the undergraduate astronomy major	Apply basic physical principles from a broad range of topics in physics to astronomical situations	Formulate scientific problems in mathematical terms and apply analytical...	Demonstrate understanding of the core foundation of astronomy including...	Design observing projects with research telescopes...	Recognize and understand the interdisciplinary aspects of astronomy as it pertains to...	Appreciate the significance of Maunakea in Hawaiian culture and its impact...
PHYS170+L	I	NA	I	I	I	NA	I	NA
PHYS272+L	I	NA	I	I	I	NA	I	NA
PHYS260+L	D	NA	NA	D	I	NA	I	NA
PHYS274	NA	NA	D	D	D	NA	D	NA
PHYS341	NA	NA	D	D	D	NA	D	NA
PHYS331	NA	I	I	D	D,M	I	D	NA
ASTR110L	I	NA	I	I	I	I	I	I
ASTR180	I	NA	I	I	I	I	I	I
ASTR181	I	NA	I	I	I	I	I	I
ASTR250	D	D	D	I	D	D	D	D
ASTR250L	D	D	D	I	D	D	D	D
ASTR350	D,M	NA	M	M	M	D,M	M	D
ASTR351	D,M	NA	M	M	M	D,M	D,M	D
ASTR495A	D	I	I	NA	NA	NA	I	NA
ASTR495B	D	I	D	NA	NA	NA	I	NA
UD ASTR elec. (6 cr)	D,M	I	D,M	D,M	D,M	D,M	D,M	NA
MATH241	NA	NA	NA	I	NA	NA	I	NA
MATH242	NA	NA	NA	I	NA	NA	I	NA
MATH243	NA	NA	NA	D	NA	NA	I	NA
MATH244	NA	NA	NA	D	NA	NA	I	NA
MATH300	NA	NA	NA	D	NA	NA	I	NA
CS150 or CS172	NA	I	NA	I	NA	NA	I	NA
CHEM161+L or GEOL111+L	I	I	I	I	I	NA	I	NA
HWST211 or HWST 213 or KHWS381	NA	I	NA	NA	NA	NA	I	I

Assessment Rubric for PLOs 1 & 6: ASTR495B Presentation

PLO 1: Demonstrate fluency in the scientific enterprise (e.g., experimental design and technique, clear communication, attention to potential biases)
PLO 6: Design observing projects with research telescopes (specifically demonstrating understanding of observing techniques and astronomical instrumentation) and/or projects drawing upon data in the literature and in archives

Dimension of PLO	**Level 1: Beginner** (what it looks like when student is novice/rudimentary w.r.t. outcome)	**Level 2: Intermediate** (what it looks like when student needs to work more w.r.t. outcome)	**Level 3: Competent** (what it looks like when student is proficient w.r.t. outcome)	**Level 4: Advanced** (what it looks like when student is advanced w.r.t. or has mastered outcome)
PLO 1: Overall covers basics of scientific process: big-picture science objective, use of data or theoretical foundation, immediate conclusions, and future work	Major element of scientific process unaddressed	All elements of scientific process addressed, generally weakly	All elements of scientific process addressed, with varying quality	All elements of scientific process well addressed
PLO 1: Science objective is well motivated for a broad science-literate audience	Science objective is not clearly provided	Science objective is clearly provided but too technical or too generically/simply for a broad science-literate audience	Science objective is well motivated for a broad science-literate audience	Science objective is well motivated, with specific attention to the broader science-literate audience as well as the (few) experts in the audience
PLO 1&6: Science objective is investigable, given technical and physical constraints and resources	Science objective effectively not investigable, given technical and physical constraints and resources	Science objective mostly investigable given technical and physical constraints and resources	Science objective investigable, given technical and physical constraints and resources, though constraints and resources not directly addressed	Science objective investigable and the technical and physical constraints and resources are clearly addressed
PLO 1: Experiment or theoretical work clearly addresses the science objective (loosely, “tests a hypothesis”)	Experiment or theoretical work does not address the presented science objective	Experiment or theoretical work mostly addresses the science objective	Experiment or theoretical work indirectly addresses the science objective	Experiment or theoretical work clearly addresses the science objective
PLO 1&6: Uncertainties and assumptions are addressed in context of robustness of conclusions	Does not address sources of uncertainties	Identifies sources of uncertainties	Identifies sources of uncertainties and indicates how they might affect conclusions	Identifies sources of uncertainties and quantifies how they affect conclusions
PLO 1&6: Conclusions directly based on data or theoretical framework	Conclusions not based on data or theoretical framework	Conclusions indirectly based on data or theoretical framework	Conclusions directly based on data or theoretical framework	Conclusions directly based on data *and* theoretical framework