Presenting

Today

- The sounds of music
- Sound Intensity
- Harmonics
- Decibels

Tuning Fork

- The fork is stuck, putting energy into the fork.
- It oscillates, compressing the air around it.
- This creates longitudinal waves.

What you hear

- The transverse waves pass the energy through the air.
- Eventually, the pulse of energy meets your eardrum.
- The movement of the air is turned into nerve pulses and your brain interprets the frequency of the pulses of energy as noise.

Notes

- The frequency of notes is the vibrations that an air particle experiences every second.
- Each vibration is one oscillation.
- Humans can detect 20 to 20,000Hz tones.
- Dogs: 50 to 45,000Hz.
- Cats: 45 to 85,000Hz.

Octave

- One cycle through the notes.
- When the frequency doubles or halves, the same note is heard.
- Oct: 8. There are eight notes in a traditional musical scale.
- There are 12 total notes in an octave.

Harmonics: Frequency x 2^(x)

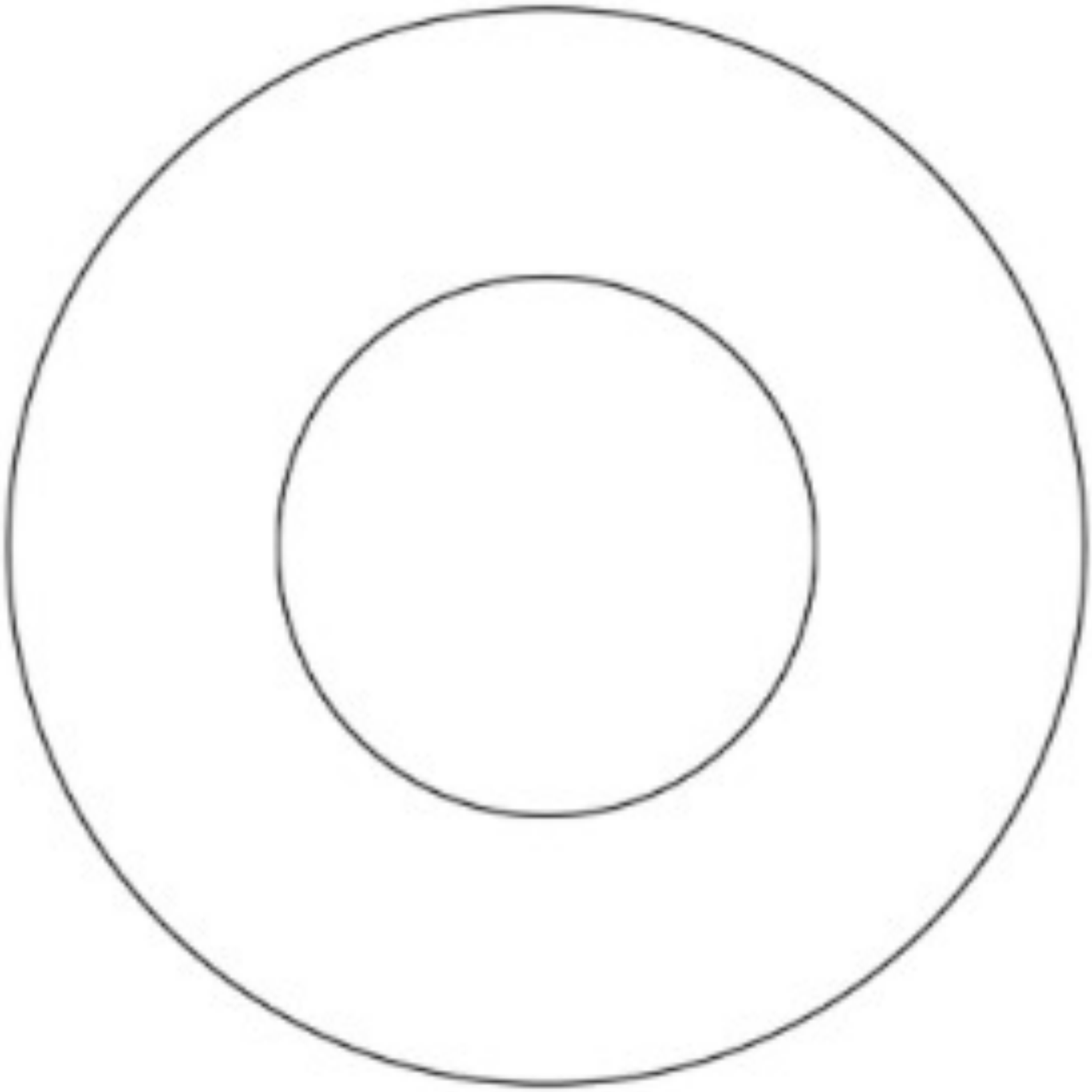
- The same note, multiples of 2 of the frequency.
- Twice the frequency: 1st harmonic.
- Four times the frequency: 2nd harmonic.
- Eight times the frequency: 3rd harmonic.

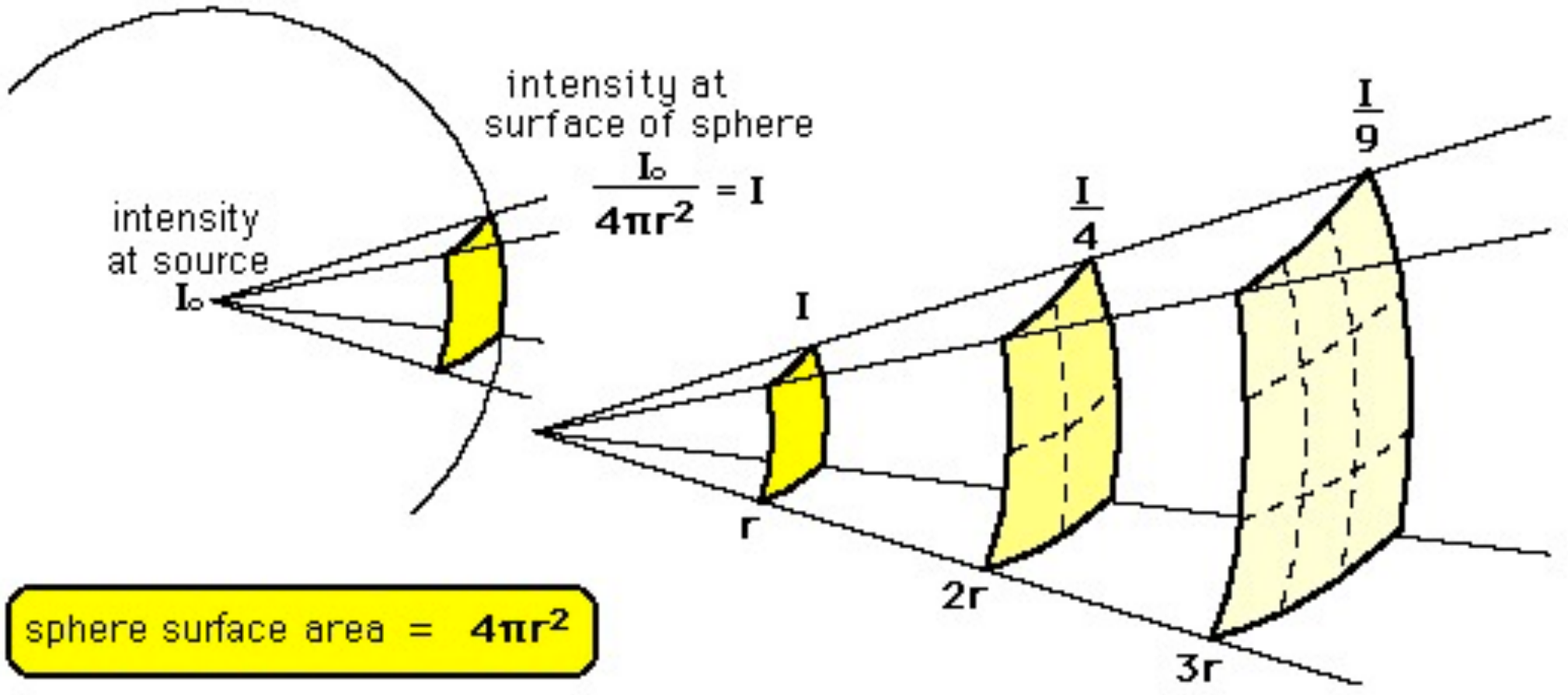
Intensity

- How loud something is.
- This is a function of the energy that is being perceived by your ears.
- Intensity = Energy/(time x area)
- Intensity = Power/area

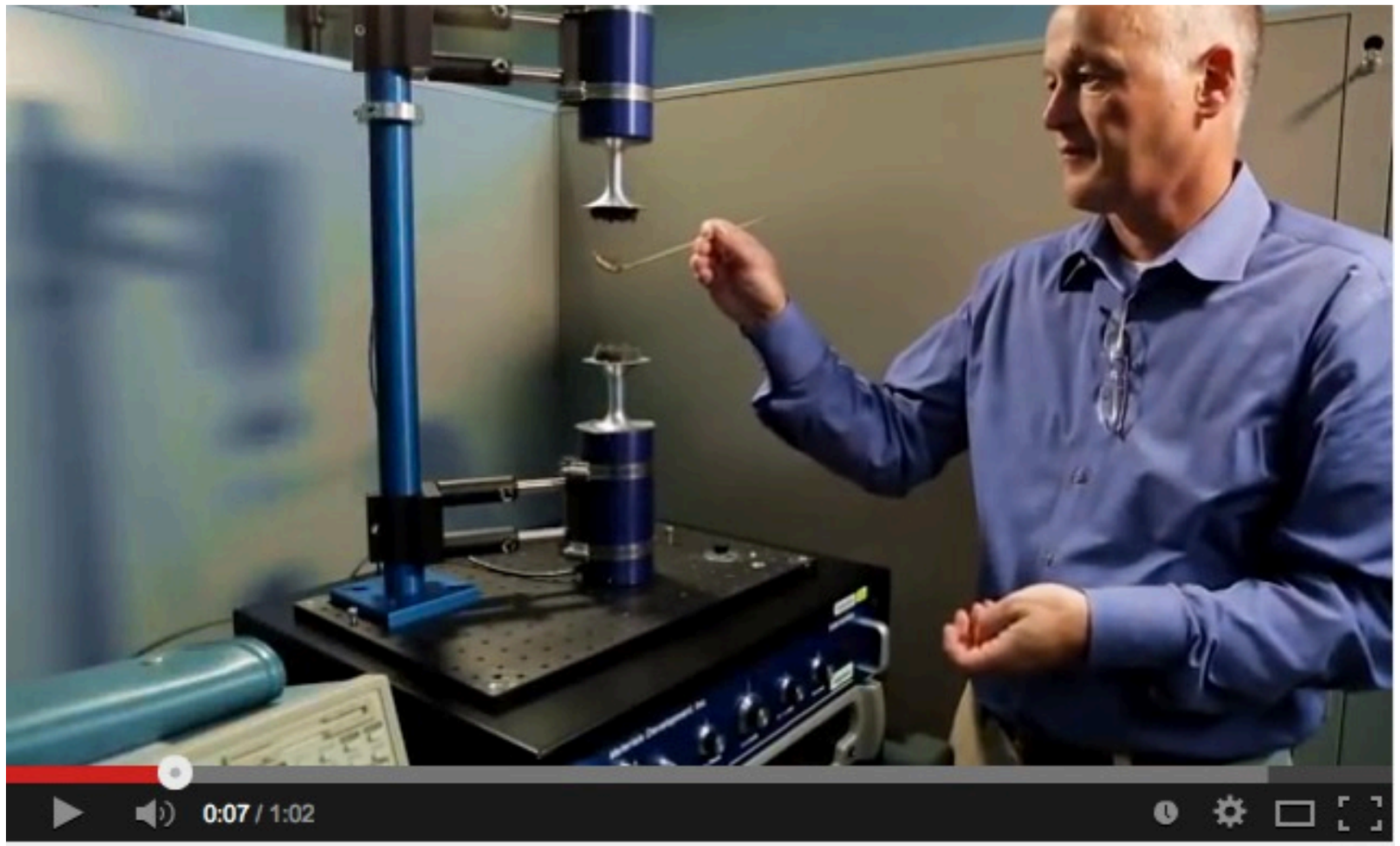
Intensity and Distance

- Sound generally travels from a source in all directions if not obscured.
- The further away the softer it sounds.
- By how much?





Inverse Square



Scientists Achieve Levitation with Acoustics

Sound is Energy

Amazing Water & Sound Experiment #2

What!?!?!?!?

Decibel Scale

Base Units

- Waves are energy [joules] traveling through air.
- Sound a frequency [Hz=1/s].
- The energy is transferred to our ear drum which is a 2-D surface [m^2]

Decibels: W/m^2

- This is a logarithmic (base 10) scale that begins at 0.
- Low end: 0 decibels= 1 x 10^(-12)W/m^2
- Rustling leaves: 10 decibels:
  1 x 10^(-11)W/m^2
- Whisper: 20 decibels:
  1 x 10^(-10)W/m^2

High End

- Painful: 130 decibels= 1 x 10^1 W/m^2
- Serious Hearing Loss: 160 decibels = 1 x 10^4 W/m^2

Calculations

- Given: W/m^2 = some number.
- Press the log button.
- Add 12
- Multiply by 10

Calculations

- Given: Decibels
- Divide by 10
- Subtract 12
- 2nd log = 10^(-x)

A conversation is about 60 decibels. What is the power/area hitting your ear drum?

A jet taking off is 1 x 10^2W/m^2. What is the decibel rating?

A vacuum cleaner produces 1 x 10^(-4) W/m^2 of sound. How many decibels is this noise level?

A loud classroom is about 65 decibels. How much more energy (ratio) is needed to reach this noise compared to 60 decibels?

The Coolest Things Sound Waves Do

Other Applications