

Name: \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_

PhET Wave Reflection, Diffraction and Interference

This is an adaptation of a lab originally submitted to PhET by Marsh Harden ([marshaharden@katyisd.org](mailto:marshaharden@katyisd.org)), of the Katy Independent School District, on 5/8/2008.

Everybody has at some time thrown a pebble into a puddle and observed the ripples spreading across the surface. Most people have gone to the beach and watched waves crash onto the shore and into barriers. Water waves and sound waves act in a similar way.

**OBJECTIVE:** To examine reflection, interference, and diffraction in two dimensions.

**SAFETY:** A COMPUTER SCREEN ON THE WRONG WEBSITE WILL BE SHUT DOWN!

**PROCEDURE:** Setup

1. Open the PhET lab at <http://phet.colorado.edu/en/simulation/wave-interference>.
2. Move the **frequency** marker and **amplitude** marker to the center of their scales.
3. Click on “**Show Graph**”. This shows a side view of the ripples leaving the disturbance caused by the drop of water.
4. Click on the **measuring tape** box. The placement of the two red x’s are used to measure the wavelength ( $\lambda$ ).
5. Click on “**Add Detector**”. This gives you the ability to determine the number of waves passing in a second ( $f$ ).
6. Drag the “**Measuring Tape**”, and the “**Detector**” to the white area out of the water.
7. **BEFORE YOU CHANGE ANTHING ELSE! CALCULATE THE VELOCITY OF THE WAVES!**

$$\text{VELOCITY (m/s)} = \text{FREQUENCY (Hz)} \times \text{WAVELENGTH (m)} \quad \text{or} \quad V = f\lambda$$

8. **Click Pause, move the marker on “ROTATE VIEW to SIDE”. Using the measuring tape, Place the red X under Phet on top of a crest first, then move the other red X to the top of the next crest. The centimeters in the green box is the wavelength. Record the distance in centimeters ( $\lambda$ ). Move the marker on “ROTATE VIEW back to TOP”.**

Answer:

9. **Click Play.** Use the **Detector** to determine the number of complete waves that occur each second. (HINT: Each block in the Detector is one second.) **Record** the number of waves per second (cycles per second) or Hertz (Hz) ( $f$ )

Answer:

10. Using the frequency and wavelength data that you collected, **calculate** the velocity. **SHOW YOUR WORK! Use UNITS ON ALL NUMBERS!**

Answer:

## REFLECTION

- Click the **off button** on the faucet.
- Add a **vertical wall** (bottom right corner) across the entire width of the tank by clicking on “**One Slit**” then adjusting the “**Slit Width**” to **zero**.
- Move the “**Barrier Location**” marker to **6.2 cm**.
- Click the ON button on the faucet. Click **PAUSE** after the wave returns back to the faucet. **Draw and label the pattern REFLECTION. Describe the wave pattern in complete sentences.**

Answer:

## WAVE INTERFERENCE

- Click on “**Pause**”. Click on “**No barrier**”. Click on “**Two Drips**”. Adjust the “**Spacing**” to **5 cm**.
- Click on “**Play**” and when the first wave reaches the far wall click on “**Pause**”. **Draw and label the pattern WAVE INTERFERENCE. Describe the wave interaction in complete sentences.**

Answer:

## DIFFRACTION

- Click on “**PAUSE**”. Click “**Reset All**”.
- Increase the **amplitude and frequency markers to maximum** (far right).
- Click on **ONE SLIT** to the **BARRIER** and **adjust its size to 1.25 cm (halfway between 0 and 2.5)**.
- Move the **BARRIER** marker to **6.2 cm** from the faucet. Click on “**PLAY**”.
- Allow the wave to reach the far wall and click on “**PAUSE**”. **Draw and label the wave pattern DIFFRACTION. Describe the wave pattern in complete sentences.**

Answer:

## YOUR EXPERIMENT!!!!!!!!!!!!!!!!!!!!!!!!!!!!

- Click “**Reset All**”. Click “**Pause**”.
- Set up a situation which has not been tried. Such as: What would happen if two slits were in the barrier instead of one? (Keep it simple.) **Write your question.**

Answer:

- Write your **hypothesis**. **Write a probable answer to your question or predict the outcome of the experiment. (Draw what the wave patterns might look like, then write it in complete sentences.)**

Answer:

- Write down** all of the parameters (settings planned for the simulation) for simulation.

Answer:

- Set the changes desired on the simulator and click “**Play**” to start the experiment. **Collect data by drawing the wave pattern created. Describe the pattern in complete sentences.**

Answer:

26. Write a conclusion comparing your hypothesis to the data collected.

Answer:

**SOUND - REPEAT STEPS 7 THROUGH 26 FOR SOUND, THEN ANSWER QUESTIONS 3 & 4.**

1. Make sure that “Gray Scale” is clicked.
2. Do the steps 7-26 for sound. Do not forget your experiment.

7. **BEFORE YOU CHANGE ANTHING ELSE! CALCULATE THE VELOCITY OF THE WAVES!**

$$\text{VELOCITY (m/s)} = \text{FREQUENCY (Hz)} \times \text{WAVELENGTH (m)} \quad \text{or} \quad V = f\lambda$$

8. Click Pause, move the marker on “ROTATE VIEW to SIDE”. Using the measuring tape, Place the red X under Phet on top of a crest first, then move the other red X to the top of the next crest. The centimeters in the green box is the wavelength. Record the distance in centimeters ( $\lambda$ ). Move the marker on “ROTATE VIEW back to TOP”.

Answer:

9. Click Play. Use the Detector to determine the number of complete waves that occur each second. (HINT: Each block in the Detector is one second.) Record the number of waves per second (cycles per second) or Hertz (Hz) ( $f$ )

Answer:

10. Using the frequency and wavelength data that you collected, calculate the velocity. SHOW YOUR WORK! Use UNITS ON ALL NUMBERS!

Answer:

**REFLECTION**

11. Click the off button on the faucet.
11. Add a vertical wall (bottom right corner) across the entire width of the tank by clicking on “One Slit” then adjusting the “Slit Width” to zero.
12. Move the ‘Barrier Location’ marker to 6.2 cm.
13. Click the ON button on the faucet. Click PAUSE after the wave returns back to the faucet. Draw and label the pattern REFLECTION. Describe the wave pattern in complete sentences.

Answer:

**WAVE INTERFERENCE**

14. Click on “Pause”. Click on “No barrier”. Click on “Two Drips”. Adjust the “Spacing” to 5 cm.
15. Click on “Play” and when the first wave reaches the far wall click on “Pause”. Draw and label the pattern WAVE INTERFERENCE. Describe the wave interaction in complete sentences.

Answer:

### DIFFRACTION

16. Click on “PAUSE”. Click “Reset All”.
17. Increase the amplitude and frequency markers to maximum (far right).
18. Click on ONE SLIT to the BARRIER and adjust its size to 1.25 cm (halfway between 0 and 2.5).
19. Move the BARRIER marker to 6.2 cm from the faucet. Click on “PLAY”.
20. Allow the wave to reach the far wall and click on “PAUSE”. **Draw and label the wave pattern DIFFRACTION. Describe the wave pattern in complete sentences.**

Answer:

### YOUR EXPERIMENT!!!!!!!!!!!!!!!!!!!!!!

21. Click “Reset All”. Click “Pause”.
22. Set up a situation which has not been tried. Such as: What would happen if two slits were in the barrier instead of one? (Keep it simple.) **Write your question.**

Answer:

23. Write your hypothesis. **Write a probable answer to your question or predict the outcome of the experiment. (Draw what the wave patterns might look like, then write it in complete sentences.)**

Answer:

24. **Write down** all of the parameters (settings planned for the simulation) for simulation.

Answer:

25. Set the changes desired on the simulator and click “Play” to start the experiment. **Collect data by drawing the wave pattern created. Describe the pattern in complete sentences.**

Answer:

26. **Write a conclusion comparing your hypothesis to the data collected.**

Answer:

3. Click on “Particles”. Click on “Show Markers”.
4. Describe the movement of the markers. **What conclusion/inference** can you make about the movement of matter in a sound wave?

### LIGHT – REPEAT STEPS 7 THROUGH 26 FOR LIGHT, THEN ANSWER THE QUESTIONS 2 through 4 BELOW.

7. **BEFORE YOU CHANGE ANTHING ELSE! CALCULATE THE VELOCITY OF THE WAVES!**

$$\text{VELOCITY (m/s)} = \text{FREQUENCY (Hz)} \times \text{WAVELENGTH (m)} \quad \text{or} \quad V = f\lambda$$

8. Click Pause, move the marker on “ROTATE VIEW to SIDE”. Using the measuring tape, **Place the red X under Phet on top of a crest first, then move the other red X to the top of the next crest.** The centimeters in the green box is the wavelength. **Record** the distance in centimeters ( $\lambda$ ). **Move the marker on “ROTATE VIEW back to TOP”.**

**Answer:**

9. **Click Play.** Use the **Detector** to determine the number of complete waves that occur each second. (HINT: Each block in the Detector is one second.) **Record** the number of waves per second (cycles per second) or Hertz (Hz) ( $f$ )

**Answer:**

10. Using the frequency and wavelength data that you collected, **calculate** the velocity. **SHOW YOUR WORK! Use UNITS ON ALL NUMBERS!**

**Answer:**

### **REFLECTION**

11. Click the **off button** on the faucet.
11. Add a **vertical wall** (bottom right corner) across the entire width of the tank by clicking on “**One Slit**” then adjusting the “**Slit Width**” to **zero**.
12. Move the “**Barrier Location**” marker to **6.2 cm**.
13. Click the ON button on the faucet. Click **PAUSE** after the wave returns back to the faucet. **Draw and label the pattern REFLECTION. Describe the wave pattern in complete sentences.**

**Answer:**

### **WAVE INTERFERENCE**

14. Click on “**Pause**”. Click on “**No barrier**”. Click on “**Two Drips**”. Adjust the “**Spacing**” to **5 cm**.
15. Click on “**Play**” and when the first wave reaches the far wall click on “**Pause**”. **Draw and label the pattern WAVE INTERFERENCE. Describe the wave interaction in complete sentences.**

**Answer:**

### **DIFFRACTION**

16. Click on “**PAUSE**”. Click “**Reset All**”.
17. Increase the **amplitude and frequency markers to maximum** (far right).
18. Click on **ONE SLIT** to the **BARRIER** and adjust its size to **1.25 cm** (halfway between 0 and 2.5).
19. Move the **BARRIER** marker to **6.2 cm** from the faucet. Click on “**PLAY**”.
20. Allow the wave to reach the far wall and click on “**PAUSE**”. **Draw and label the wave pattern DIFFRACTION. Describe the wave pattern in complete sentences.**

**Answer:**

### **YOUR EXPERIMENT!!!!!!!!!!!!!!!!!!!!!!**

21. Click “**Reset All**”. Click “**Pause**”.
22. Set up a situation which has not been tried. Such as: What would happen if two slits were in the barrier instead of one? (Keep it simple.) **Write your question.**

**Answer:**

**23. Write your hypothesis. Write a probable answer to your question or predict the outcome of the experiment. (Draw what the wave patterns might look like, then write it in complete sentences.)**

**Answer:**

**24. Write down all of the parameters (settings planned for the simulation) for simulation.**

**Answer:**

**25. Set the changes desired on the simulator and click “Play” to start the experiment. Collect data by drawing the wave pattern created. Describe the pattern in complete sentences.**

**Answer:**

**26. Write a conclusion comparing your hypothesis to the data collected.**

**Answer:**

1. After repeating the stepS for waves, click “Pause”.
2. Move the wavelength marker to purple and click “Play”. Measure the wavelength between two crests with the measuring tape.
3. Move the wavelength marker to **bright red** and make **the wavelength measurement** again.
4. What conclusion/inference can you make about the wavelengths of color?

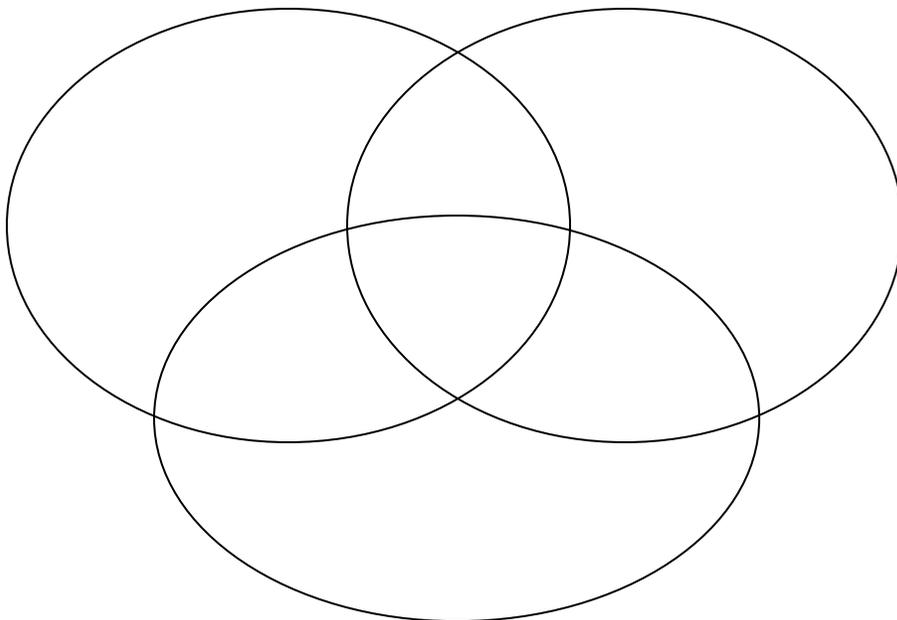
**Answer:**

### **OVERALL CONCLUSION:**

1. Compare the data collected and drawn for waves, sound, and light. Draw a Venn diagram on your paper to make your comparisons. Yours would be larger.

### **ROOM FOR IMPROVEMENT**

Comments:



When complete, E-mail to Mr. Smith @ [smithky@pcsb.org](mailto:smithky@pcsb.org)

Ensure your filename is

“FirstInitialLastNamePerXLabName”

**The answers on this lab are a product of my own work and effort. Though I may have received some help in understanding the concepts and/or requirements, I did the work myself.**

**Student Signature (for electronic submission, type student number in lieu of signature)**