

**Annual Assessment Report
Department of Physics
15 May 2020**

This year marks the first year of our new student assessment cycle. In 2020 the assessment cycle called on our department to evaluate our first learning goal:

“Upon successful completion of the requirements for the physics major, students will be able to demonstrate an understanding of physical phenomena and the models that describe them.”

Direct Assessment

The Senior Capstone Experience in Physics requires students to pass a summative exam over the material covered in the major. The vast majority of students take an exam written and administered by our department, but any student who does sufficiently well on ETS’s GRE Physics Subject Test can use their score to satisfy the senior capstone.¹ Our department directly assessed how well students understood physical phenomena and the models that describe those phenomena by applying our Capstone Exam Rubric to the student responses to the exam. (A copy of our Capstone Exam Rubric can be found in Appendix A of our Student Assessment Plan.)

We group physical phenomena covered in our curriculum into four broad areas: Mechanics, Electricity & Magnetism, Thermal & Statistical Physics, and Quantum Mechanics. Each of the four tenured and tenure-track members of the Department of Physics used physics students’ work on the departmental exam to assess students in one of these broad areas. On April 30, 2020, the department met to share our initial evaluations, discuss our rationales when applying the rubric, collectively decide on our final scores, and consider the implications of the results. The results of this direct assessment can be found in Figure 1.

Indirect Assessment

The Department of Physics uses an online Microsoft Form to administer an exit survey to soon-to-be graduates. We ask that all departing physics students complete the survey including: graduating physics majors, graduating chemical physics majors, graduating physics minors, and those physics and chemical physics majors who are leaving Hendrix to study at the dual-degree engineering partner school. (A copy of our Physics Exit Survey can be found in Appendix F of our Student Assessment Plan.)

We indirectly assess whether students have an understanding of physical phenomena and the models that describe them through question 6 of the exit survey which asks students how they “feel about [their] preparation” in “some of the areas typically covered in undergraduate physics programs.” Nine physics majors completed the survey and the results for the four major content areas are shown in Figure 2. A discussion of these results were part of our April 30 assessment meeting.

¹ In 2020 only one physics student used her Physics GRE score to satisfy the senior capstone experience.

Use of Evidence

The department is generally pleased with what our students demonstrated on the senior capstone exam, and we do not see any evidence here that suggests we should rethink the content or pedagogy of our major. The small differences in the number of students reaching mastery within the four content areas is best explained by the statistical fluctuations of testing a small number of students or by how recently a student completed coursework in the content area. For example, because we teach our upper-division courses every other year, it has been 18 months since a student covered material for some content areas. Most students were taking electrodynamics (E&M) at the same time they were taking their capstone exam, and we see that 100% of students demonstrated mastery in that content area. Quantum Mechanics, for which 88% of students demonstrated mastery, was taught last semester. It has been at least a year since students took Classical Mechanics (Mechanics) and Thermal Physics – two subject areas for which 50% and 63% of students, respectively, were able to demonstrate mastery.

Our departmental discussion did reveal that the capstone rubric does not completely align with the capstone exam. We felt that the exam questions intended to measure whether a student had met the “Developing” milestone in several content areas seemed inadequate. We think this is largely a function of the way the capstone exam is organized by coursework in the major rather than by the broad thematic content areas outlined in the rubric.² In response to this assessment, we have decided as a department to rewrite our capstone exam next year to be aligned with the rubric.

We also note here that our direct assessment does not capture students who use the GRE Physics Subject Test to satisfy their Senior Capstone Exam. For typical years like this one, when only a small fraction of students takes the exam, we do not think this poses any obstacle to assessing our program broadly. However, should there be a year in which a larger fraction of students use the GRE Physics Subject test, the department would like the flexibility to apply the rubric to a student’s final exam work. We have edited our student assessment plan to document this change.

Also important is whether students *feel* that the department is adequately preparing them in these broad content areas. We note here that between 78% and 100% of respondents felt prepared in the core subject areas. As a department, we are happy with these responses. We did look at individual responses to see if there were some insights to be gleaned about why one or two students only felt “exposed to” a subject, but the comments only reveal that those students wanted more physics courses – something we cannot do with the current staffing model.

² This explains why no students were marked as “Developing” in the Thermal Physics and Statistical Mechanics section – the exam did not require students to answer a question that really addressed its developing milestone. This was true of the other three broad content areas, but to a lesser extent for Mechanics and Quantum.

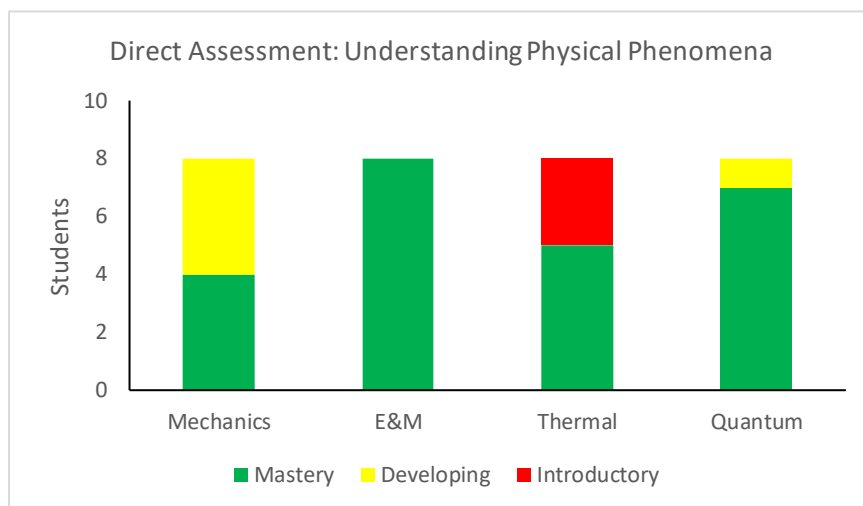


Figure 1. The results of the department's direct assessment of physics students' understanding of physical phenomena. The results are grouped by content area and show what fraction of the students demonstrated *mastery* of the material, demonstrated they had reached the *developing* milestone, or only showed evidence they had met the *introductory* milestone. These results include the assessment of eight physics majors. Three students who graduated in 2019-2020 are not included in these results: a student who graduated in December of 2019 before revisions to our student assessment plan, a student who used the ETS GRE Physics Subject Test as her capstone experience, and a Chemical Physics major who used the physics exam to satisfy her Chemical Physics Senior Capstone Experience.

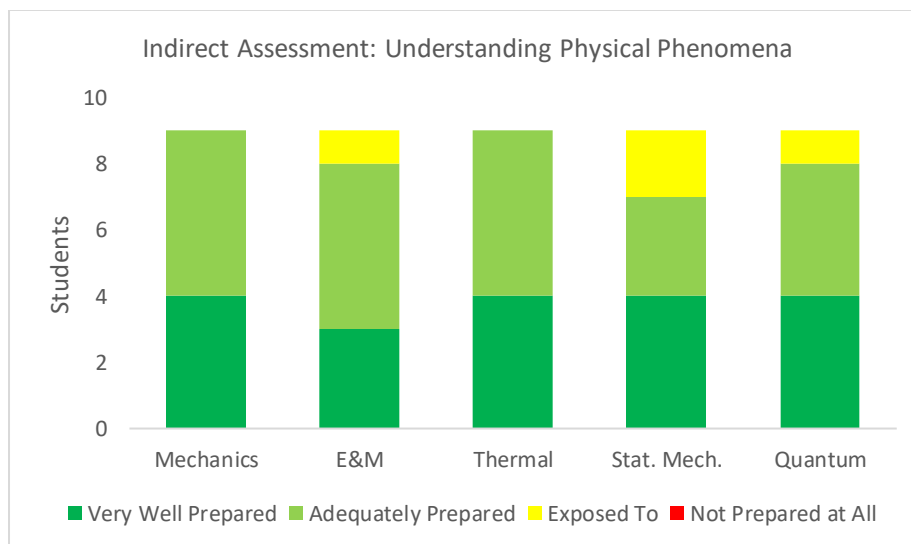


Figure 2. The results of the department's indirect assessment of physics students' understanding of physical phenomena. The results are grouped by content area and show what fraction of the students felt they were *very well prepared*, *adequately prepared*, *exposed* to the material, or *not prepared at all*. These results include the assessment of nine physics majors. While thermal physics and statistical mechanics are grouped in the direct assessment, they are separate here; this proves to be of little consequence given the similarities in the distributions of student responses.