Wave Speed

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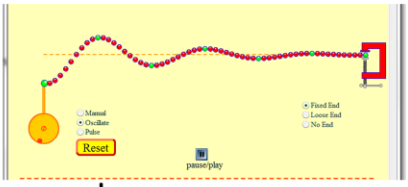
Wave on a String:



Does the speed of the wave depend on

- Amplitude? A – Yes, B – **No**
- Frequency? A – Yes, B – **No**
- Damping? A – Yes, B – **No**
- Tension? A – **Yes**, B – No

Have to change the characteristics of the string

- Speed of a wave on a string:

$$v = \sqrt{\frac{T}{\mu}}$$

- T is tension sometimes listed as F for force on string.
- μ is the density of the string (mass/length)

$$v = \sqrt{\frac{T}{\mu}} \quad \text{and} \quad f = v/\lambda$$

If wavelength is fixed, how does frequency change if tension is increased?

A. Goes up
B. Goes down

BORING – lost everyone very quickly.

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If the string is fatter is the speed higher or lower than skinny string?

A. Higher
B. Lower

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Speed of Sound in Air

$$v = 331\ m/s\sqrt{1 + \frac{T}{273}}$$

If the air is hotter, is the speed of sound

A. Faster
B. slower

In air

$$v = 331\ m/s\sqrt{1 + \frac{T}{273}}$$

If the air is hotter, is the speed of sound

A. Faster

B. Slower

In air

$$v = 331\ m/s\sqrt{1 + \frac{T}{273}}$$

Does hotter air have more collisions or less than colder air?

A. More
B. less

In air

$$v = 331\ m/s\sqrt{1 + \frac{T}{273}}$$

Does hotter air have more collisions or less than colder air?

A. More

B. less

$$v^2 = \frac{\text{rigidity}}{\text{Inertia}} \qquad v = \sqrt{\frac{T}{\mu}}$$

Material	Speed of sound
Air (0°C)	331 m/s
Air (20°C)	343 m/s
hydrogen	1290 m/s
Water	1490 m/s
Aluminum	5100 m/s
Lead	1320 m/s
Rubber	54 m/s

Why do you think your voice sounds higher when you inhale helium gas?

I have the students discuss and suggest a reason for each of these speeds of sound before I reveal them.

Science Geek Girl explanation:

This website has a nice description of why helium makes the voice sound higher.

Pitch of voice w/ Helium

- Speed of sound higher in Helium $f = v/\lambda$
- But that's not the whole picture….
- After the sound leaves your mouth, it goes into air so it slows back down.
- If you sing a C note, your vocal chords (vocal folds) make a range of C's. Your mouth and throat shape to resonate middle C, for example.
- If the speed of sound is higher than usual, a higher C resonates in your mouth and throat.
- So a higher note is amplified if Helium is in your mouth and throat. That's what we hear.

After this I showed the video of how a voice sounds if Sulfur Hexafluoride is inhaled. The video is on the Science Geek Girl page.