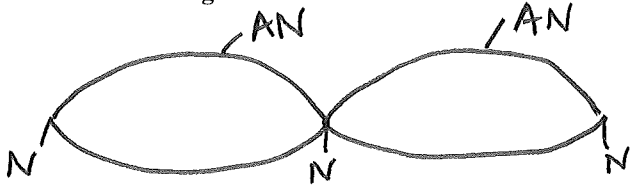
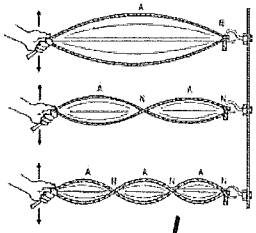
D) Standing Waves

standing wave- *a wave pattern that results when two identical waves travel in* opposite directions *and* interfere.
(waves that reflect and bounce back)

Sketch of a standing wave:

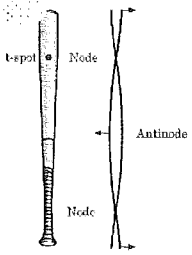




node- *a point on a standing wave that has* very little movement

antinode- *a point on a standing wave where the* maximum vibration *occurs*

Answer the following questions from the ESPN Sports Figures 10-minute video.

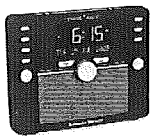


1. ***Explain why baseball bats have a "sweet spot."***
bat vibrates and sets off standing wave
* ball hit at node - won't vibrate & lose energy
vibrations waste energy - won't go as far

2. ***Bats break not because the players are hitting so hard but because of*** excessive vibrations !

3. ***Will a baseball generally travel further with a wooden bat or an aluminum bat? Explain your answer in physics terms.***
Aluminum stiffer than wood - less vibration - more energy into ball → hit farther

Quote from Justin Morneau after hitting a homerun: "It feels almost effortless. You don't have that resistance; it just hits the sweet spot, as they call it, and it feels like it just jumps off of there. It doesn't have any vibration or anything. It just feels good."



Electromagnetic Spectrum:

Radio Microwaves Infrared visible ultraviolet X-ray gamma

↑ wavelength ↓ wavelength

↓ frequency ↑ frequency

Radio Waves: Produced by combining an audio wave with a carrier wave
Audio wave = sound converted to electrical currents
Carrier wave = steady, high frequency wave that changes when combined with audio wave

FM stands for frequency modulation

FM stations are measured in Mega Hertz (MHz) 1 MHz = 10^6 Hz)

KDWB 101.3 = 101.3×10^6 Hz

Wave looks like:

frequency of wave changes

AM stands for amplitude modulation

AM stations are measured in kilo Hertz (kHz) 1 kHz = 1000 Hz)

AM 1500 = 1500×10^3 Hz or 1500000 Hz

Wave looks like:

amplitude (height) changes

Radio waves travel at the speed of light, so v = 3×10^8 m/s

EX: Find the wavelength for K102.1 FM. (2.94 m)

$f = 102.1 \times 10^6$ Hz

$v = 3 \times 10^8$ m/s

$3 \times 10^8 = (102.1 \times 10^6)\lambda$

$\lambda = 2.94$m

EX: Find the wavelength for AM 1500. (200 m)

$f = 1500 \times 10^3$ Hz

$v = 3 \times 10^8$ m/s

$3 \times 10^8 = (1500 \times 10^3)\lambda$

$\lambda = 200$m

* covers longer distances

Do you think AM or FM works better for music? WHY?

FM - more frequencies - more pitches, better for music

Why can't we see radio waves?

frequencies are not ones that our eyes are receptive to visible light $\lambda = 400\text{-}750$nm