

“Choose your own adventure” labs for introductory physics

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AAPT physics laboratory goals

The AAPT has laid out five goals of intro physics lab[1]. I choose to focus on the following three:

- ❶ The art of experimentation
- ❷ Experimental and analytical skills
- ❸ Develop collaborative learning skills

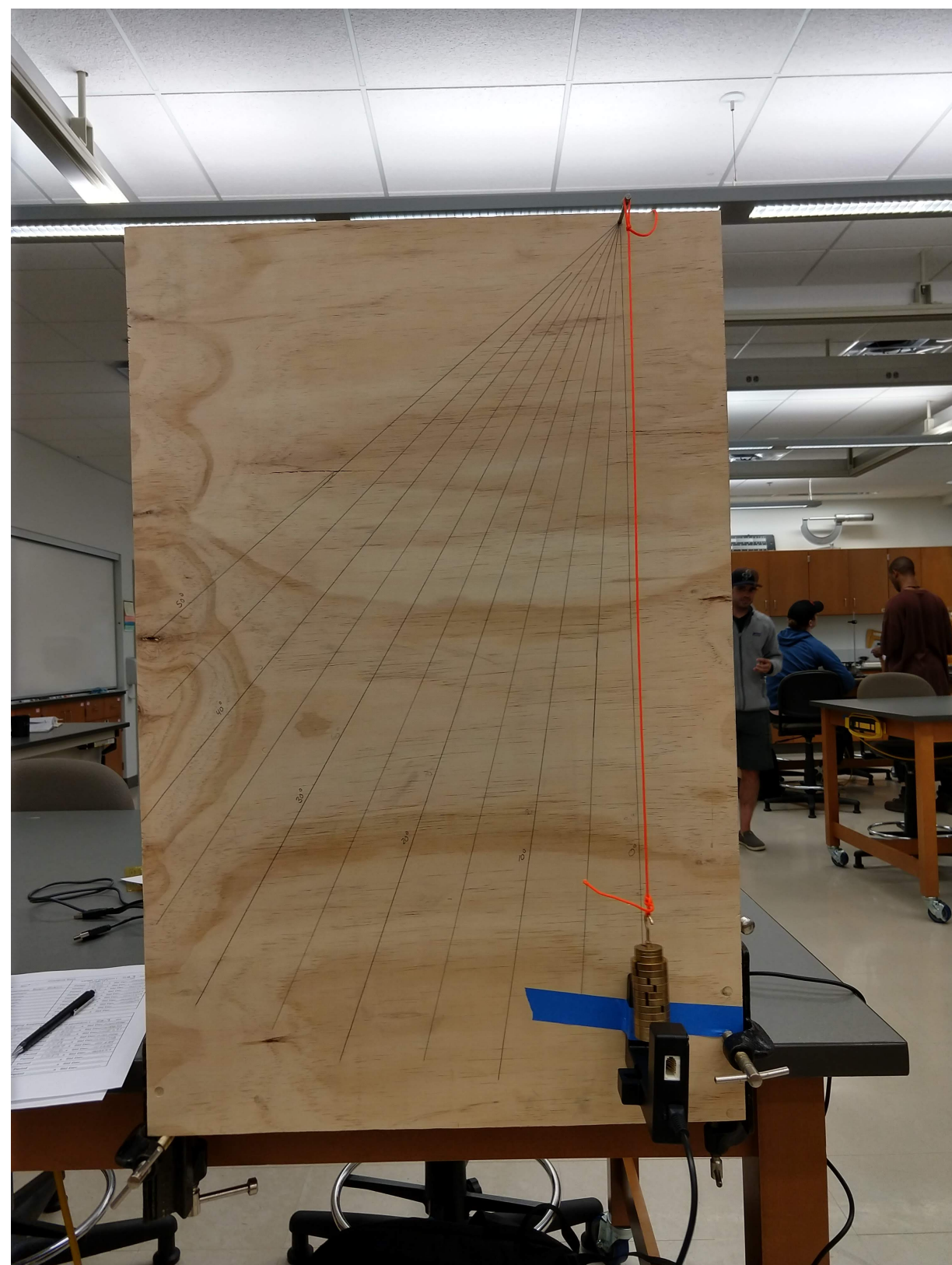


Figure 1: Student-created setup to measure relationship between period and amplitude of a pendulum

Traditional labs

- Two hours, once per week
- Very prescriptive
- Students do not get practice designing valid experimental procedures
- Students do not gain meaningful understanding of measurement uncertainty
- Insignificant student learning[2][3][4]

CYOA labs

- Multiple weeks
- Broad scope
- Students design their own experiments, take preliminary data, then refine the experiment in following weeks
- Students need to consider sources of experimental error and how they can be overcome

How it looks in practice

First week of a project

- Introduce the big picture for the lab
- Go over equipment available
- Take some questions—but give no detailed answers
- Pay attention to what the students do

Following weeks

- Brief introduction: remind students what they’re working on
- Call attention to common pitfalls observed from the previous week
- Give some direction to groups who are lost

I use **multi-week projects** instead of cookbook labs to teach **experimental** and **error analysis** skills in the context of physics to introductory students

“I took pride in the lab reports”

“**I have developed more on the skill of thinking like an engineer.** I really liked the aspect of not being given a way to do the lab and having the free range to choose what I thought was best to find the data needed [...] **With past labs, I always felt like I was just doing what I was told and then that was it.** I never really had to think about it and apply what I am learning in class. Instead with these labs, **I took pride in the lab reports because my partner and I had figured out all that work** [...] The water property lab really allowed for everyone to have different experiments to find the same thing.”

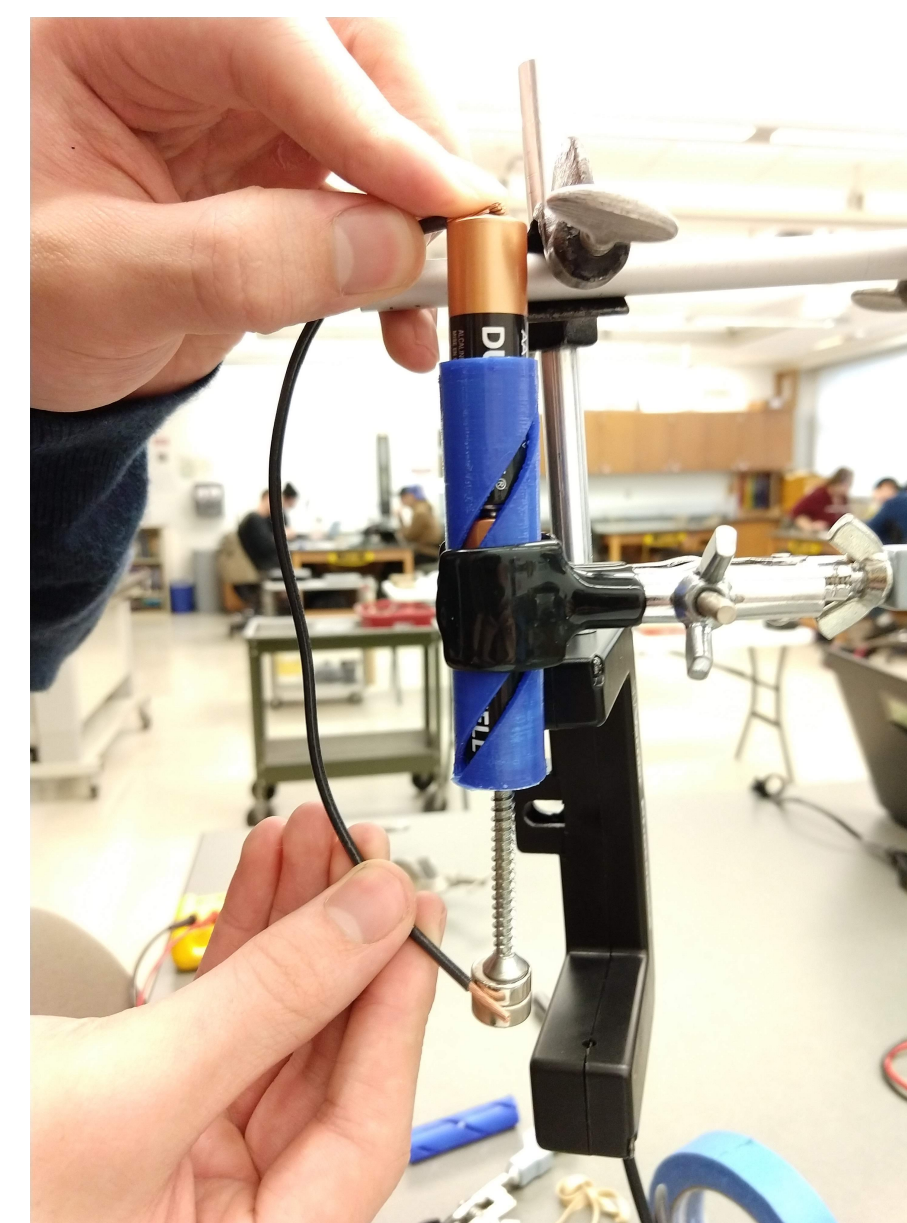


Figure 2: 3D-printed battery holder for homopolar motor lab

References

- [1] AAPT, “Goals of the introductory physics laboratory,” *Am. J. Phys.*, vol. 66, pp. 483–485, June 1998.
- [2] N. G. Holmes and C. E. Wieman, “Introductory physics labs: We can do better,” *Phys. Today*, vol. 71, pp. 38–45, Jan. 2018.
- [3] A. B. Arons, “Guiding insight and inquiry in the introductory physics laboratory,” *Phys. Teach.*, vol. 31, pp. 278–282, May 1993.
- [4] N. G. Holmes and D. A. Bonn, “Quantitative comparisons to promote inquiry in the introductory physics lab,” *Phys. Teach.*, vol. 53, pp. 352–355, Sept. 2015.

For more information

- Email: droth@olympic.edu
- Link to examples: tinyurl.com/CYOALabs

