

The Physics of Sound

&

Sound Reproduction

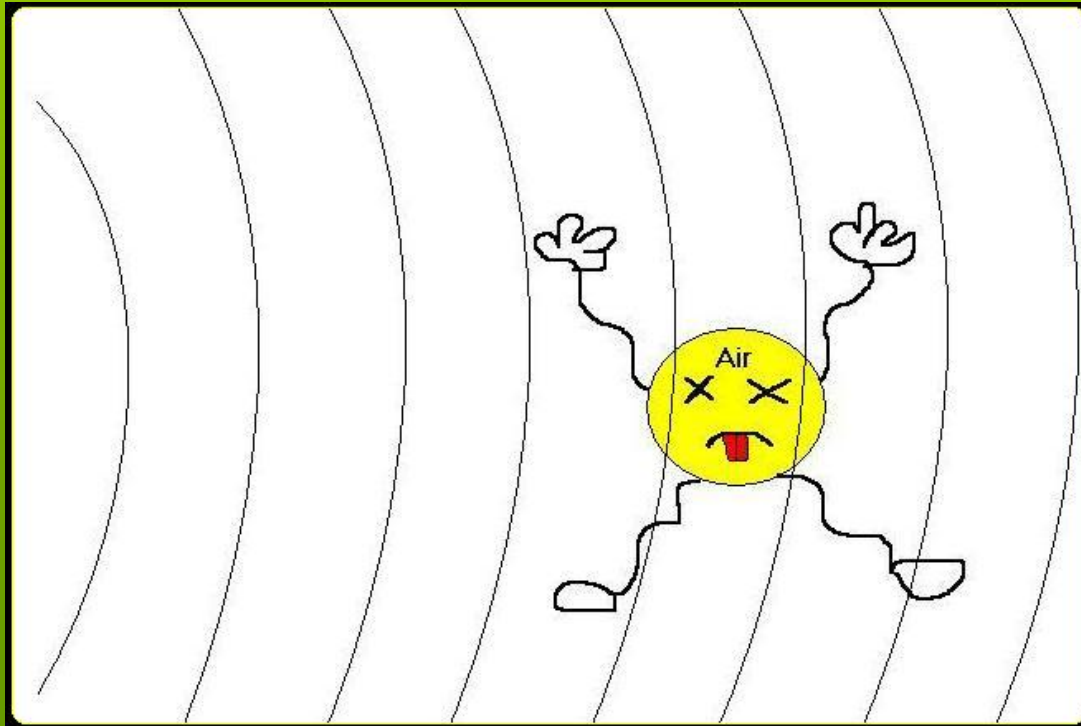
By: Newton Lo
Physics 420



- A.K.A. **The Paper Cup Phone**
- Why do you hear things on the other end?
- **What is sound anyways?**

The Physics of Sound

- Sound travels through the air (and different media) in waves, called **Sound Waves**
- These waves cause the air to **oscillate** (vibrate) back and forth



Not Just Any Wave

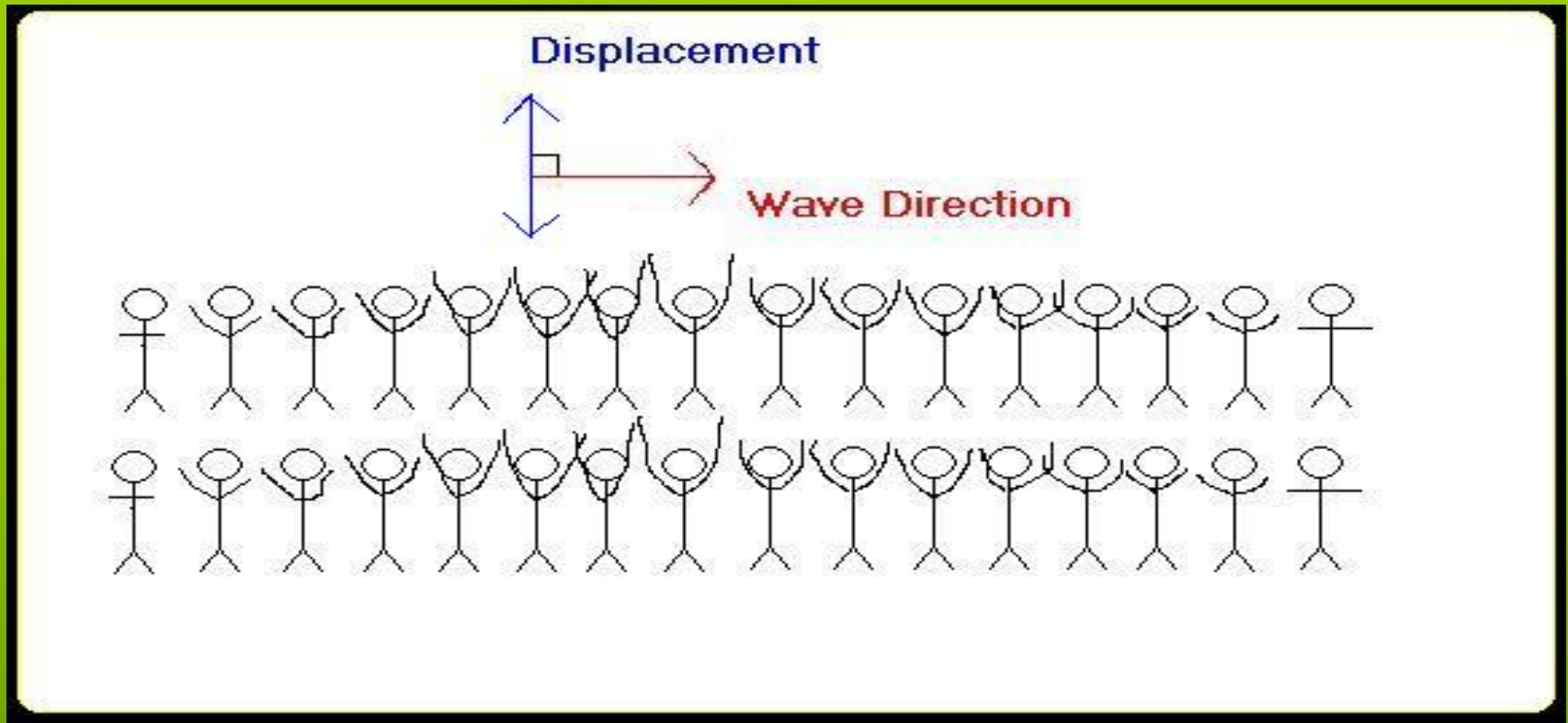
- The waves (ripples) created by throwing a rock into the pond are **Transverse Waves**
- Sound waves are **NOT** transverse waves
- Sound waves **ARE** **Longitudinal Waves**



Transverse Waves

- Pretend like you are at a Canucks game. Everyone do the **wave** starting from the left to the right!
- What direction is the wave traveling?
 - The wave travels to the right
- What direction is the displacement caused by the wave?
 - Displacement is vertical; **Perpendicular** to the travel direction.

Transverse Waves



- NOT SOUND WAVES !!!

Longitudinal Waves

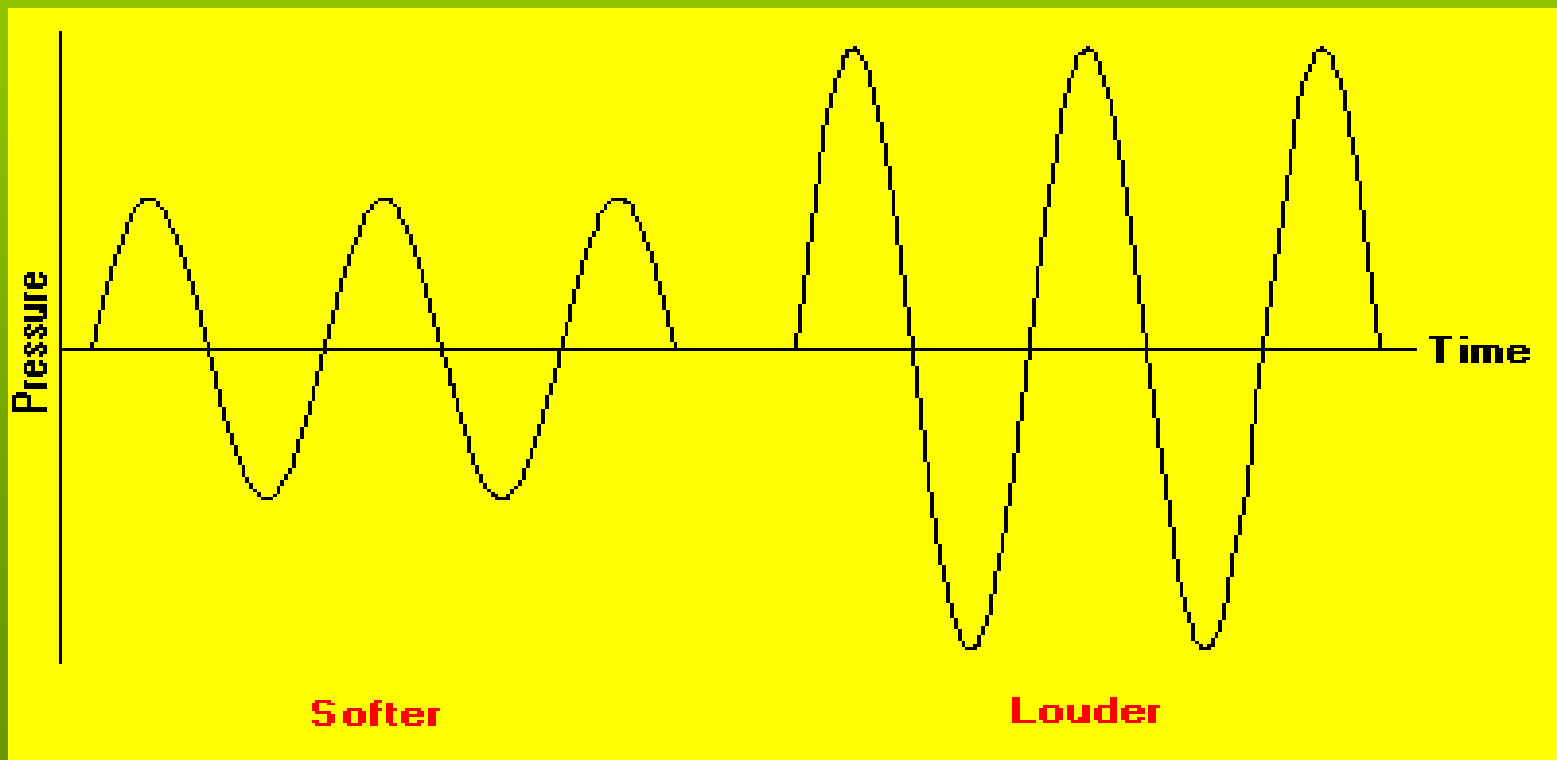
- Do the wave again, but this time, instead of moving your arms up and down, move them **side to side**.
- What direction is the wave traveling?
 - The wave travels to the right
- What direction is the displacement caused by the wave?
 - Displacement is horizontal; **Parallel** to the travel direction

Sound Wave Basics

- Two main components of a sound wave that affects what we hear are amplitude and frequency.
- **Amplitude** determines how **loud** it is.
- **Frequency** determines the “**pitch**”.

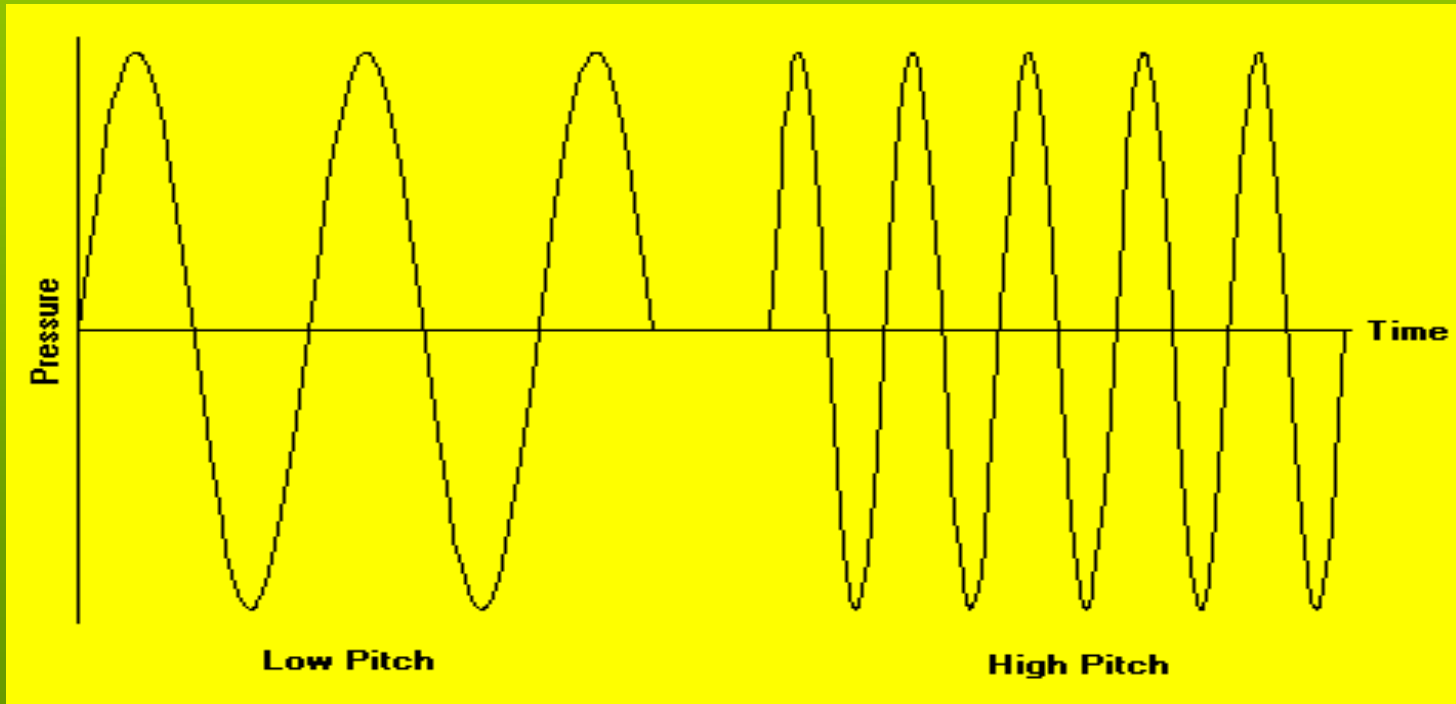
Amplitude

- The **Amplitude** measures the **displacement** of the air molecules.



Frequency

- Frequency is the number of times the wave oscillates back and forth in 1 second. It has units called **Hertz**



Sound Production

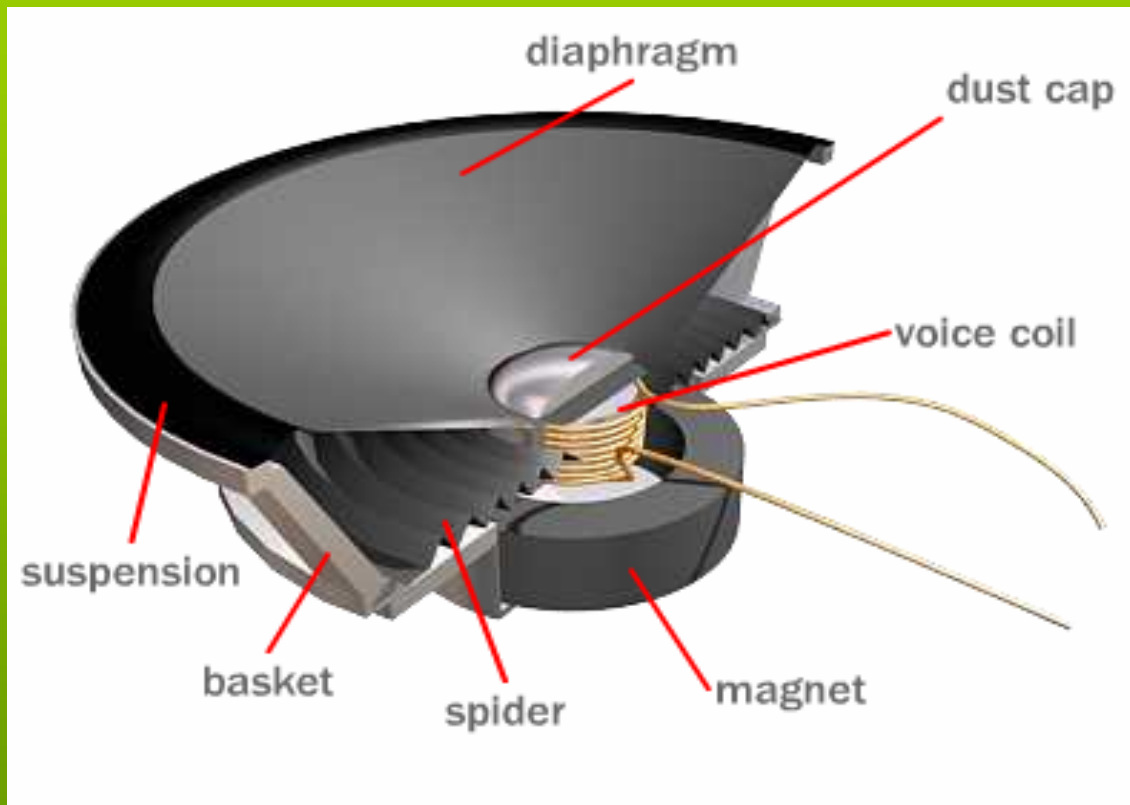
- How does one make sound?
 - Vocal cords, speakers, headphones etc.
- What do these all have in common?
 - They all vibrate the air!



Sound Reproduction

- Speakers take an **electronic signal**, and reproduce sound.
- By far most common type of speaker is the **Dynamic Speaker**.
- Other types of speakers include piezoelectric speakers, plasma arc speakers and electrostatic speakers.

Dynamic Speakers



Voice Coil

- The voice coil is **solenoid** (loop of wires) that is attached to the **diaphragm**
- When a **current** passes through the wires, a **magnetic field** is produced. The direction of the **magnetic field depends on the direction of the current.**

Apply an Electronic Signal

- What happens when an **electronic signal** is applied to the sound coil?
- The magnetic field created in the sound coil will either be **opposed** or attracted by the field from the permanent magnet.
- This causes the sound coil to oscillate.
- The **diaphragm oscillates** as well and thus produces a sound wave.

LET'S BUILD A
SPEAKER!