Voice – 2 stations

Equipment:

Rubber bands

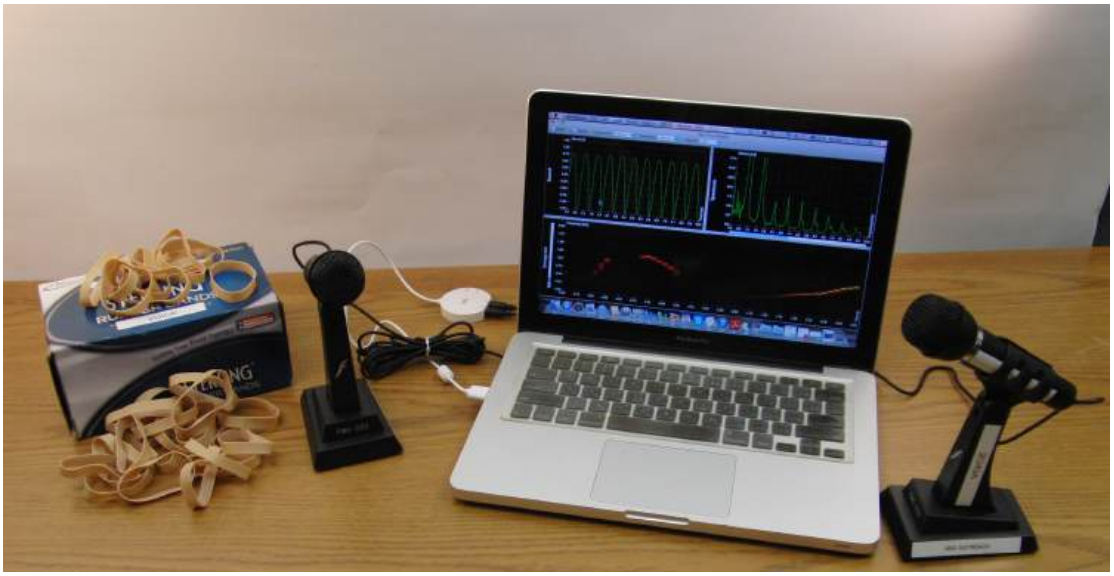
Laptop with waveform view & spectrogram

Stroboscope video clip

Oscilloscope/spectrogram

Microphone

Diagram of human noise production system



Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Vocal Folds

What's the process for making speech sounds?

- *Show diagram of speech anatomy and talk about the parts.*

What do the vocal folds do?

- *Feel vibrations of Adam's apple for voiced speech sounds and lack of vibrations for unvoiced sounds*

How do the vocal folds make different pitches/frequencies?

- *Demonstrate the change in plucking frequency on a rubber band for changes in tension and mass per unit length with the rubber bands (give one to each participant) and relate these to the mass-spring systems in the Resonance station.*

Station 2: Vocal Tract

- *Explain that the vocal folds generate the sound but changing the vocal tract is what makes the different speech sounds.*

What is your vocal tract?

- *Explain what the vocal tract is.*

What are you doing with your vocal tract when you make the different vowels?

- *Have them try it.*

- *Look at speech waveforms and spectrograms of vowels and other phonemes.*

What is the same and different?

Do you know anyone who reads lips? How does that work? Is it ever confusing?

- *Try "marry" and "bury"*

Hearing – 1 station

Equipment:

Short Boomwhackers (x3)

Laptop with internet connection to view Video clip of the anatomy of the ear and basilar membrane

Diagrams of anatomy of the ear

Mass/spring set

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station: Hearing

How do your ears work?

Explain anatomy and parts using diagram or watching the Video clip of the anatomy of the ear and basilar membrane: http://www.youtube.com/watch?v=dyenMluFaUw

Pinna – collects the sound

What animals have big ears? How does that influence their hearing?

Ear canal – increases some parts of the sound.

- *Hold short boomwhacker up to ear.*

  How does that sound? How does the sound change if you cap the end?

Ear drum – changes the sound wave into motion

Middle ear – small bones amplify the motion.

Have you learned about levers? What does a lever do?

Cochlea – a wave in the fluid causes the Basilar membrane to move which causes hair cells to move which send signals along the auditory nerve. The portion of the basilar membrane responds to the sound depends of the frequency. Stiffness and thickness change so high frequencies resonate near the entrance and low frequencies farther downstream. Show or remind of mass-spring demo.

Hearing Loss – 1 station

Equipment:

Sound level meters (x6)

Laptop to play NASA Auditory Animation CD

Ear plugs

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station: Hearing Loss

What loud sounds do you hear regularly?

How loud do you think too loud is?

Do you know how we measure loudness?

- *Explain and demonstrate how to use sound level meter.*
- *Let them measure different sounds.*
- *See how levels change with distance to source.*

Do you know anyone who is losing or has lost their hearing?

Do you know what it sounds like when someone loses their hearing?

- NASA Auditory Demo CD

How can you protect your hearing?

- *Teach how to properly put in hearing protection.*

What changes when you wear the ear plugs?

Piano/Dulcimer – 1 station

Equipment:

- Piano diagram
- Backpack dulcimer
- Soft hammers
- Hard hammers

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station: Piano and Dulcimer

Does anyone play the piano?

How does a piano work?

Why do different keys play different notes?

- *Remember modes on a string.*
- *Natural frequencies determined by length, tension and density. Different kinds of strings in the piano.*

Where is the piano sound mainly coming from?

Have you seen a dulcimer before?

Why do different strings play different notes?

What is different about the sound of the soft and hard hammers?

Where is the sound mainly coming from?

Violin/Guitar – 2 stations

Equipment:

- Pasco Shaker (x2)
- Sine wave generator (x2)
- Chladni plate (x5)
- Sand
- Slide guitar (x2)
- Ukulele (x2)
- Stereo banana connector

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Ukulele

Does anyone know how to play a string instrument? How do they work?

What is the difference between the sound produced when a string instrument is bowed vs. plucked?

How do you play different notes on a string instrument?

- *Demonstrate with ukulele.*

What are different ways to change the pitch being played by a string instrument?

How do you tune a string instrument?

- *Demonstrate with ukulele.*

How does the body of the instrument affect the sound?

- *Resonances of the body change the sound.*

Station 2: Chladni Plates

Use chaldni plate to show how the body of a string instrument has multiple natural frequencies/resonances.

Explain that the salt falls into the nodal lines – places that aren't moving, like they saw with the standing waves on the slinkies.

Electronic Music – 2 stations

Equipment:

Laptop with

Audacity or Garage band

Theremin

Oscilloscope/spectrogram

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Electronic Music Software

Have you ever looked at what the sound waves of the music you listen to looks like?

- *Play music and look at the oscilloscope and spectrogram.*

What shows the loudness or volume?

What shows the pitch or frequency?

- *Show effects – ways to play around with the sounds (Echo, Reverb, filters,…)*

Station 2: Theremin

Use the theremin as an example of an electronic instrument.

Take turns making sound effects and trying to play a song.

Note: finger must depress black button and make contact with the metal ring below it.

Wind/Brass Instruments – 2 stations

Equipment:

- Boomwhackers
- Recorders
- Mouthpiece spray
- Garden hose
- Funnel/mouthpiece
- Alcohol wipes

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Recorders

Has anyone ever played a wind instrument? How do they work?

What is the difference between reed, flute, and brass instruments and how they are played?

How do you play different notes on wind instruments?

- *Change length of tube, overblow*

Station 2: Boomwhackers

Which boomwhackers do you think have a higher pitch and which have a lower pitch?

What happens to the sound when you cover one end?

How do you play a lower pitch on a recorder? How is that related to the boomwhackers?

Let them play with boomwhackers to explore the effect of length and the difference between an open-open and an open-closed pipe resonance.

Echolocation – 1 station

Equipment:

Laser pointer (x2)

Hypersonic speaker

Power cord

Music player (iphone, android, etc) with music

1/8” to RCA cable

Mirror

Illustrations of bats/dolphins/SONAR

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants’ interests to direct the focus.

Station: Echolocation

Where have you heard echoes?

What is different about a room with lots of echoes and a room without?

- *Bounce the laser off the mirror to show how it reflects. Explain how sound is similar.*

How do animals like bats use echoes?

What other animals or tools use echoes? (dolphins, SONAR, RADAR)

Shine the hypersonic speaker (playing music) in different locations and at the kids to show echoes in action.

Resonance – 2 stations

Please feel free to send feedback & suggestions to cvongsawad@gmail.com.

Equipment:

- PASCO mass set
- PASCO spring set (x4)
- Pop bottles (x4)
- Wipes
- Crystal glasses (x3)
- Water

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Mass-Spring systems and Pop bottles

- *Explore changes in the natural frequency of the oscillations when different mass/spring combinations are used.*

What changes when a stiffer spring is used?

How does the natural frequency change when a larger mass is used?

How is this related to making a sound by blowing across a pop bottle?

Which bottles make a lower pitch?

How can we change the pitches of the bottles?

Note: a bottle is a Helmholtz resonator analogous to a mass-spring system, with the volume of air in the body inversely proportional to stiffness of a spring and the volume of air in the neck proportional to mass.

Station 2: Tuning Forks and Glasses

- *Use tuning forks to show specific resonances (Use rubber stopper when striking tuning forks)*

Can you make different notes with the tuning forks?

- *Use Ames tube to show how coupling with more air increases the amplitude.*

How does this relate to making glasses sing?

- *Make different notes with the glasses and bottles and explore the differences and what changes the pitch*

Noise Control – 1 station

Equipment:

Noise cancelling headphones (x2)

Music player (iphone, android, etc) with music

Music box

Foam

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station: Noise Control

What are some annoying noises in life? What makes them annoying?

When have you had a hard time hearing because of background noise?

- *Use noise cancelling headphones to show that adding noise can actually make it quieter.*

Have you ever been in a room that had lots of extra noise? How would you limit the noise?

- *Use music box demo to show the effects of amplification and noise cancellation due to foam.*

How easy is it to hear the music box? How about when it is put inside the plastic box (better or worse)?

What do you think will happen when we place foam inside the box also?

How would the difference inside the box and with the foam apply to different life situations? (instruments, sound recording studios, etc.)

Loudspeakers – 1 station

Equipment:

Surface vibration speaker

Loudspeaker in a box

1/8” to RCA cable

Diagram cutaway of loudspeaker

Laptop with a frequency generator

Music

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants’ interests to direct the focus.

Station: Loudspeakers

- *Show the small loudspeaker.*

Does anyone know how a loudspeaker works? How do you think a loudspeaker works?

Have you ever wondered why speakers are put in boxes?

- *Play a low frequency sine wave through the small loudspeaker held in your hand. (a few hundred Hertz)*

How well can you hear the sound?

- *Place it in the box.*

What is different when the loudspeaker is by itself vs. in a box? Do you have any idea why it is that way?

- *Explain front-back interference of the waves.*

- *Play music through the “surface” mount speaker*

How well can you hear this “surface mount” speaker? How do you think we can make it louder?

- *Place the speaker against the table or other objects.*

Where is the sound coming from?

Standing waves – 2 stations

Equipment:

- Long thin spring (x2)
- Slinkys (large and small)
- Sine wave generator
- Power supply
- PASCO driver
- Elastic string
- Stereo banana cable
- Torque wave on a string

Engage audience for approx. 5 min. by exploring the topic together by asking questions and allowing the participants' interests to direct the focus.

Station 1: Slinkys

- *Demonstrate wave pulses and standing waves on a slinky.*

What's the difference between a pulse and a standing wave?

How many antinodes or bumps can you get in the standing wave?

What do you change to get a different pattern?

Station 2: Standing Waves on a String

- *Create standing wave on the PASCO driver and the torque waves on a string demos. The frequency can be changed on the PASCO driver to change the mode being seen.*

Explain frequency, wavelength, node, anti-node

What do you think will happen to the wavelength when the frequency is increased?

What do you think will happen to the amplitude when the frequency gets higher?

Is all of the wave moving or is only some of it moving and some not moving?