**Wave Interference Remote Lab Lesson Design** by Trish Loeblein

**Topics** Interference, Double Slit, Diffraction, Waves

**Description** Make waves with a dripping faucet, audio speaker, or laser! Add a second source to create an interference pattern. Put up a barrier to explore single-slit diffraction and double-slit interference. Experiment with diffraction through elliptical, rectangular, or irregular apertures.

**Sample Learning Goals**

* Make waves with water, sound, and light and see how they are related.
* Design an experiment to measure the speed of the wave.
* Create an interference pattern with two sources, and determine the ways to change the pattern.
* Find points of constructive and destructive interference by eye and by using the detectors.
* Put up a barrier to see how the waves move through one or two slits. What sort of pattern do the slits create? How can you change this pattern?
* For light, predict the locations of the fringes that appear on the screen using d sin(θ) = mλ. Use the tape measure to verify your predictions.
* Explain how the aperture geometry relates to the diffraction pattern.
* Predict how changing the wavelength or aperture size affects the diffraction pattern.

**For Lab1**

I used the lab I wrote for [Waves Intro Remote Lab](https://docs.google.com/document/d/1hVYKo329RQaC3gfH7I2Bd2NrM3RbR17cjMjU58rYDcs/edit?usp=sharing) and edited the directions to fit the Wave Interference [Waves](https://phet.colorado.edu/sims/html/wave-interference/latest/wave-interference_en.html?screens=1) screen.

**Note about prior learning:** Students should have completed[Waves on a String Remote Lab](https://docs.google.com/document/d/1_qiaLNltKZ3zrMiI0U0UOJqcWUGz6dz0yanoWsVhriQ/edit?usp=sharing)

 <https://phet.colorado.edu/en/contributions/view/2819> or lessons with similar learning goals.

**From** [**Sim page**](https://phet.colorado.edu/en/simulation/waves-intro) **of Wave Intro**

**Topics** Frequency, Amplitude, Wave Speed. Wavelength, Water, Sound, Light

**Description** Make waves with a dripping faucet, audio speaker, or laser! Adjust frequency and amplitude, and observe the effects. Hear the sound produced by the speaker, and discover what determines the color of light.

**Sample Learning Goals** (I used these)

* Make waves with water, sound, and light and see how they are related.
* Discuss wave properties using common vocabulary.
* Explain how changing the frequency and amplitude affects the characteristics of the wave.
* Design an experiment to measure the speed of the wave.

Notes: In class, I would just make the challenges I put in this lab by projecting the questions. We would have class discussion during which groups would share out results. I have assumed in my writing that students will use a text or online research to define words that they do not know like “wavelength” and “period.”

**For Lab 2** [**Wave Interference**](https://phet.colorado.edu/sims/html/wave-interference/latest/wave-interference_en.html?screens=2) **Screen 2 and 3**

**Note about prior learning:** Students should have completed[Waves on a String Remote Lab](https://docs.google.com/document/d/1_qiaLNltKZ3zrMiI0U0UOJqcWUGz6dz0yanoWsVhriQ/edit?usp=sharing)

<https://phet.colorado.edu/en/contributions/view/2819> or lessons with similar learning goals. Also, [Waves Intro‌ Remote Lab](https://docs.google.com/document/d/1hVYKo329RQaC3gfH7I2Bd2NrM3RbR17cjMjU58rYDcs/edit?usp=sharing)‌  <https://phet.colorado.edu/en/contributions/view/5466> or [Waves Interference Remote Lab ‌1](https://docs.google.com/document/d/1Fri4FGhWpgBdbAw52-3R5FIKBMARdCAMD9SH92St8Wg/edit?usp=sharing)  <https://phet.colorado.edu/en/contributions/view/5467>

**Topics** Interference, Double Slit, Waves

**Description:** Add a second source to create an interference pattern. Put up a barrier to explore single-slit diffraction and double-slit interference.

**Learning Goals**

1. Create an interference pattern with two sources, and determine the ways to change the pattern.
2. Find points of constructive and destructive interference by eye and by using the detectors.
3. Put up a barrier to see how the waves move through one or two slits. What sort of pattern do the slits create? How can you change this pattern?

For Remote Learning, I have decided not to address the Sample Goal “For light, predict the locations of the fringes that appear on the screen using d sin(θ) = mλ. Use the tape measure to verify your predictions.”. The Slits screen would work for this goal.

Interference screen 2 goals A and B

Slits screen 3 goals C

This lab is designed for inquiry learning and there will be many possible answers for questions. Just a few ideas that might be helpful:

#1 Similar is important because the patterns have been changed size. Frequency and distance give similar patterns. By not including the wave generators, I have made the lab more inquiry based.

#4 is a repeat of ideas from #3, but is an opportunity to practice goal B in a more structured way.

#5 these patterns can be made by varying distance or frequency

For Remote Learning, I have decided not to address the Sample Goal “For light, predict the locations of the fringes that appear on the screen using d sin(θ) = mλ. Use the tape measure to verify your predictions.”

**Lab 3 Diffraction Advanced screen 4**

**Topics** Interference, Diffraction through apertures, waves

**Description:** Experiment with diffraction through elliptical, rectangular, or irregular apertures.

**Learning Goals**

1. Compare light wave patterns made by passing through slits to patterns passing through holes.
2. Explain how the aperture geometry relates to the diffraction pattern.
3. Predict how changing the wavelength or aperture size affects the diffraction pattern.

#1 Using extremes on sliders is to best see how variations change patterns.