

**Assurance of Student Learning  
2019-2020**

Ogden College of Science and Engineering

Physics and Astronomy

Physics 754

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*Use this page to list learning outcomes, measurements, and summarize results for your program. Detailed information must be completed in the subsequent pages.*

**Student Learning Outcome 1: Students will show a mastery of foundational principles and requisite mathematics**

**Instrument 1** MFT scores

**Instrument 2**

**Instrument 3**

Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 1.

**Met**

Not Met

**Student Learning Outcome 2: Students will develop a mastery of empirical methods**

**Instrument 1** Presentation of research projects in Senior Seminar (Physics 498).

**Instrument 2** Presentation of research projects at local, state and national conferences.

**Instrument 3**

Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 2.

Met

**Not Met**

**Program Summary (Briefly summarize the action and follow up items from your detailed responses on subsequent pages.)**

We expect our students to develop and display a mastery of the empirical methods used in Physics and Astronomy and demonstrate a mastery of foundational principles and requisite mathematics.

The Major Field Test (MFT) subscores are monitored and used to determine areas in the curriculum where our students are not performing at or above national medians. Multi-year trends are used to determine curricular weakness and then the curriculum is examined to determine the appropriate course(s) to examine for improvement. The most recent subscore show our students remain within the bounds of the national medians for the introductory and advanced physics content knowledge, with no discernable trends. In Spring 2021, the first cohort of students who were taught University Physics with the Matter and Interactions Curriculum will take the MFT. At that time we will be able to evaluate if that curricular change resulted in any gains or losses.

In the senior seminar courses, students often show weakness in oral expression of empirical methods, which stems in part from weakness in their ability to express empirical methods in a written format. Written skills are honed throughout the laboratory portion of the physics program curriculum; oral skills are honed via oral assessments in junior and senior level classes. Oral and written skills are assessed via presentations in the Physics 498 (senior seminar) class and oral presentations at local, regional and national conferences.

The detected weaknesses are being addressed via modifications to the University Physics I and II laboratory courses (Physics 256 & Physics 266) designed to increase the emphasis on proper laboratory report preparation and in the increased use of both oral and written project based assessments in upper division Physics classes. The modifications to the University Physics I laboratory course began in Fall 2019; University Physics II modifications will begin in Fall 2020. The first cohort of these students will not reach the Physics 498 course until Fall semester 2021. At that time we will be able to evaluate if there has been a detectable improvement in student ability to express empirical their methods as a result of the course modifications.

**Student Learning Outcome 1**

|   |   |  |                |
|---|---|--|----------------|
| <b>Student Learning Outcome</b>   | <b>Students will show a mastery of foundational principles and requisite mathematics</b>  |  |                |
| <b>Measurement Instrument 1</b>   | Major Field Test (MFT)  |  |                |
| <b>Criteria for Student Success</b>   | As a cohort, students will score at or above the national median in all subfields and in the total score.   |  |                |
| <b>Program Success Target for this Measurement</b>  | 100   | <b>Percent of Program Achieving Target</b> | 100            |
| <b>Methods</b>  | The ETS provides comparative institutional data medians for the MFT. WKU students as a cohort over the same time period score at the median (within the standard deviation) in the total score, as well as the introductory and advanced sub categories. The students take the MFT as rising juniors, thus not all of them have had the complete suite of advanced coursework, yet our students do just as well compared to their peers across the nation at the introductory and advanced level. |  |                |
| <b>Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 1.</b>  |   | <b>Met</b>                                 | <b>Not Met</b> |
| <b>Actions</b> (Describe the decision-making process and actions planned for program improvement. The actions should include a timeline.)   |   |  |                |
| The subscores are monitored and used to determine areas in the curriculum where our students are not performing at or above national medians. Multi-year trends are used to determine curricular weakness and then the curriculum is examined to determine the appropriate course(s) to examine for improvement. The most recent subscore show our students remain within the bounds of the national medians for the introductory and advanced physics content knowledge, with no discernable trends. |   |  |                |
| <b>Follow-Up</b> (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.)   |   |  |                |

In spring 2021, the first cohort of students who were taught introductory Physics with the Matter and Interactions curriculum will take the MFT. At that time we will be able to evaluate if the curricular change resulted in any gains or losses.

**Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome)

This will be assessed in the next assessment cycle.

### Student Learning Outcome 2

|  |  |  |                |
|--|--|--|----------------|
| <b>Student Learning Outcome</b>  | <b>Students will develop a mastery of empirical methods</b>  |  |                |
| <b>Measurement Instrument 1</b>  | This is measured by student performance in the Physics 498 (Senior Seminar) courses. Students are required to present results of their research activities and submit a written project abstract in the course.  |  |                |
| <b>Criteria for Student Success</b>  | Student receives a grade of C or better in the course. (This will be changed for AY20-21- we did not receive the feedback on 2018-19 report in time to institute the change in time for AY 19-20)  |  |                |
| <b>Program Success Target for this Measurement</b>   | 90   | <b>Percent of Program Achieving Target</b> | 100            |
| <b>Methods</b>   | In 2019-2020 a total of 6 students were evaluated in the Physics 498 courses. Student oral and written presentations are evaluated based upon the following criteria: the content of the presentation was high quality, and the delivery of the presentation was high quality, and student made a serious effort to prepare for the presentation.  |  |                |
| <b>Measurement Instrument 2</b>  | <b>Successful presentation of research projects at local, state and national conferences</b>   |  |                |
| <b>Criteria for Student Success</b>  | 75% of students in our next assessment cycle plan, we had already discussed adding a third learning outcome (see will successfully present their research projects at local, state and/or national conferences.  |  |                |
| <b>Program Success Target for this Measurement</b>   | 75   | <b>Percent of Program Achieving Target</b> | 30             |
| <b>Methods</b>   | Faculty mentors and/ or other program faculty will attend conferences with the students and evaluate the student presentations and report back to the department their evaluation of the student performance and whether or not the student presentation won an award at the conference. The disruption to conferences due to COVID 19 severely limited the opportunities for students to present their work at conferences. |  |                |
| <b>Based on your results, highlight whether the program met the goal Student Learning Outcome 2.</b> |  |  | <b>Met</b>     |
|  |  |  | <b>Not Met</b> |

|   |  |  |
|---|--|--|
|   |  |  |
| <b>Actions</b> (Describe the decision-making process and actions for program improvement. The actions should include a timeline.)   |  |  |
| <p>The majority of students display a gradual maturation in their oral and written expression as they progress through the physics curriculum and are engaged in mentored research projects with faculty. This is assessed in student presentations in the Physics 498 course sequence, as well as in their preparation of research presentations as part of mentored research experiences. In the senior seminar courses, students often show weakness in independent writing skills as well as in oral expression of empirical methods. As a result of this weakness, the introductory laboratory sequence (University Physics I and II) is in the process of being modified to include an increased emphasis on proper laboratory report preparation. In addition, we have begun to make use of both oral and written project based assessments in upper division Physics classes. The next step is a modification to the University Physics II (Physics 266, to begin Fall 2020) laboratory course to further emphasize and improve these skills.</p> |  |  |
| <b>Follow-Up</b> (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.)   |  |  |
| <p>The modifications to the University Physics I laboratory course began in Fall 2019; those for University Physics II begin in Fall 2020. These students will not reach the Physics 498 course until Fall 2021. At that time we will be able to evaluate if there has been a detectable improvement in student oral and written presentation skills.</p>   |  |  |
| <b>Next Assessment Cycle Plan</b> (Please describe your assessment plan timetable for this outcome)   |  |  |
| <p>This will be assessed in the next assessment cycle. We plan on drilling deeper into the student's ability to display a mastery of empirical methods by separately examine their oral and written communication skills. Written skills will be evaluated via written research abstracts in the Senior seminar class. The writing examples will be evaluated on a rubric (see attached) with the goal that 90% of all students evaluated will have an overall score of good or better. This will become measurement instrument 1 for learning Outcome 2. Oral communication skills will be evaluated via the research presentations in the senior seminar class and at conferences. Student oral presentations will be evaluated via a rubric (see attached) with the goal that 90% of all students evaluated will have an overall score of good or better. Oral communication skills will become a new learning outcome (Learning Outcome 3), with the evaluation of the oral presentations as the measurement instrument.</p>                          |  |  |

## Oral Presentation evaluation rubric

Based on presentation of work in Senior seminar.

|                                     | 4: Excellent  | 3: Good  | 2: Needs some improvement  | 1: Needs major improvement  |
|-------------------------------------|---|--|--|---|
| Understanding of material           | Presentation demonstrated excellent understanding of the topic and its context. | Presentation demonstrated adequate understanding of the topic and its context. | Presentation demonstrated some gaps and/or errors in student understanding of the topic and context. | Presentation demonstrated significant gaps or errors in student understanding of the topic and context. |
| Presentation organization and flow. | Presentation was well organized and seamlessly presented.                       | Presentation was logically organized and adequately presented.                 | There were minor issues with the organization and flow of the presentation.                          | Presentation was disorganized and/or confusingly presented.   |
| Interaction with audience           | Student developed excellent rapport with the audience during the presentation.  | Student interacted with the audience and made eye contact most of the time.    | Student had a little interaction with the audience and made eye contact some of the time.            | Student did not interact with or look at audience.  |
| Answering questions                 | Student provided thoughtful, quality responses to questions from audience.      | Student provided adequate responses to questions from audience.                | Student had some difficulties in understanding or answering questions from audience.                 | Student completely misunderstood or was unable to provide answers to questions from audience.           |

## Scientific Work evaluation rubric

Based on written abstract

|  | 4: Excellent | 3: Good | 2: Needs some improvement | 1: Needs major improvement |
|--|--------------|---------|---------------------------|----------------------------|
|  |              |         |                           |                            |

|                      |   |  |   |   |
|----------------------|---|--|---|---|
| Research question    | Research question is original, clearly articulated and of compelling importance.                            | Research question is clear and doable.   | Research question is presented but it is poorly articulated, too broad or narrow in scope, or otherwise problematic.                | No identifiable research question presented.  |
| Research methodology | Research methodology exceptionally well designed and executed to answer research question.                  | Employs a research methodology that is appropriate for answering the question.                               | Research methodology is mismatched or incomplete for answering research question.   | No research methodology employed, or that employed seems unrelated to the research question.  |
| Data and theory      | Compelling, high-quality data collected & analyzed and/or an ambitious theoretical investigation completed. | Sufficient data collected and analyzed OR theoretical investigation carried out to answer research question. | Some data collected and analyzed OR theoretical investigation conducted giving a suggestive or partial answer to research question. | No/insufficient data collected and analyzed, or incomplete theoretical investigation, such that cannot begin to answer research question. |
| Conclusions          | Clear, articulate and compelling conclusions drawn from investigation.                                      | Appropriate conclusions drawn from investigation.  | Conclusions ambiguous or only partially supported by the investigation.   | No conclusions presented or the conclusions are unrelated to the scientific investigation.  |