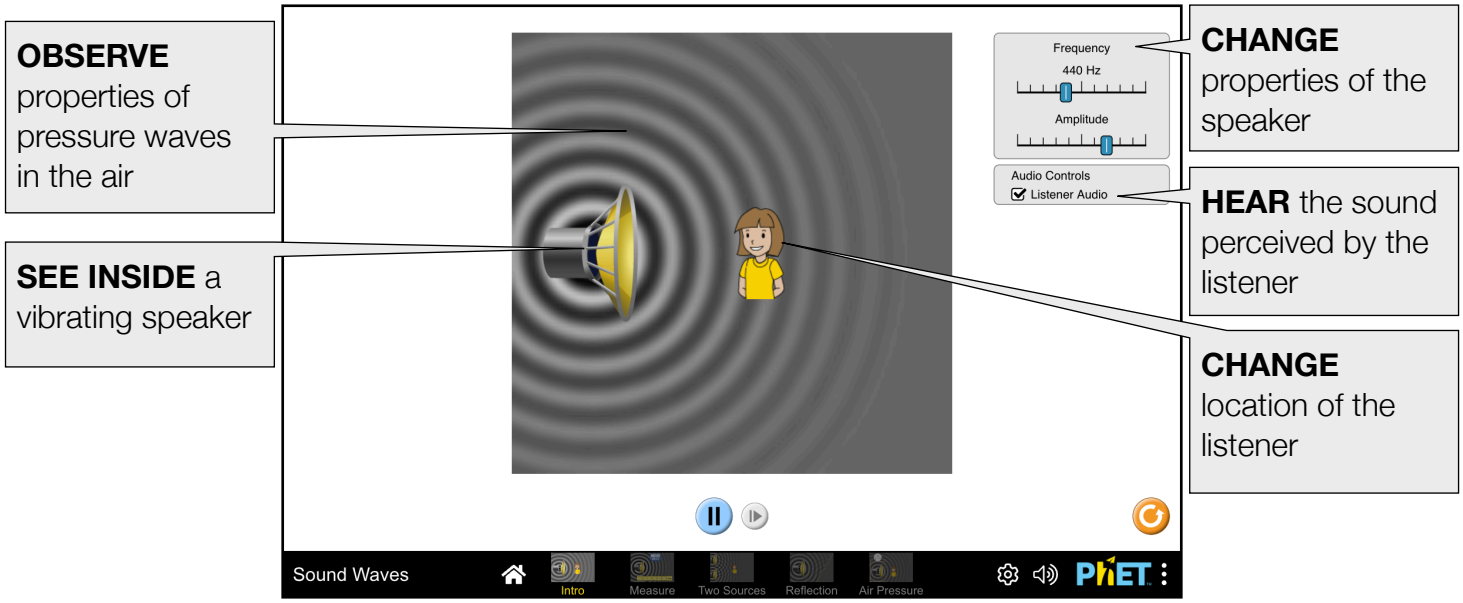
PhET Tips for Teachers

Sound Waves

The ***Sound Waves*** simulation allows students to explore the properties and behavior of sound in air.

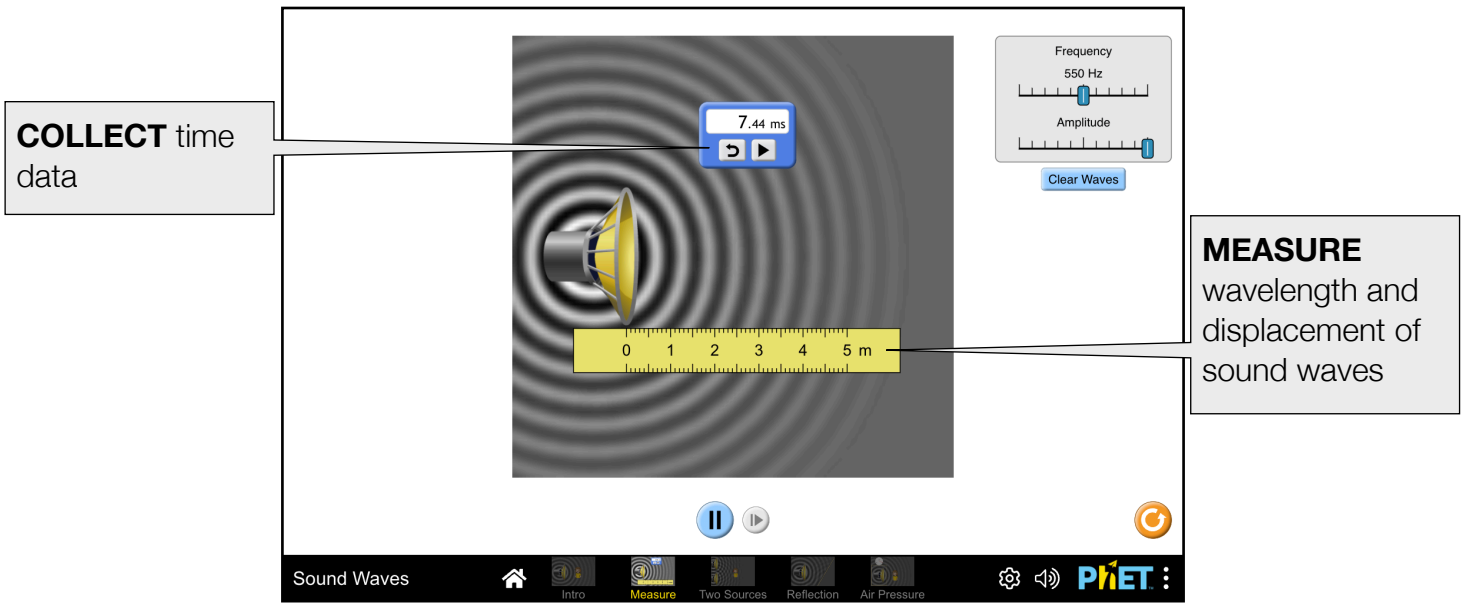
Intro Screen

In the Intro screen, students can explore the relationship between frequency, pitch, amplitude, volume and wavelength of sound waves.



Measure Screen

In the Measure screen, students can measure the speed, wavelength and period of sound waves.



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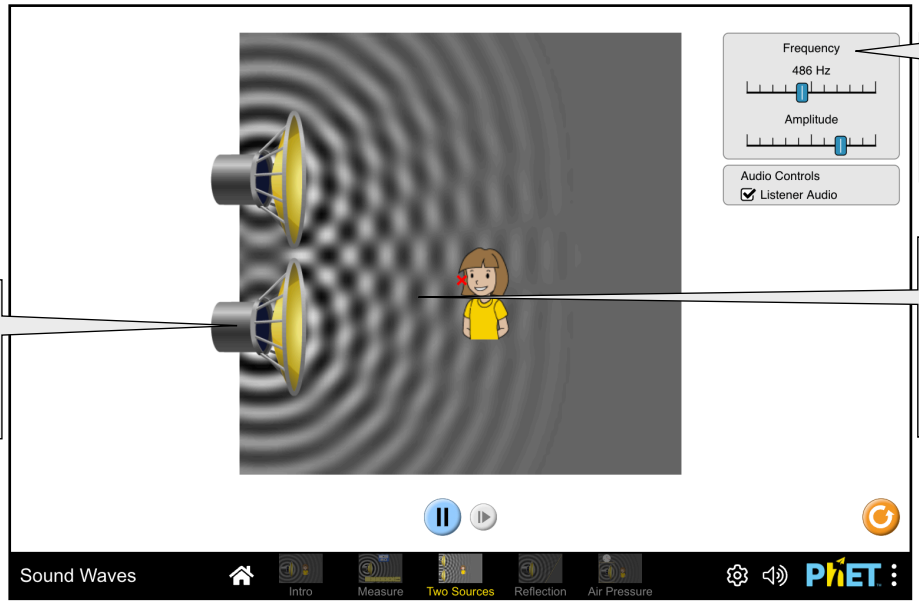
Two Sources Screen

In the Two Sources screen, students can explore the interference pattern produced by constructive and destructive combination of sound waves.



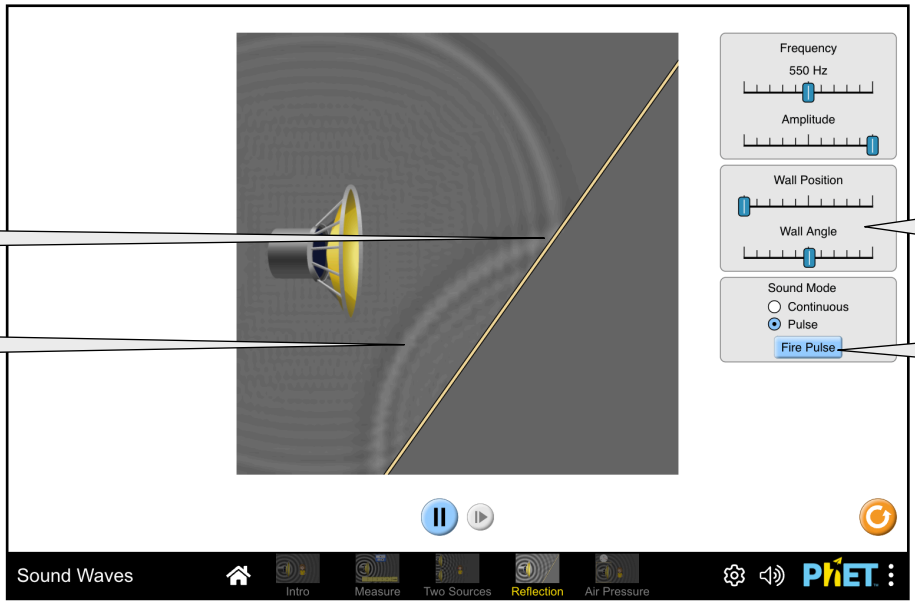
ADJUST the distance between speakers

CHANGE properties of both speakers

OBSERVE lines of constructive and destructive interference

Reflection Screen

In the Reflection screen, students can investigate the role of a reflective surface on the direction of wave propagation.



OBSERVE the reflection of a sound wave

COMPARE waves before and after reflection

CHANGE the wall's position and orientation

FIRE individual pulses to isolate the reflection

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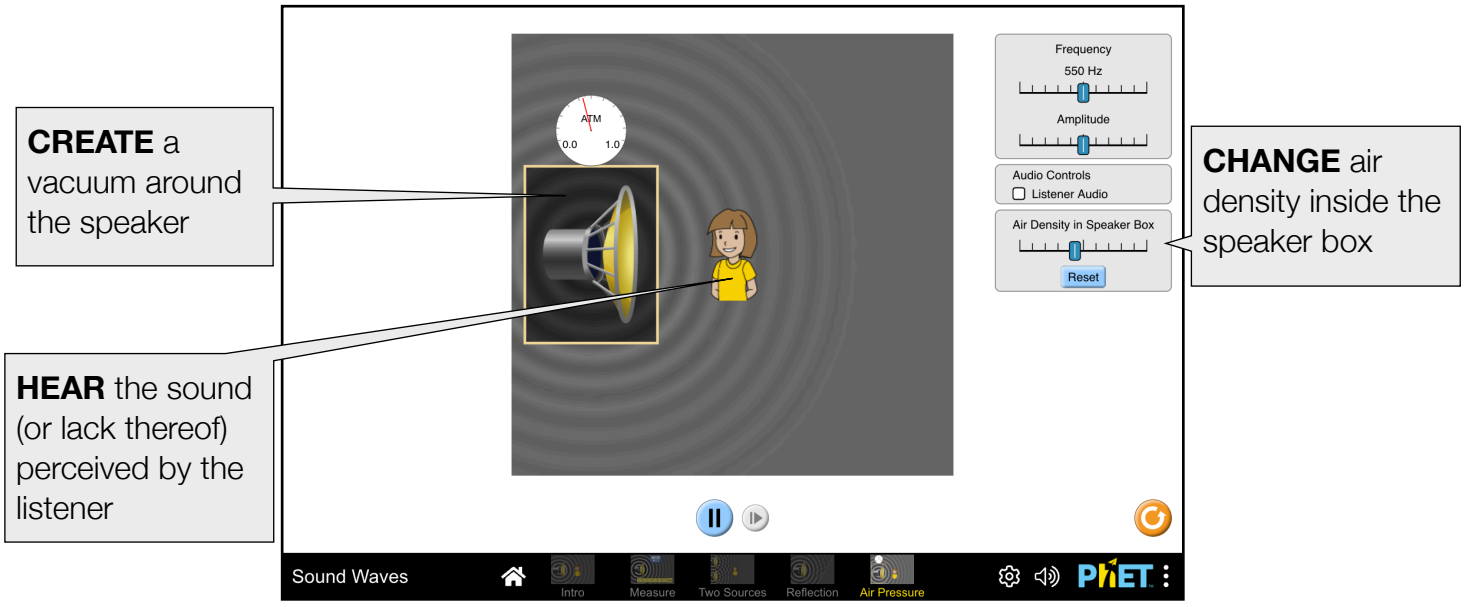
Air Pressure Screen

In the Air Pressure screen, students can investigate the role of a medium on the propagation of sound.



Insights into Student Use

- The 'Listener Audio' checkbox must be checked to hear the sound perceived by the person.
- Unless prompted, students may not notice that they can drag the person, as well as the bottom speaker in the 'Two Sources' screen.
- When setting up an experiment, it may be helpful to first pause the simulation. The step forward button is a good way to incrementally analyze.

Suggestions for Use

- Determine the mathematical relationship between frequency and wavelength.
- Design an experiment within the simulation to determine the speed of sound in air.
- Explore the effects of two-source interference and how they manifest in the simulation.
- Recreate the "vacuum in a jar" experiment to see how sound behaves in a vacuum.

Sample Challenge Prompts

- Design an experiment using the simulation to determine if the speed of sound is affected by properties of its source, such as frequency or amplitude.
- Experiment with sound waves hitting various surfaces and angles. Determine a rule for how sound waves reflect off these surfaces. Is the rule consistent across different angles?
- Describe the effects you observe in the two-source interference pattern within the simulation. What happens when the two sources move closer together? What happens when the frequency of the sources is changed?

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Customization Options

Query parameters allow for customization of the simulation, and can be added by appending a '`?`' to the sim URL, and separating each query parameter with a '`&`'. The general URL pattern is:
`…html?queryParameter1&queryParameter2&queryParameter3`

For example, if you only want to include the 1st and 2nd screens (`screens=1,2`), with the 2nd screen open by default (`initialScreen=2`) use:
https://phet.colorado.edu/sims/html/sound-waves/latest/sound-waves_all.html?screens=1,2&initialScreen=2

To run this in Spanish (`locale=es`), the URL would become:
https://phet.colorado.edu/sims/html/sound-waves/latest/sound-waves_all.html?locale=es&screens=1,2&initialScreen=2

⚙ Indicates this customization can be accessed from the Preferences menu within the simulation.

Query Parameter and Description	Example Links

`screens` - specifies which screens are included in the sim and their order. Each screen should be separated by a comma. For more information, visit the Help Center.	`screens=1`
	
	`screens=2,1`

`initialScreen` - opens the sim directly to the specified screen, bypassing the home screen.	`initialScreen=1` `initialScreen=3`
⚙ `locale` - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	`locale=es` (Spanish) `locale=fr` (French)
⚙ `colorProfile` - changes simulation colors for easier projection.	`colorProfile=projector`
`audio` - if muted, audio is muted by default. If disabled, all audio is permanently turned off.	`audio=muted` `audio=disabled`
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`
`supportsPanAndZoom` - when `false`, disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is `true`.	`supportsPanAndZoom=false`

See all published activities for Sound Waves here.
For more tips on using PhET sims with your students, see Tips for Using PhET.

Name: _____

Sound Waves

Learning Objectives:

- Explore and draw conclusions about the nature, properties and behaviors of sound waves.
- Use the simulation to develop your own definition of frequency and amplitude.
- Describe how frequency and amplitude affect the sounds we hear.
- Given a description of a sound like “high pitched and loud”, describe the amplitude and frequency.

1. Discuss examples of things that make the different types of sounds listed in the table below.
   Write your examples in the table below.

2. Open **Sound** simulation from the icon on your computer.
   Use the **Listen to a Single Source** tab. Turn on the **Audio Enabled** so you can hear the sound.

   Create the sounds in the table below!

Sound	Example of something that makes this sound	Explain how you used the simulation to make the right noise	Draw what the sound waves look like in the simulation
Case A: Loud, High-pitched			
Case B: Soft, High-pitched			
Case C: Loud, Low-pitched			
Case D: Soft, Low-pitched			

3. Which cases in Question #2:

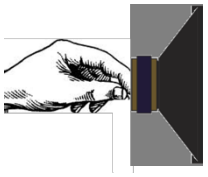
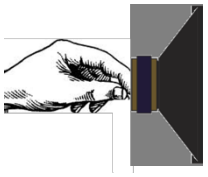
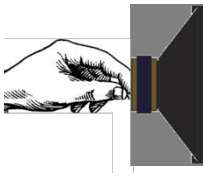
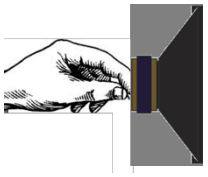
a. Have a high frequency? _____

b. Have a large amplitude?_____

Explain what controls pitch, and what controls loudness.

4. Creating Sounds …

- **Compare** how you would have to **move the speaker** to produce the sound in each case.
- **Describe the motions below.**
- Be sure to describe what is different about each one.

Sound		Is this sound **Low or high pitch? Loud or soft?**
Case E: Low Frequency, Low Amplitude		
Case F: High Frequency, Low Amplitude		
Case G: Low Frequency, High Amplitude		
Case H: High Frequency, High Amplitude		

5. **Develop rules** for what effects frequency and what effects amplitude to explain your observations from Question 4.

6. Some of your friends are confusing frequency and amplitude. How would you describe these terms in **your own words or pictures** to help your friends understand each one?