

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.

OBSERVE properties of pressure waves in the air

SEE INSIDE a vibrating speaker

CHANGE properties of the speaker

HEAR the sound perceived by the listener

CHANGE location of the listener

Sound Waves Intro Measure Two Sources Reflection Air Pressure PhET

Measure Screen

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

COLLECT time data

MEASURE wavelength and displacement of sound waves

Sound Waves Intro Measure Two Sources Reflection Air Pressure PhET

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

Sound Waves | Intro | Measure | **Two Sources** | Reflection | Air Pressure | PhET

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

Sound Waves | Intro | Measure | Two Sources | **Reflection** | Air Pressure | PhET

Air Pressure Screen

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

The screenshot shows the 'Air Pressure' simulation interface. A central speaker is shown with sound waves propagating outwards. A listener character is positioned to the right of the speaker. A pressure gauge is visible above the speaker, showing a scale from 0.0 to 1.0. On the right side, there are control panels for Frequency (set to 550 Hz), Amplitude, Audio Controls (with a 'Listener Audio' checkbox), and Air Density in Speaker Box (with a 'Reset' button). At the bottom, there is a navigation bar with icons for 'Sound Waves', 'Intro', 'Measure', 'Two Sources', 'Reflection', and 'Air Pressure', along with a 'PIET' logo.

CREATE a vacuum around the speaker

HEAR the sound (or lack thereof) perceived by the listener

CHANGE air density inside the speaker box

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?

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 an '&'. 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
<code>screens</code> - 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 .	<code>screens=1</code> <code>screens=2,1</code>
<code>initialScreen</code> - opens the sim directly to the specified screen, bypassing the home screen.	<code>initialScreen=1</code> <code>initialScreen=3</code>
☞ <code>locale</code> - 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".	<code>locale=es</code> (Spanish) <code>locale=fr</code> (French)
☞ <code>colorProfile</code> - changes simulation colors for easier projection.	<code>colorProfile=projector</code>
<code>audio</code> - if muted, audio is muted by default. If disabled, all audio is permanently turned off.	<code>audio=muted</code> <code>audio=disabled</code>
<code>allowLinks</code> - when <code>false</code> , disables links that take students to an external URL. Default is <code>true</code> .	<code>allowLinks=false</code>
<code>supportsPanAndZoom</code> - when <code>false</code> , disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is <code>true</code> .	<code>supportsPanAndZoom=false</code>

See all published activities for Sound Waves [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).