

University of Maryland  
PHYS 499X  
Making Physics Experiments  
Syllabus  
Spring 2019

**Professor**

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**Course Emphasis**

Physics 499x is a laboratory course emphasizing practical skills used for making Physics experiments within the broader context of the maker movement and the maker culture. The course will cover design, fabrication, hands-on skills, repair, and safety. It will utilize the Physics Department's Makerspace to offer a curriculum focusing on practical skills that are not otherwise covered in the traditional coursework (e.g.: carpentry, electronics disassembly/assembly, soldering).

Each week the course will have two hours of interactive lectures on practical skillsets. A two-hour lab will include hands-on experiential project-based learning in the makerspace and field trips to various campus locations (e.g. the various machine shops and maker spaces around campus). The first third of the semester the labs will cover skills we will then use to improve and repair some physics lecture demonstrations. We will then turn to the design and fabrication of new lecture demonstrations. Students will be evaluated on participation, hands-on assignments, and project activities. Active participation by everyone is expected for us to make a real impact.

Most projects will involve developing new lecture-demonstrations or upgrades to existing demonstrations. Projects will be evaluated based on specifications, a manual, a project oral presentation, and results. The field trips will be either to (1) campus locations where things are fabricated or (2) unique facilities that show different technologies.

Skills obtained and techniques learned in this course might serve as a gateway into the Physics Makerspace community, and may prepare students for experimental research experiences in future career trajectories, whether in research or industry.

More information about the maker movement and culture can be found here:

[https://en.wikipedia.org/wiki/Maker\\_culture](https://en.wikipedia.org/wiki/Maker_culture)

### **Location**

Lecture meets Monday and Wednesday 1-1:50 p.m. in Room Toll 1309  
The laboratory section will meet Friday 1-2:50 p.m. in the Physics Maker Space: the Vortex. The Vortex is located in the former physics welding shop (building 111), tucked between the physics and chemistry buildings. The official address is: Physics Welding Shop, 8124 Chemistry Ln, College Park, MD 20740 and you can get to there directly from the courtyard between the physics, chemistry, and math buildings. Occasional lectures or labs may morph into field trips to on-campus fabrication facilities.

### **Laboratory Practice and Write-ups**

Students will work in pairs on the laboratory activities. Format for the write-ups and possible associated videos will be discussed in lecture and the assignments. Students are encouraged to be creative with regard to the assignments. In cases where modifying the project is desired, an alternative design is needed; ideally those should be reviewed with the instructor prior to the modified project. All students are expected to work creatively during the course.

### **Grades**

The semester grade for the course will be determined in the following way:

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Lab results and resulting documentation	60%
Participation in lab and lecture (sign-in)	10%
Homework and designs	30%

### **LIST OF LABORATORY ACTIVITIES (all labs will have a safety component)**

- 1) Intro to woodshop – warm-up soft wood and Schrödinger’s dice
- 2) Laptop tear-down and harvesting
- 3) Knots and Sewing
- 4) Welding steel
- 5) 3D printing
- 6) Soldering and unsoldering
- 7) Lecture demonstration repair
- 8) Lecture demonstration upgrades
- 9) New lecture demonstrations

### **PRELIMINARY LECTURE TOPICS**

- 1) Overview of the maker culture; overview of making physics experiments; safety intro -- all lectures will touch on safety
- 2) Safety and fire safety
- 3) Creativity and design

- 4) Electrical circuits, sensors and actuators
- 5) Materials overview
- 6) Traditional fabrication and power tools
- 7) Modern 3D/water/laser fabrication
- 8) CAD
- 9) Skills: knots, treads, cable, and sewing
- 10) Metal materials fabrication, welding/soldering
- 11) Plastics and glass
- 12) Composites and adhesives
- 13) Vacuum
- 14) Optics
- 15) Budgets/credit/venture creation
- 16) 3D printing

**Additional possible topics:**

vacuum forming

laser-cutting

optical systems

micro and nanofabrication

machine design II (power, rotating systems)

microcontrollers

vacuum technology