

New Oscillations Lab(s)

Worcester Polytechnic Institute

C term 2023

Some notes on this lab: There are several lab proposals below that we are hoping you can help us test // have fun with. We are not certain how well this will go, so we have several places for you to leave feedback, including here! Feel free to add comments and edits to this document as you go along.

Deliverables

Pre-lab 4

Please submit a project proposal for your 4th lab. In the proposal please include **two** ideas of new labs or additions to old labs that you are hoping to develop. You may submit the same proposal as your lab partner. The options for this are

- We have several setups you can work with, and are included below
- You can work to expand a lab that you have already done,
- Or if you have access to supplies (instruments, recording equipment, skateboards, etc.) you would like to integrate, and a random idea we encourage you to consider trying it out.

In your prelab please include:

- A list of supplies you want to use
- The general theory you want to look at and a general motivation for your proposed lab

Post-Lab 4 Deliverables

- If you are working through a new lab you may write your own version of a lab guide for said new lab. Include in it:
 - A motivation for your experiment
 - Parts list and basic procedure
 - Pictures of the setup
 - One example data set
- If you are working to expand an old lab please write a full traditional lab report.
 - Check in with your lab instructor before beginning here to make sure your expansion is different enough to fulfill the requirements of this lab.

In your fifth lab, your writeup for lab 4 will be given to another student who will then use your writeup to perform that lab that week. They will then provide feedback on your lab, and for lab 5 you will submit a full lab writeup, integrating the other student's feedback. That means your lab 4 post lab must be submitted on time.

Post-Lab 5 Deliverables

Part 1: To be emailed // submitted and we send it to the group whose lab you tested out in your last week of lab

- Send feedback on the lab you tested in lab 5 to the student group that wrote it. Please include a dataset ++ setup photo. (2-3 days after you complete the lab)
 - Annotated photo of the setup
 - "Data set"
 - Consult the lab guide you are giving feedback on for what that means
 - 2-4 sentences for each question below individually about the lab you tested
 - What parts of the lab did you enjoy?
 - What do you think was the learning goal of the labs?
 - What parts of the lab guide were confusing?
 - 2 ways to make this lab stronger

Part 2: You'll incorporate the other student groups feedback and re-write and re-submit your original lab

- Fix and finalize your own lab. That includes adding
 - An Introduction
 - A complete, detailed method
 - Annotated pictures of the setup
 - Your example dataset

General water housekeeping notes:

- Keep water within it's bowls and containers. If you spill water or sand or hot chocolate on the floor clean it up, it is your responsibility to keep your area safe and clean.
- Much of this equipment is new and experimental. If you break it that is fine, but do a detailed log of how it broke and please feel free to try and fix it. Just keep a log of what you try to fix it.

General Supplies

- String
- Masses

- Rulers
- Springs
- Logger Pro Motion Sensor

Coupled Harmonics

- You can think about what harmonics look like as they are connected together
 - Either below as springs, or as pendulums or in some new way!
 - Frictionless surface we have are cart tracks

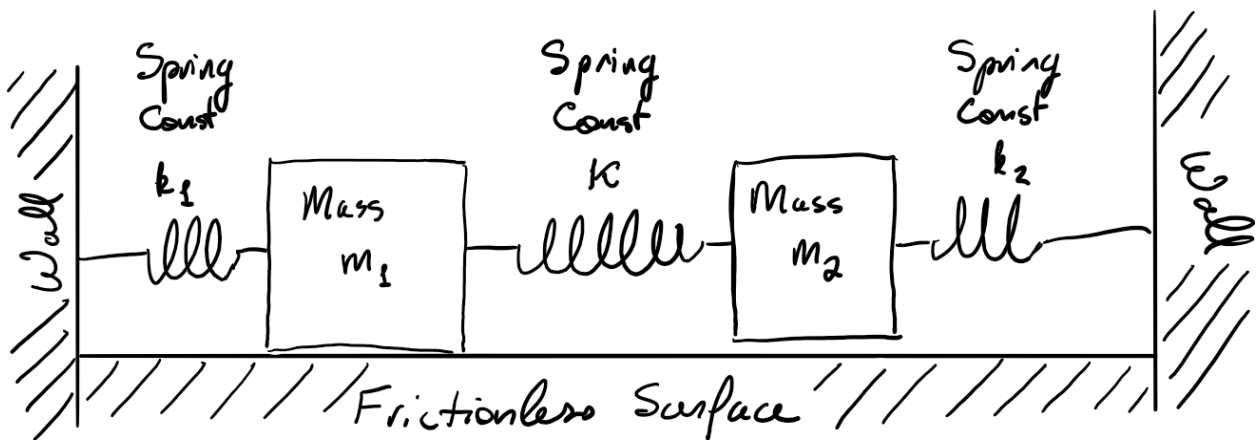


Figure 1: Example of a coupled oscillator with springs

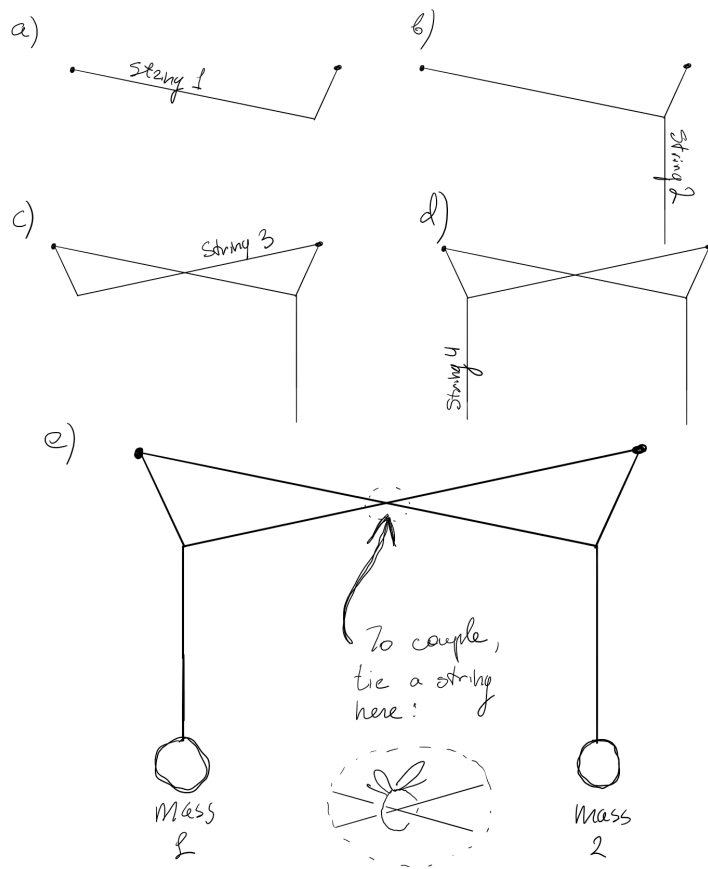


Figure 2: Example of a coupled oscillator with pendulums

Angle vs Wavelength

We have a clear acrylic box that can be tilted to different angles with a pump that will pour water into the top continuously.

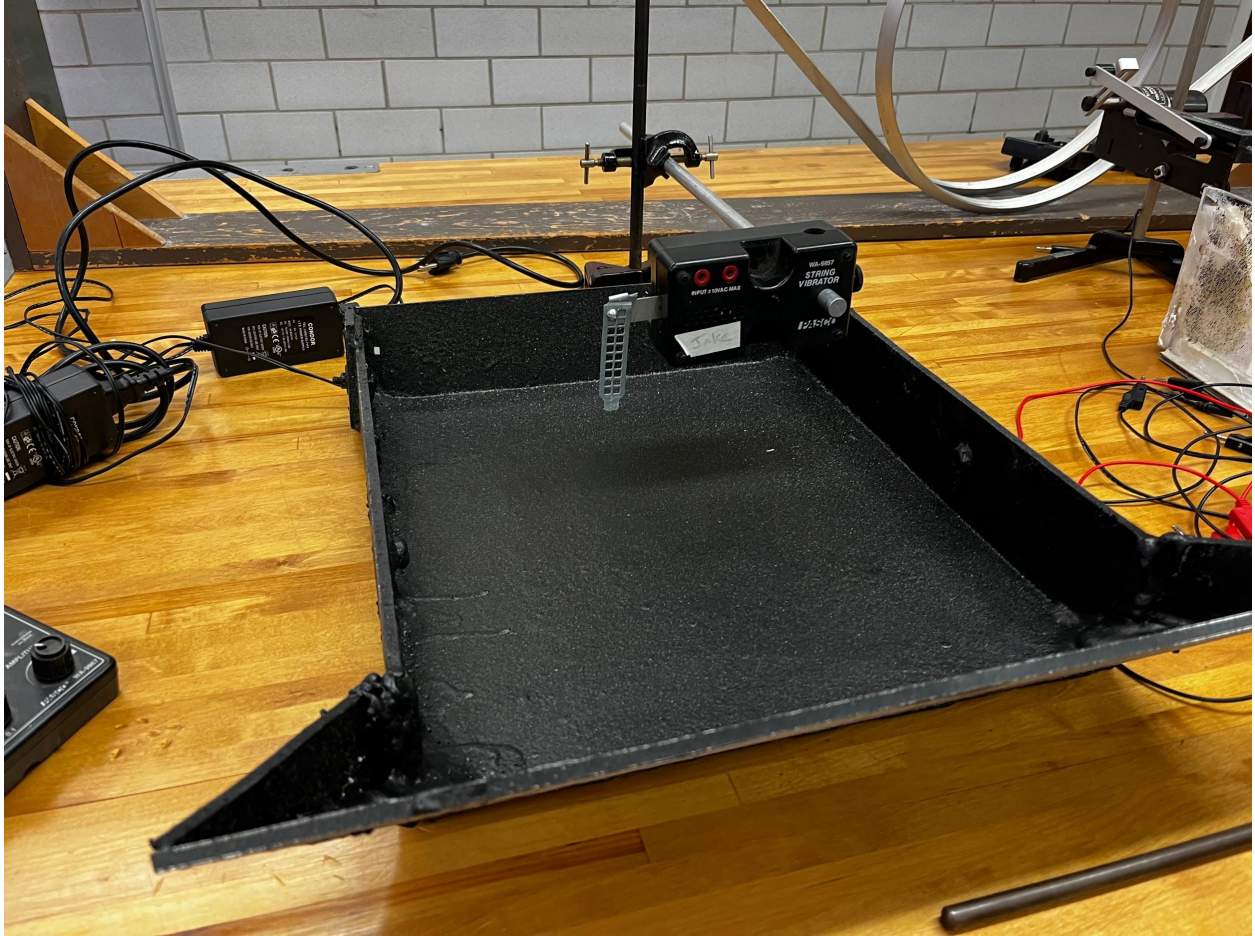


Figure 3: Example setup with an oscillator ontop of a water proof enclosure

Density mixing

- Water
- Food dye
- Salt
- Corn Syrup

See this reference here: <https://youtu.be/mNgyLD9OXs4>

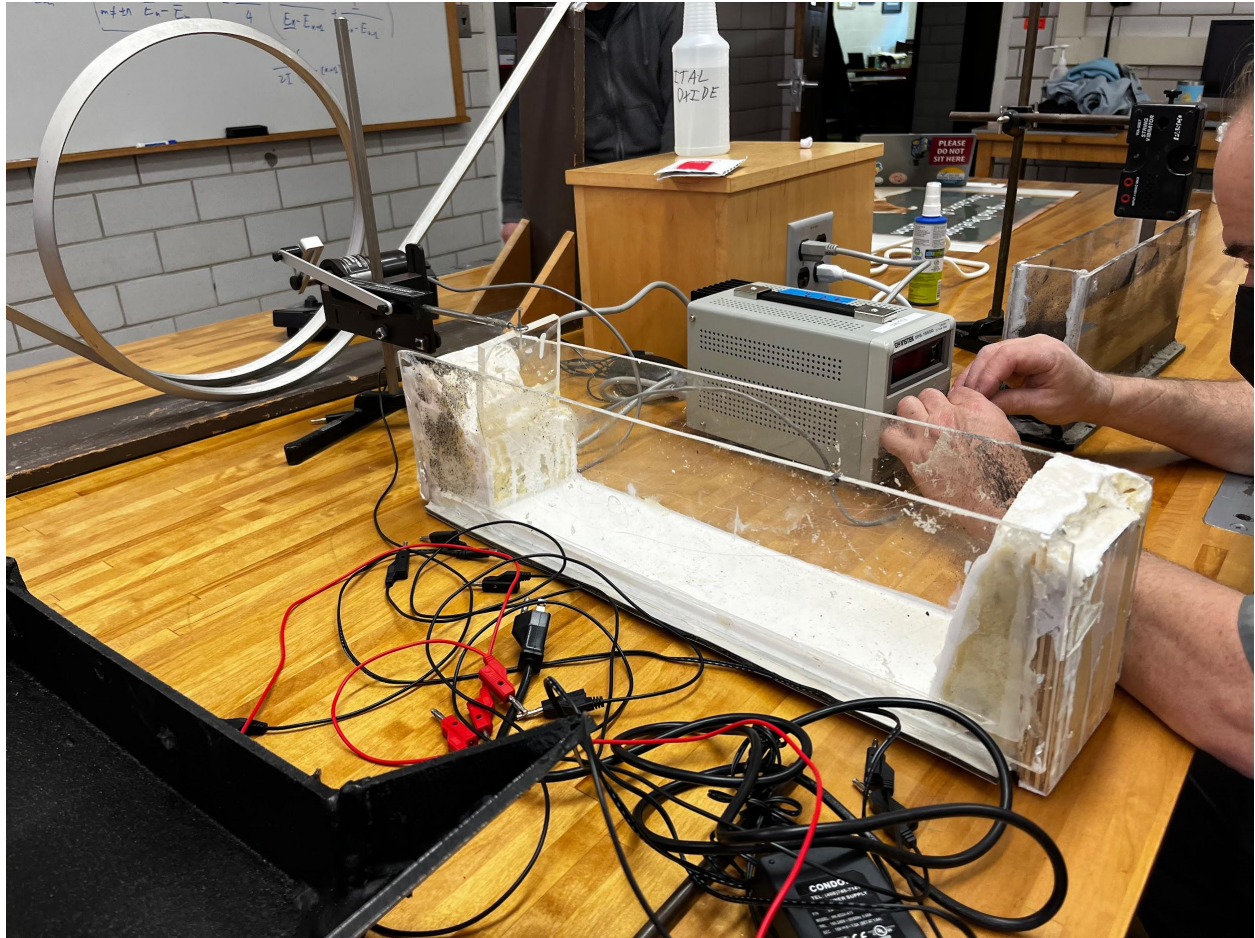


Figure 4: Waterproof enclosure with an oscillator in the top right. That oscillator can go back and forth, and is connected to a paddle that can move several inches of water.

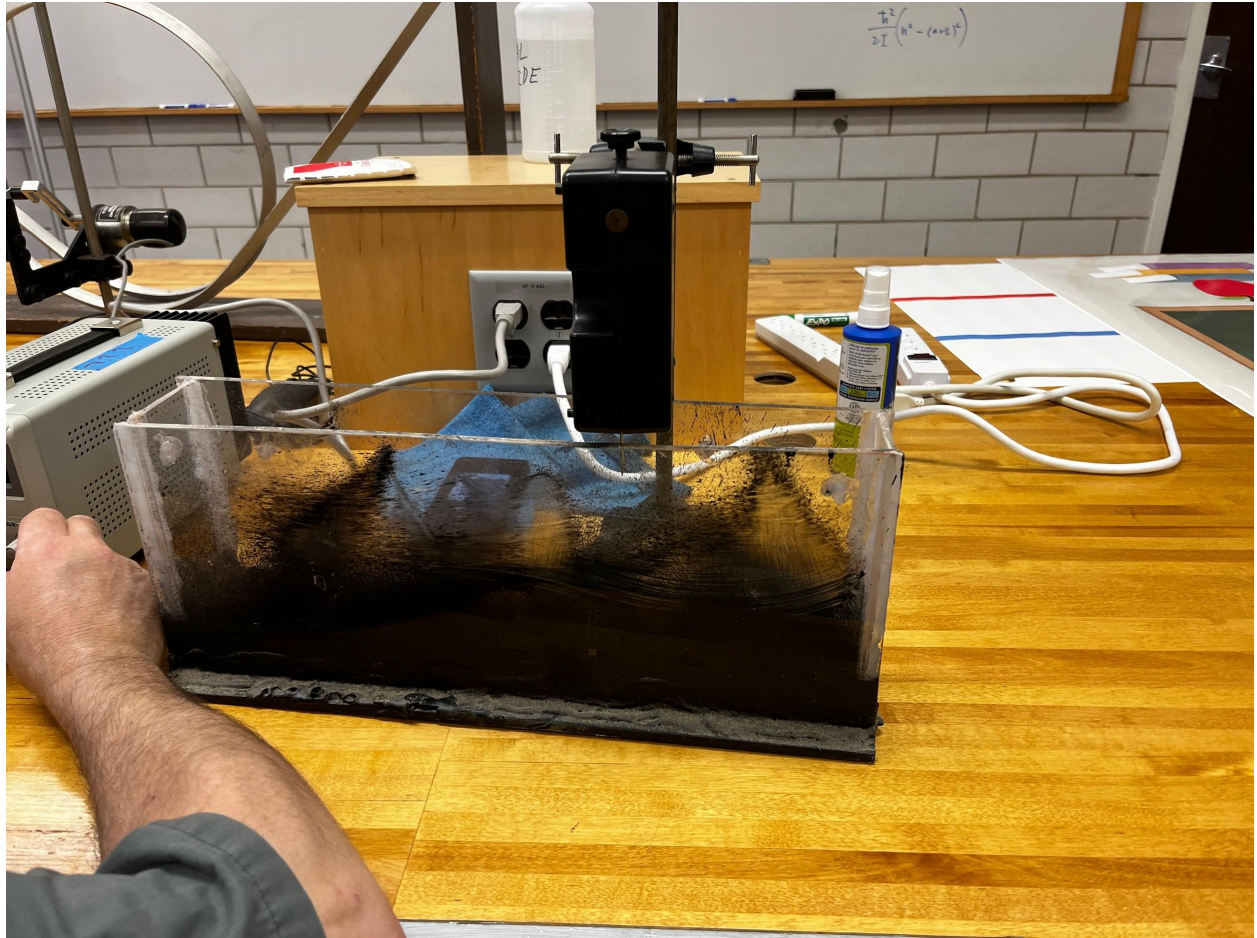


Figure 5: Waterproof setup with an oscillator ontop. This bin is long and thin.



Figure 6: A table with a soft, flexible material spread across it. Ontop of the dark blue fabric is an oscillator with a point that when connected up causes oscillations. This is also called a "chladni plate". You would add sand or some other small particle material on top (styrofoam?)

- You'd have to find sand for this. I'm told there is some sand in the fields.

Expansion on the speed of sound lab with tubes and tuning forks

Using water you can change the height of your tube and look at nodes

Doppler Ball

Doppler effect and soccer – <https://plc.tamu.edu/demo/doppler-ball/>

Double Pendulum

DIY Double pendulum –

<https://makezine.com/projects/string-up-simple-chaotic-double-pendulum-cat-toy/>

Wilberforce Pendulum

See this reference here: <https://physlab.org/experiment/wilberforce-pendulum/>

Expand on a previous lab

This should challenge you by addressing a conceptually different aspect of the lab that you did not have time to explore previously. These should be ran past your lab instructor before you begin.

Acknowledgements

We are very grateful to Doug Leonardi for building several interesting mock ups for our water labs this week.

Old options – maybe available, check with Dana before choosing

Simulating wave propagation and formation in a non-smooth surface

Figure 1: Example of our experiment to look at wave propagation. The close end shows a rocky foam that comes above the clear acrylic keeping the water in. On the far end there is a clear acrylic piece connected to a black arm. That is the wave oscillator.

Figure 2: A second view of the new wave propagation experimental setup. Here you can more easily see that the water extends about 4-6 inches deep at the deepest part. Also you can see that we have positioned it over the sink. That's intentional, at the moment it is still leaking but this way it's leaking into a plant.