

Longitudinal study tracks why undergrads stick with or leave physics

Many students entering college with an interest in physics don't end up pursuing it. Why do those who stay, stay? And why do those who leave, leave? A five-year study by the American Institute of Physics (AIP; publisher of *PHYSICS TODAY*) considered those and related questions. The data, analysis, and recommendations for boosting the numbers of physics majors are presented in the recently released report *Attrition and Persistence in Undergraduate Physics Programs*.

For the study, AIP Research surveyed 3917 students in introductory physics courses at four large, predominantly white US universities during the 2018–19 and 2019–20 school years. Students were asked whether they were interested in majoring in physics; 745 said yes or maybe. The AIP researchers sent those students follow-up yearly surveys by email through spring 2023—or until they said they were no longer interested in the major—to see how factors such as race, gender, high school

preparation, physics course experiences, self-perception of math proficiency, and self-confidence in physics tracked with their outcomes. The researchers also had one-on-one interviews with 75 students who graduated in physics and 39 students who lost interest.

Among the reasons that students gave for persisting in physics are a feeling of accomplishment and the field's relevance for math and other sciences.

More than 70% of the students who did not stay in physics left by the beginning of their second year. The interviewed students who had left the major cited both “pull” reasons, such as being more interested in another subject or career path, and “push” reasons, such as negative experiences in a physics course or physics department (see the chart).

“When students leave a physics major because of burnout or negative experiences in physics classrooms, I think it's a missed opportunity,” says AIP's Anne Marie Porter, a coauthor of the report.

“These students care so much about physics, and if circumstances were different, they would have been able to stay in the major.”

The most common major to switch to from physics was engineering (71%), followed by math (46%). Other popular destinations were astronomy or astrophysics (44%), computer science (37%), and chemistry (21%). The most common non-STEM choice was business (14%).

Of the students who left physics, those from underrepresented groups and women were more likely than their white counterparts and men to report encountering discrimination and otherwise having more unsatisfactory social experiences in their programs. African American and Hispanic students were less likely to report feeling that they received encouragement from physics professors. Women were more likely to say that they believed that they performed worse on physics assignments than their peers.

The study also delivers on the question for which it was originally crafted: When do women lose interest in physics? It's not that the field of physics is driving away women but rather that “women are a lot less interested than men in majoring in physics,” says coauthor Rachel Ivie. “It happens way before college.” The director of higher education programs and grants at the American Association of Physics Teachers, Ivie designed the study when she was director of AIP Research. The motivation for the study, she says, was the drop in female representation from more than 50% in high school physics classes to about 20% of physics majors, where it's hovered since 2005.

Recommendations to assist physics departments in attracting, retaining, and increasing the number of enrolled students can be found in the report. They include supporting undergraduate research programs; discussing physics careers early in the college experience; designing shorter, more flexible physics course sequencing; and prioritizing inclusion and retention.

Tonya Gary

Reason for leaving physics	Percentage of interviewees who cited each factor
Pull factors	
Interest in another subject	74
Interest in a different career path	32
Positive course experiences in another subject	29
Positive department climate in another subject	5
Push factors	
Negative course-sequencing experiences in physics	38
Negative course experience in physics	28
Negative department climate in physics	3

(Adapted from *Attrition and Persistence in Undergraduate Physics Programs*, table 11; <https://www.aip.org/statistics/attrition-and-persistence-in-undergraduate-physics-programs>.)

INTERVIEWS WITH 39 STUDENTS WHO LEFT PHYSICS revealed several broad classes of reasons for their decision. Some students were “pulled” toward other majors because of positive experiences and interests, and some were “pushed” away by negative experiences within physics, such as the long, rigid sequence of courses. Many of the students provided multiple reasons for leaving the field, so the percentages add up to more than 100%.