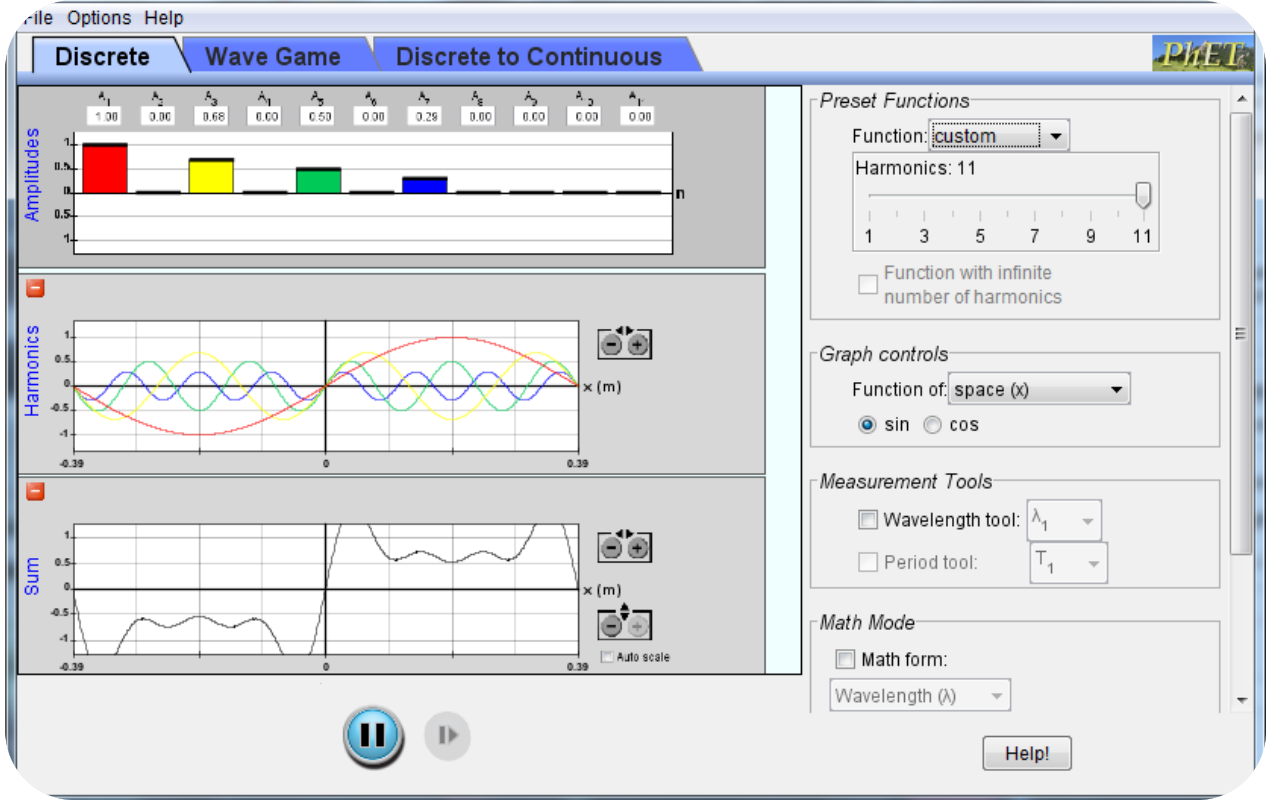
Echolocation, Intensity and Intensity Level

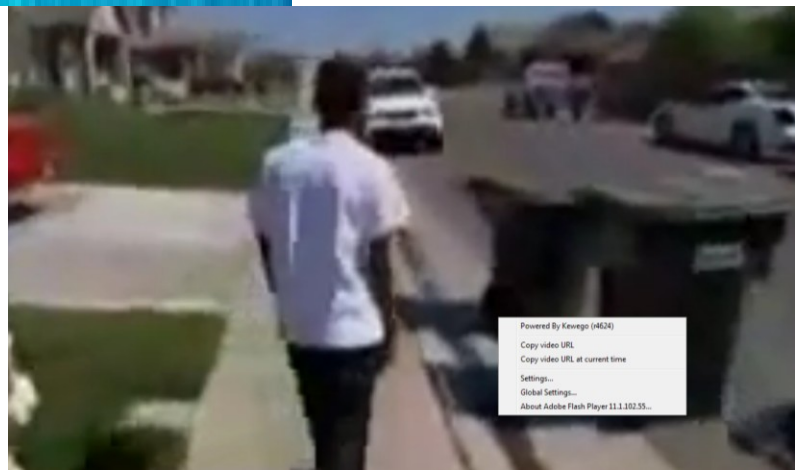


Fourier

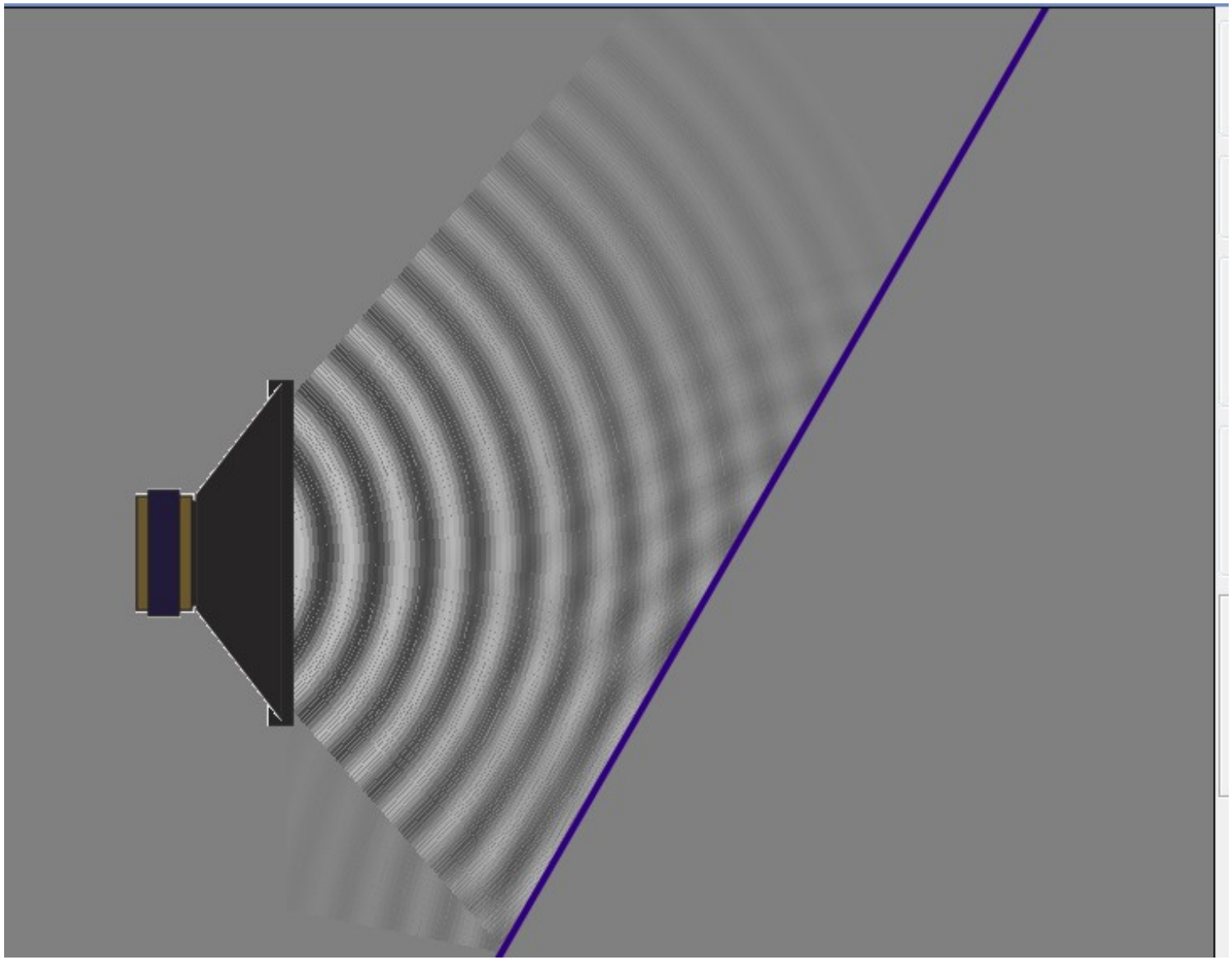
What did/will you learn??

Echolocation

batlab



Sound bounces off of different materials



Listen for echoes

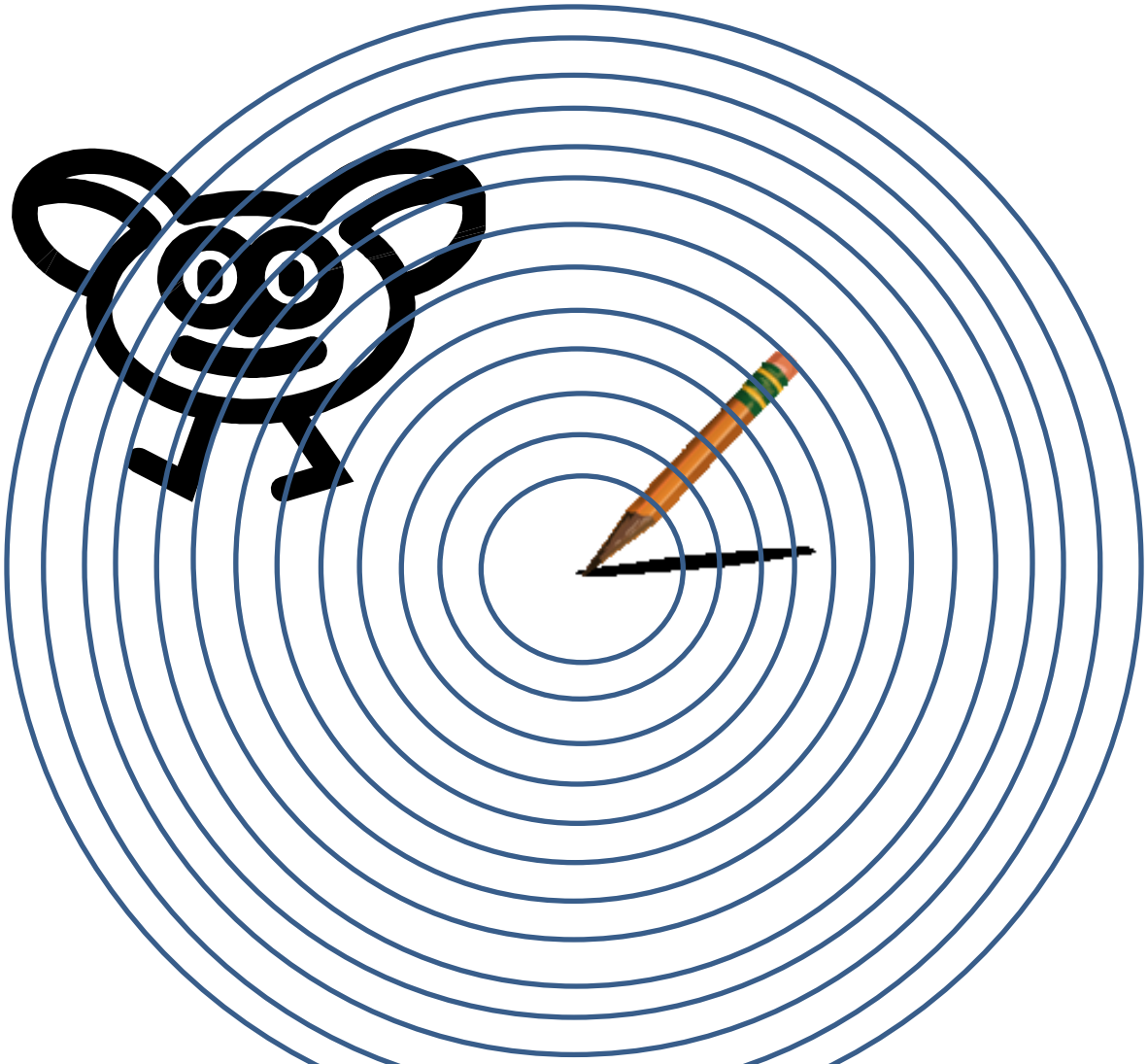
- Echolocators listen for the sounds bouncing back
- Most produce their own sounds (such as clicks) and listen for them to come back.
- People do this subconsciously
- The rate of clicking increases when more information is needed.

Results of Monday's Project:

- How many times did someone grab an object successfully?
- What was hardest location?
- Was everyone equally as good?

- Could you tell the short side of the room?

Locating sounds



Listen for the delay

- The delay tells the brain how far away an object is.
- If one ear hears it first, then it knows the object is on that side.

Acousticians

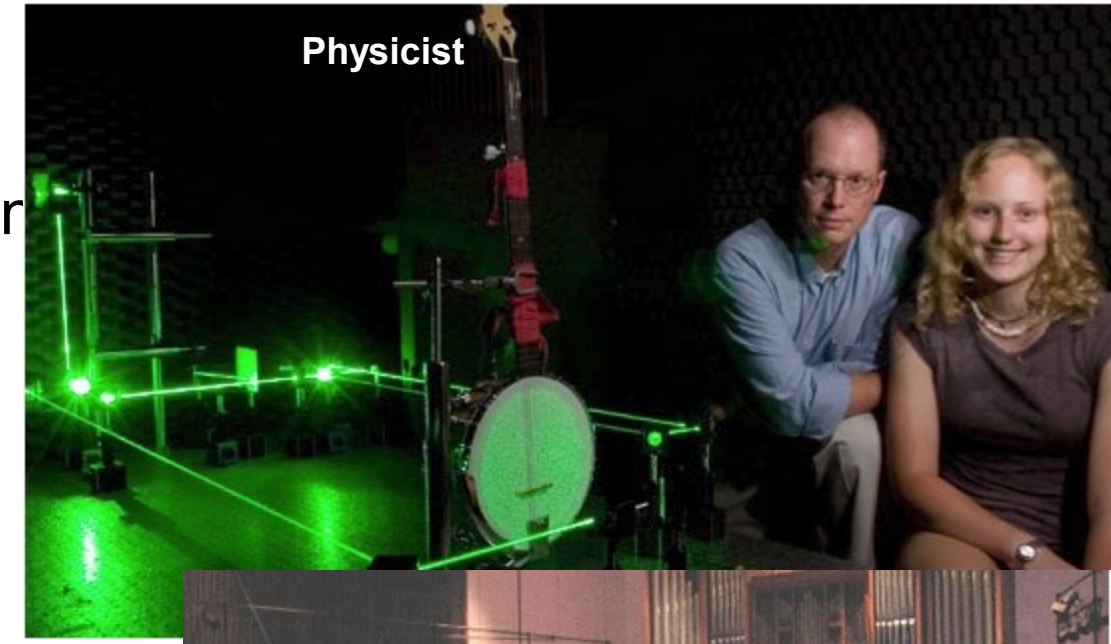
- Animal bioacousticians
- Underwater acousticians
- P &P : Physical and Psychological
- Audiologists

Psychology

Electrical Engineering and Marine Biology

Acousticians

- Musical Instrument Desigr



- Medical acoustics

- Architectural acousticians
  - Concert Halls
  - Vibration (ie. Bridges)

Intensity

- Intensity is Power per Area
- Power is Energy per time
- Intensity is “rate energy flows per unit area”

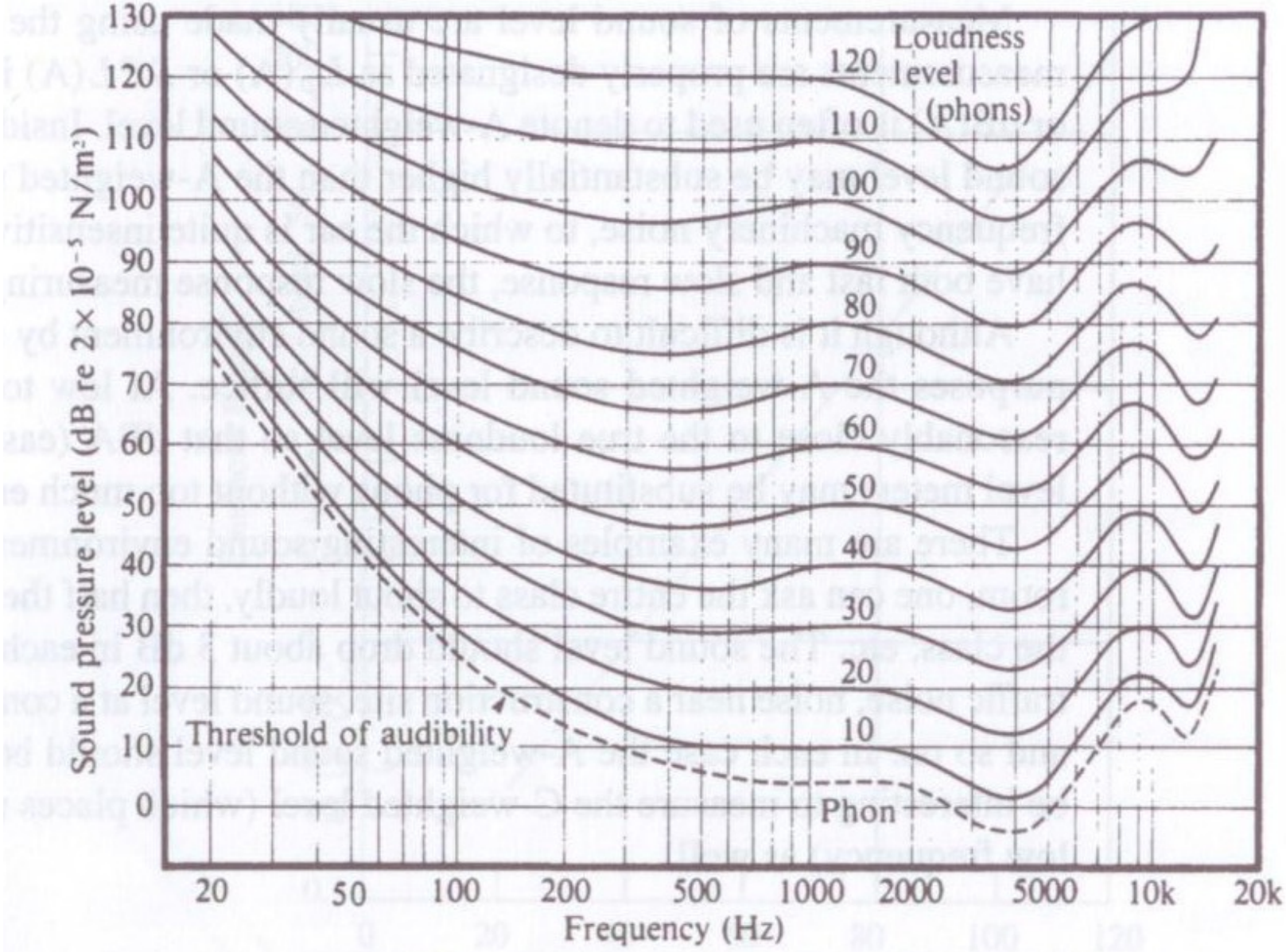
What is Loudness?

- Ears are sensitive to an phenomenal range of pressure changes.
  - Change of pressure in the inner ear: 3×10^{-5} Pa to 29 Pa (1 atm is 1×10^{5} Pa)
  - 3 parts in 10 billion!
  - Movement of 1/10 the size of an air molecule!
- sound intensities 1×10^{-12} W/m^2 to 1 W/m^2.
- Decibels
  - Logarithmic scale for comparing Intensity of a source to a reference Intensity

What is Loudness?

- But … that's still just measuring the motion of air molecules.
- Loudness is how we "perceive" Intensity Level (Decibels - dB)

Loudness vs. dB



Equations

$$I = \frac{P}{4\pi r^2}$$

$$\text{dB} = 10 \log \left(\frac{I}{I_o} \right)$$

$$I_o = 1 \times 10^{-12} \text{ W/m}^2$$