

Music Makers

Wave Simulator



Students will test out wave interference by using an online simulation, while learning about amplitude, frequency and the invisible movements of particles in the process of sound. Students will then have a chance to recreate these waves in person using a bathtub.

Materials

- Computer
- Bathtub
- Water
- Baking tray(s)
- Jug

Safety Considerations

- Students should be cautious of slipping in the bathtub and of the water around them

Keywords & Concepts

Sound results from the vibration of particles through a **medium** that the sound wave is moving through.

- A **medium** is the matter that supports sound and what sound travels through, for example, gases, liquids, solids and plasmas. Sound cannot travel through a vacuum.

Wave Interference occurs when two or more waves meet when traveling along the same medium.

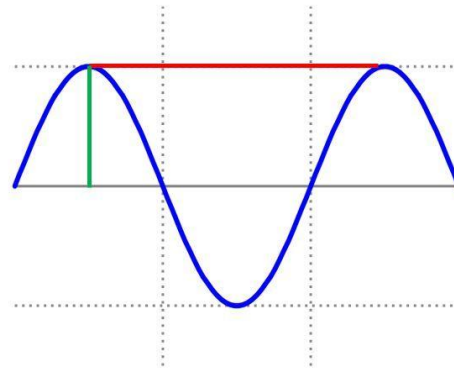
- The **interference** causes the medium to take on the form that occurs from this collision and the total force from all waves meeting.

Frequency is the rate at which a **vibration** occurs that creates a wave, either through material or an **electromagnetic field** and is measured per second.

- An **electromagnetic field** is a field of force that results from the motion of an electrically charged area and contains a certain amount of electromagnetic energy.
- Frequency also describes the number of waves that pass a certain place in a given amount of time.

The **amplitude** of a wave is the maximum extension of a vibration on a wave.

- Amplitude is the distance from rest to crest on a wave and can be measured from the resting position to the trough position on a wave.



Wavelength (λ)

Distance between identical points on consecutive waves

Amplitude

Distance between origin and crest (or trough)

Frequency (ν)

Number of waves that pass a point per unit time

Speed

= wavelength x frequency

Wave Simulator



Procedure

Using the following link to check out the wave interference website. Explore the website by using the background explanation below to help you:

https://phet.colorado.edu/sims/html/wave-interference/latest/wave-interference_en.html

Part 1

Background:

There are three ways to send out your waves:

- 1) Tap - Use the tap to observe the different kinds of waves. Check out the wave interference tab on the bottom of the page to see what happens when water collides
- 2) Horn - View 'particles'
 - What do you notice about them? How are they moving?
- 3) Laser - Check out the frequency, how does it look compared to the other options? Why might this be?

With each display, you can choose to see one wave or two waves on the left hand side of the screen.

Frequency & Amplitude:

On the right hand side of the display, you can see the frequency and amplitude of the waves, which you can change on the scale.

- What happens when you go to 0 amplitude? How about max amplitude?
- What happens when you go to low frequency vs high frequency?

You will also see a variety of options on the right hand side. Use these on the different types of waves you've created to measure the amplitude, frequencies and the waves themselves.

- Tape measure
- Timer
- Electric field measurements

To help you see what's happening, check the graph option to watch the electric field and what it looks like for each wave!

Wave Simulator



Explore: Check out the options at the bottom of the page

- Waves
 - View basic waves from a tap, horn, or laser
- Interference
 - Examine what happens when waves interact with each other. View waves colliding, sound waves colliding, and beams interacting.
- Slits
 - Check out the water wave generator and alter the 'slit' it can fit through and what happens when it does.
- Diffraction
 - Use the laser beam and change the wavelength to see what happens. Try moving the diameter of the hole and the eccentricity (the deviation of a curve from circularity)

Part 2: Real life simulation

Now that you have a good understanding of how waves work in a variety of ways, it's time to try to recreate this in real life. To recreate this you will need a bathtub (or a large rectangular sink).

Waves:

- 1) Fill the tub with water about halfway through.
- 2) Turn the tap of the tub on for 1 second to create a short burst of water into the tub.
 - What do the waves look like?
- 3) Now do the same thing continuously, leaving the water on for 1 second at a time.
 - What happens to the water when this happens?
- 4) Now place a large baking tray, flat piece of wood or other large square or rectangular surface on the tap end of the bathtub.
- 5) Making sure the bottom of your baking tray is flat against the bottom of the tub, create small back and forth movements to create waves.
 - What do the waves look like in this form?
 - How far are they going - do they reach the end of the tub?

Wave Simulator



Continuation

Slits:

- If you haven't already, look at the 'Slits' tab on the webpage.
- 1) Using two more pieces of wood, trays or other materials, build a wall like it shows in the simulation. You could have someone hold these here for you or you could try taping them down with duct tape (if so, you will need to empty the tub and make sure it is dry before taping it down)
 - 2) Turn the tap on like you did previously - how do the water waves disperse?
 - 3) Now create waves with your baking sheet like you did previously - do they go through the slit?
 - What if you change the size of the slit, what changes?

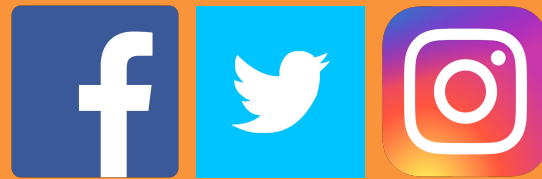
Interference:

- If you haven't already, look at the 'Interference' tab on the webpage.
- 1) Fill a jug with water and have someone else hold it over the other end of the tub.
 - 2) At the same time, turn the tap of the tub on for 1 second at a time while the other person pours water out of the jug for 1 second at the same time.
 - Are you able to notice an interference?
 - Does it look the same or different from the simulation?

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Want to share your
project or results with us?

Email or tag us
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Have a question?

Reach us at
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