Sound and Music

Acoustical Society of America

What is Sound?

- Strike the tuning fork with a rubber mallet or text book.
- Listen to the fork
- Now look very closely at the fork while it's making a sound.

What do you observe?

Warning: Do not touch your glasses or teeth with the tuning fork!

What is Sound?

- When the fork is making a sound, touch the fork.
- Touch the fork to your nose or your hand.

What do you feel when it's making a sound?

What do you feel if it's silent?

Vibrations make sound

Warning: Do not touch your glasses or teeth with the tuning fork!

What is Sound?

When the fork is making a sound, **how can you make the sound stop?**

What was making the sound?

Vibrations make sound

Warning: Do not touch your glasses or teeth with the tuning fork!

What is Sound?

- Set the handle end of your tuning fork on the table top.

What happens? Why?

Sound is energy. **– It can make things move.**

Warning: Do not touch your glasses or teeth with the tuning fork!

What is Sound?

- One student hangs a ping pong ball from the string.
- Another student gently touches *the quiet* tuning fork to the ping pong ball.

What do you observe?

Warning: Do not touch your glasses or teeth with the tuning fork!

What is Sound?

- Strike the tuning fork so that it is making a sound.
- Have a student touch the tuning fork to the ping pong ball again.

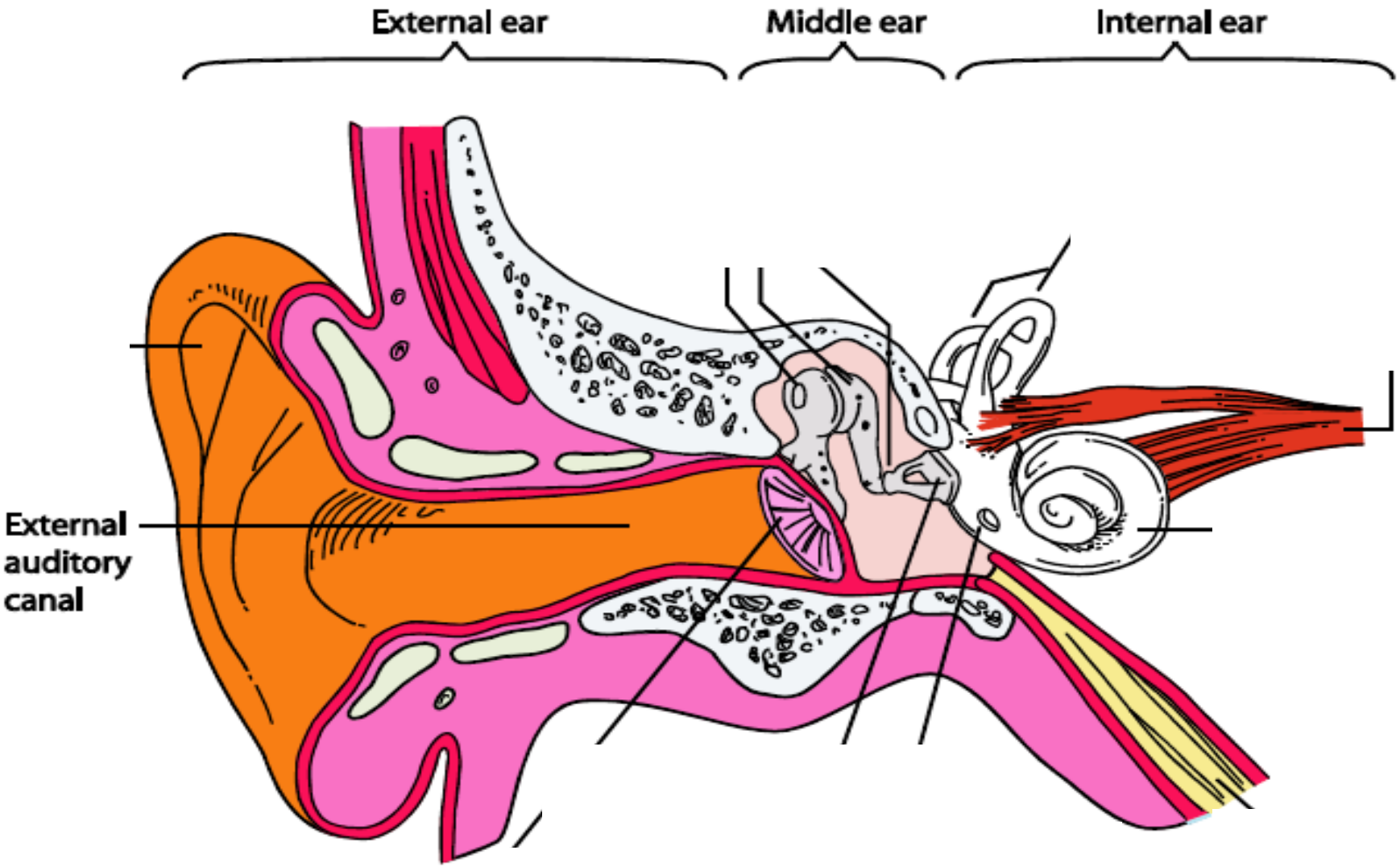
What happens?

Why is this?

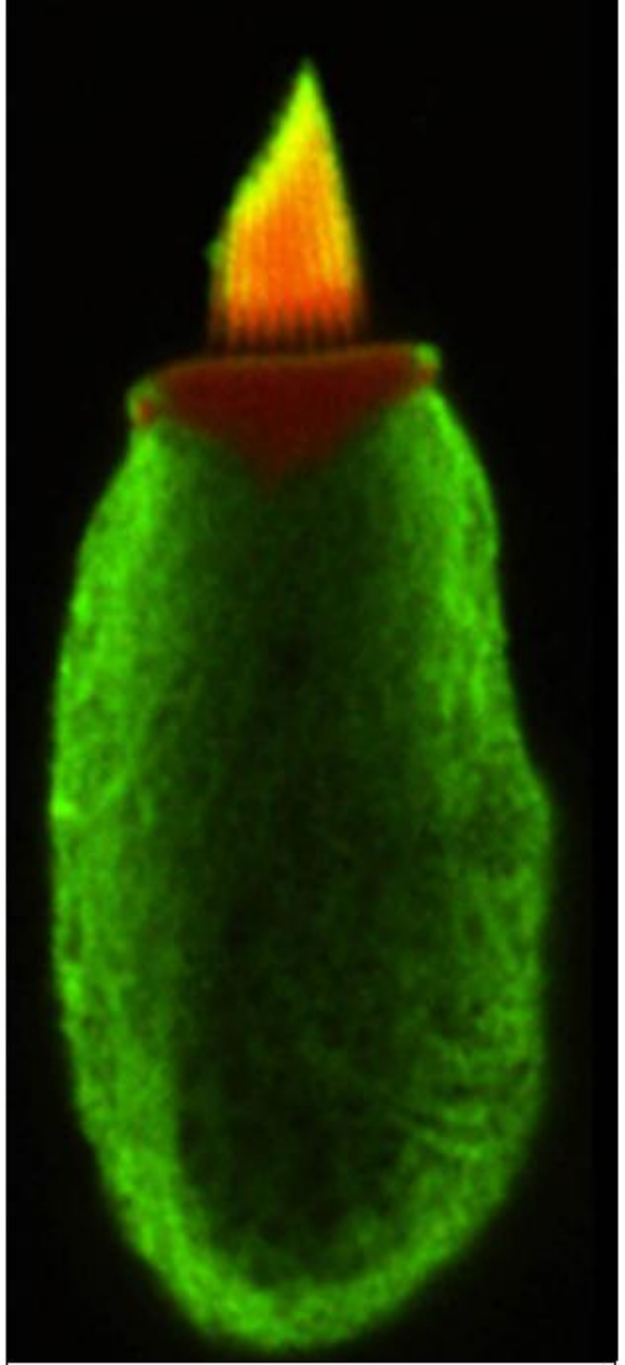
Sound is energy. **– It can make things move.**

Warning: Do not touch your glasses or teeth with the tuning fork!

Your ear



http://www.dangerousdecibels.org



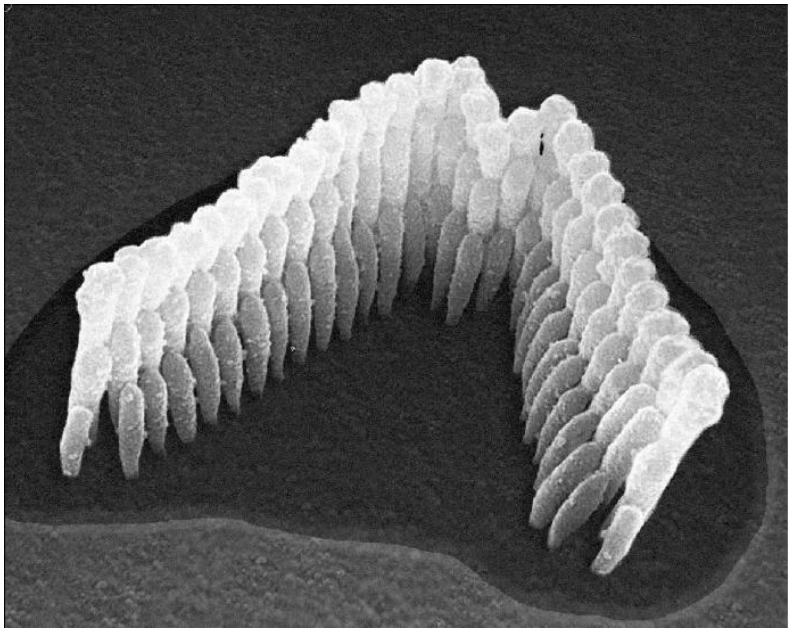
Peter Gillespie and Janet Cyr, Oregon Hearing Research Center, Oregon Health & Science University. 2005

http://www.dangerousdecibels.org

One Inner Ear Hair Cell

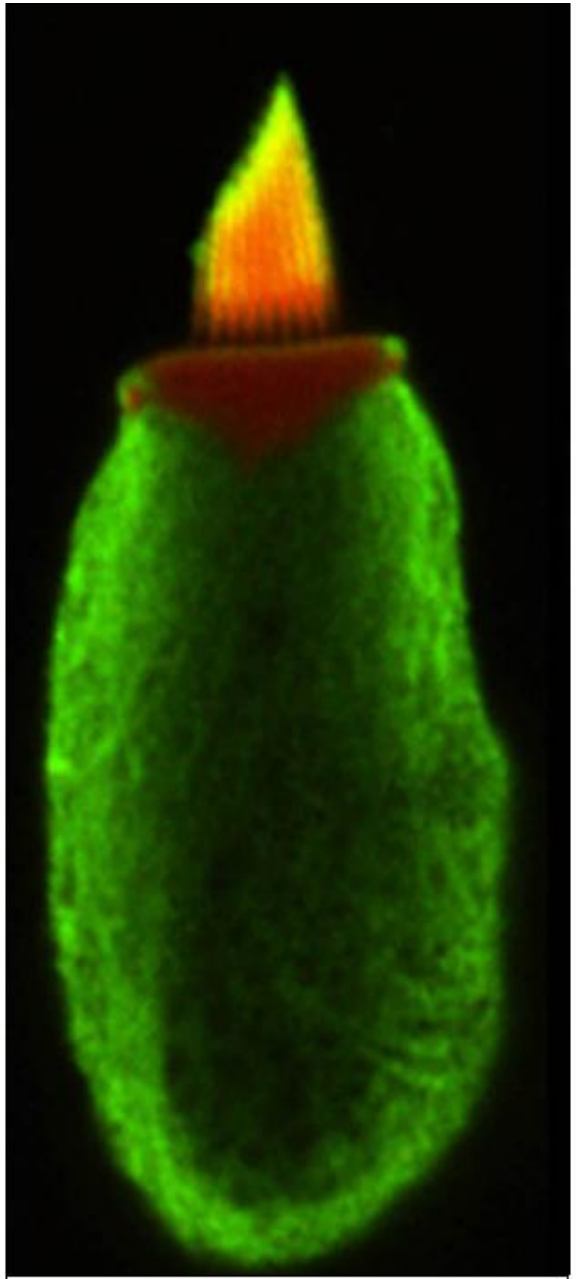
Large Cell body with hair bundle on top

Hair Bundle (yellow/orange)



Black and white photo of one hair bundle

Hair Cell (green)

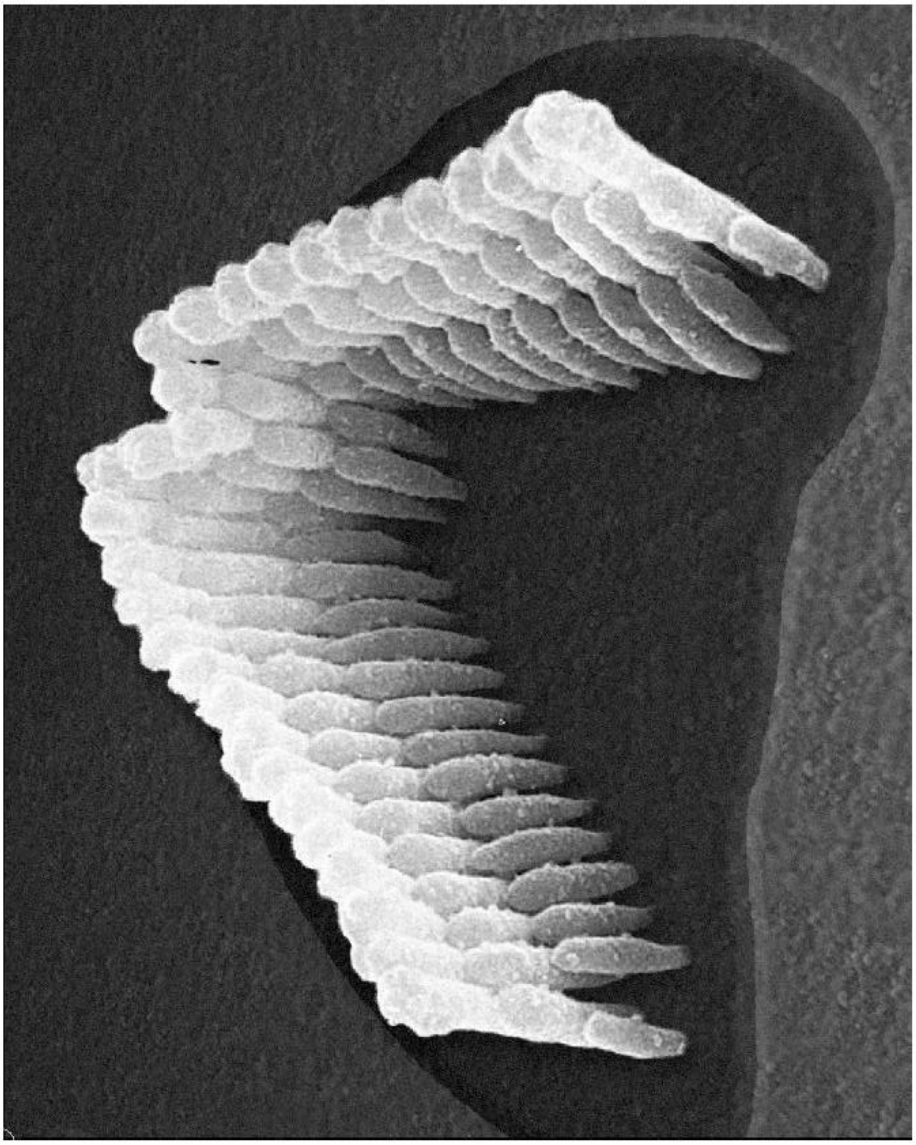


Peter Gillespie and Janet Cyr, Oregon Hearing Research Center, Oregon Health & Science University. 2005

http://www.dangerousdecibels.org

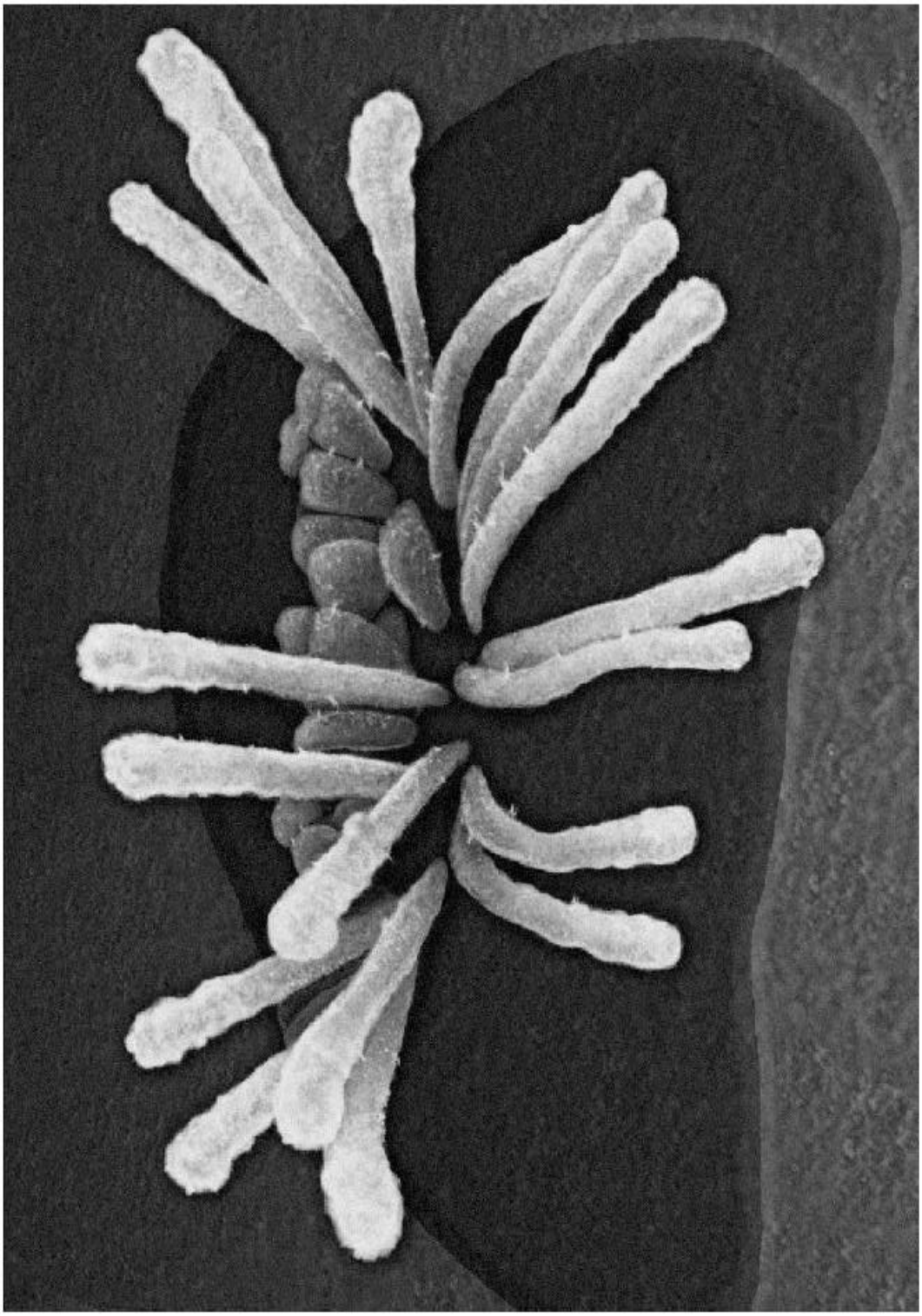
Healthy hair bundle.

Appendix D.1 Normal Healthy Hair Cell Stereocilia (Hair Bundle)



Damaged hair bundle

Appendix D.2 Hair Bundle After Loud Sound Exposure



Build a Model

What does your arm represent?

Build a Model

You're going to go watch fireworks from the stadium.

First you have to mow the lawn.

Build a Model

Fireworks show!

How loud are fire works if you get very close?

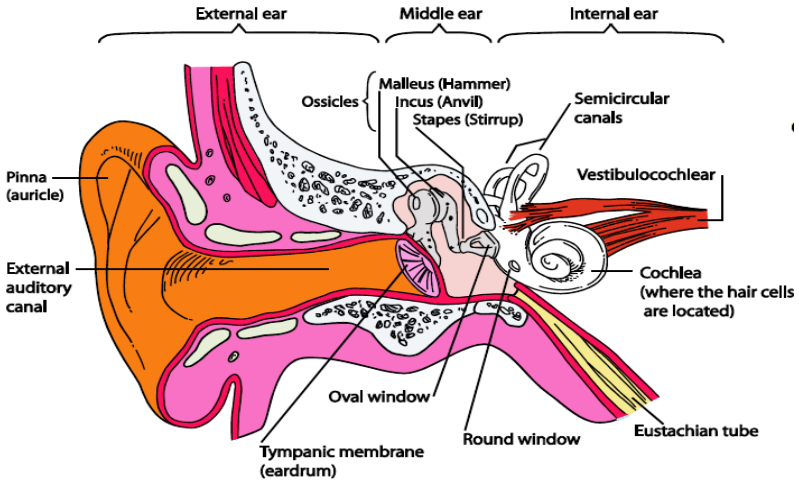
What do your hair bundles look now?

Can you fix them?

Loud sounds carry more energy than soft sounds.

Listening to loud sounds for too long can damage the hair cells, which can't be fixed.

Your Ear



- Amazing organ
  - Listen to a range of sounds from 20 Hz to 20,000 Hz
  - http://www.burninwave.com/#freqsweep (play 10 s wave)
  - Now play each frequency found here: http://www.noiseaddicts.com/2009/03/can-you-hear-this-hearing-test/

Raise your hands when you hear the sound.

High pitch is a high sound

Your Voices

- Hold your fingers on the front of your throat and say Aaaah

Notice the vibration?

Vibrations make sound.

- Now make a high Aaaah and a low Aaaaah

High pitch is a high sound.

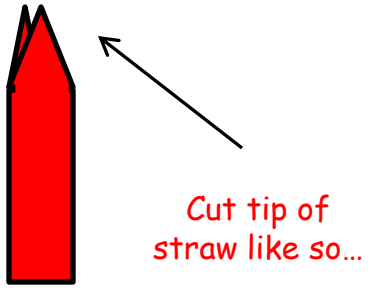
Do low and high voices feel different?

High pitch has a higher rate of vibration – more wiggles per second.

Straw Instrument

cup instrument as alternative

- Take the straw and the scissors, and cut off the tip of the straw to a point, like so. (Try to get both sides to be the same.)
- Now, *gently* chew on the straw to soften the tip, and to get the edges to be smooshed together. You would like the straw just below the two tips to be *almost* touching.
- Now, put the pointy end in your mouth, and *blow really hard*. If you do it right (it might take some practice), you will get a very loud sound from the straw instrument!



Straw Instrument

What is vibrating?

Vibrations make sound.

Straw Instrument

Does the person across the room hear your straw instrument?

Does the air you blow into the straw go in his/her ear for them to hear?

Sound is energy it travels through air, air is not the sound.

Straw Instrument

Sound is energy. It travels through air, but air is not the sound.

If you have bad breath (eat tuna) can the person across the room smell it when they hear you talk?

Why is that?

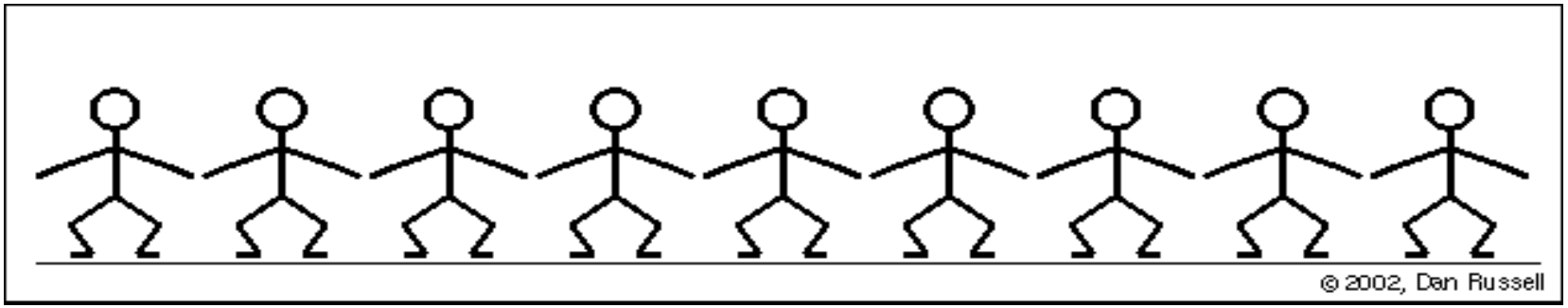
Sound travels

- Do the wave :

Did the wave make it across the room?

How did you move?

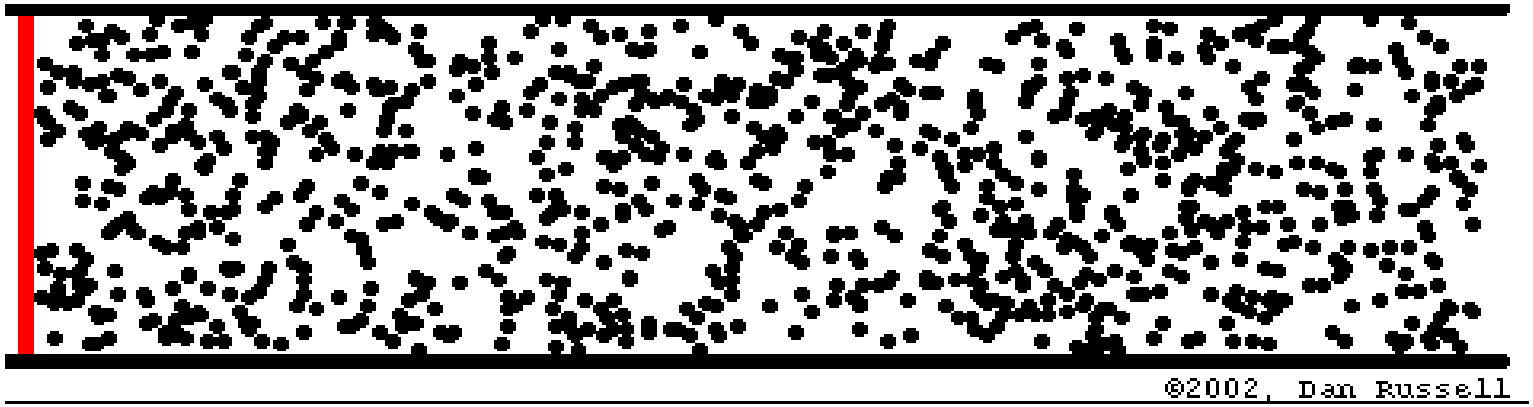
Did the people who started it move across the room?



http://www.kettering.edu/physics/drussell/Demos/waves-intro/waves-intro.html

Sound travels

Air moves back and forth as sound energy goes past.

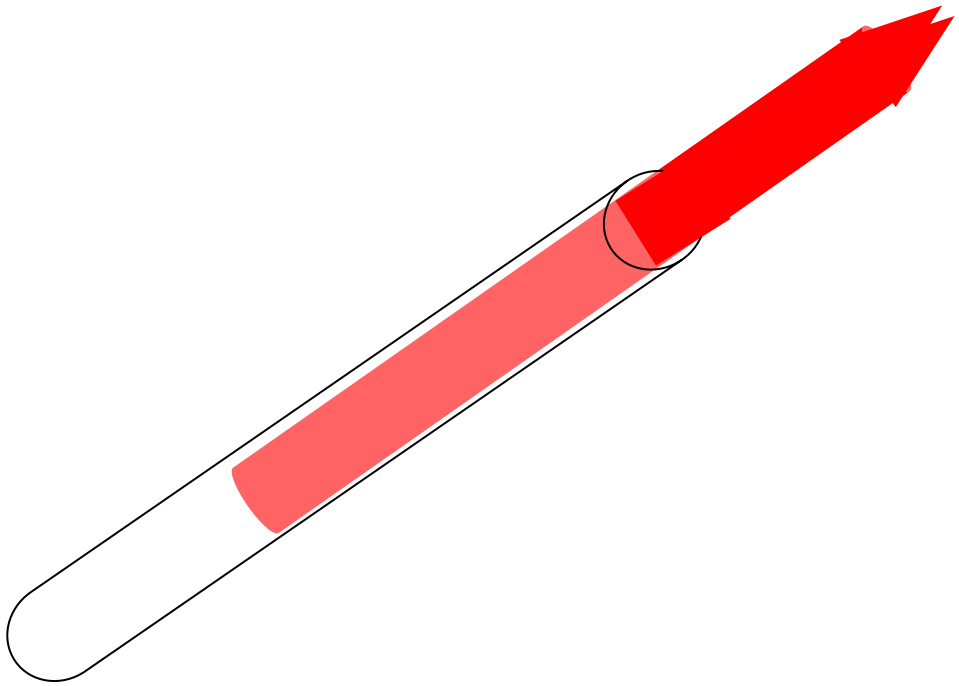


http://www.kettering.edu/physics/drussell/Demos/waves-intro/waves-intro.html

Sound is energy. **It travels through the air, but air is not the sound..**

Straw Instrument

- Put the bigger straw over the end of your straw instrument.
  This makes a sort of straw trombone!



Straw Instrument

- Make the lowest pitch, bass notes, that you can.
- Make the highest pitch, treble notes, that you can.

High pitch is a high sound.

Straw Instrument

- **Is the buzzing on your lips different with low and high sounds?**

High pitch has a higher rate of vibration.

Straw Instrument

- You get to keep your straw instruments.

- Put the straw instruments away (not just on desk, **out of sight**.)

Resonance

- Frequency: rate: wiggles per second (moves back and forth).

- Resonant, or natural frequency: the frequency at which an object likes to vibrate

Pasta Demo

- **Why does the longer pasta shake more when the hand is moved slowly?**

Here is a video of the pasta raisin demonstration:
http://www.youtube.com/watch?v=MA8WEFhA3DM&feature=player_embedded

Resonance

- Longer pasta shakes at lower frequencies.

  Lower frequencies have longer wavelengths.

- Remember: Low pitch is a low sound,

  and low pitch has less wiggles per second

- Pitch is how we hear wiggles per second that air shakes. Pitch is how we hear frequency.

Straw resonance

- Straws are similar. Different lengths of straws like different frequencies or pitches.
- Air moves a lot at the resonant frequency (like the pasta) so the sound is loud.

For a low (bass) frequency was your straw longer or shorter?

Low frequencies have longer wavelengths.

Cup Instrument

Vibrations make sound.

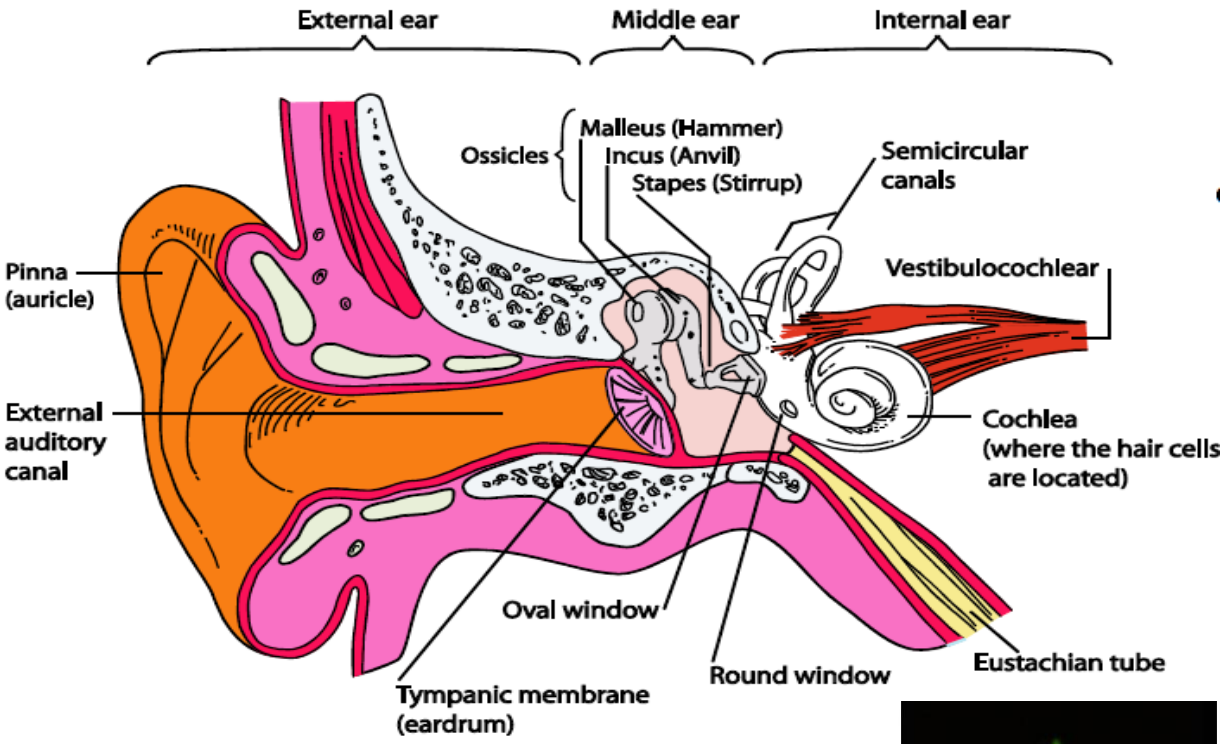
What do you think will happen if you make the string shorter?

Cup Instrument

Resonant frequency: The frequency an object likes to vibrate.

Lower frequencies have longer wavelengths.

- Sound is made from vibrations
- The vibrations travel through the earcanal, eardrum, ossicles – the three tiny bones and then into the cochlea.



- Different parts of the cochlea resonate with certain frequencies ....

  Some like high pitches and

  Some like low pitches…

- The hair cells sense the sound and send electrical signals to your brain.