



# AL-MUSTAQBAL UNIVERSITY

## Babylon–Iraq



### Department of Biomedical Engineering

- Subject : Physics
- Grade: 1<sup>th</sup> Class
- Lecture : 8    Sound
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# Sound



What is sound?



Sound is a series of waves (sound waves) caused by vibrations.





# Sound: What is it?

- **Sound is a disturbance that travels through a medium as a longitudinal wave.**

# WHAT IS SOUND?

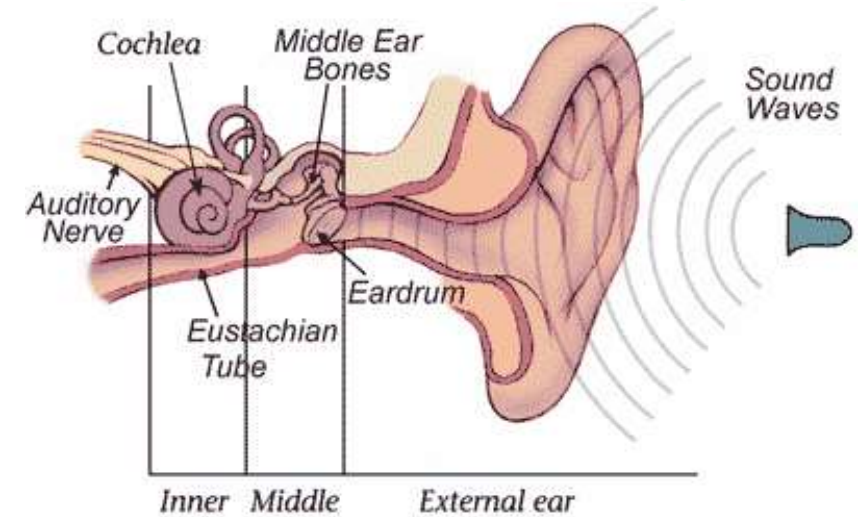


**A form of energy that travels through the air.**

- **Sound is made when something vibrates.**
- **Sound needs a medium to travel.**
- **The loudness of a sound is called volume**

# HOW SOUND TRAVELS

- Sound waves carry energy through a medium without moving particles of the medium along
- Each particle of the medium vibrates as the disturbance passes.
- When the disturbance passes your ear you hear the sound
- A common medium for sound is air, but sound can travel through many other mediums



Anatomy of the Ear

## Interactions of sound waves:



- Reflection: Sound waves reflect when they strike an object.
  - You hear this as an echo.
- Diffraction: Sound waves “bend” around corners or “squeeze” through a door.
- Interference: Sound waves may interact with each other.

# Speed of sound waves:



- **Depends on**
- elasticity,
- density,
- temperature of the medium the sound is traveling through.

# Speed of sound waves:



- .
  - Elasticity: the ability of a material to bounce back after it is disturbed.
  - The more dense the medium the slower sound travels through it.
  - The lower the temperature the slower sound travels through a medium.



# Speed of Sound: Elasticity



- The more elastic the medium, the faster sound travels
  - Sound travels well in solids because they are usually more elastic
    - Particles of solids do not move very far , so they bounce back and forth very quickly as the compressions and rarefaction of the sound waves pass
  - Most liquids are not very elastic and sound does not travel well
  - Sound travels very slowly in gases because gases are not very elastic

# Speed of Sound: Temperature

- Sound travels more slowly at lower temperatures than at higher temperatures
  - This is because at low temperatures, the particles of the medium move more slowly
  - At low temperatures the particles are harder to move and return to their original positions more slowly.
    - Example: @ 20°C → 343 m/s
    - @ 0°C → 330 m/s



# Speed of sound waves:



- Air at room temp. = 343 m/s
- Fresh water = 1,509 m/s
- Glass = 5,170 m/s

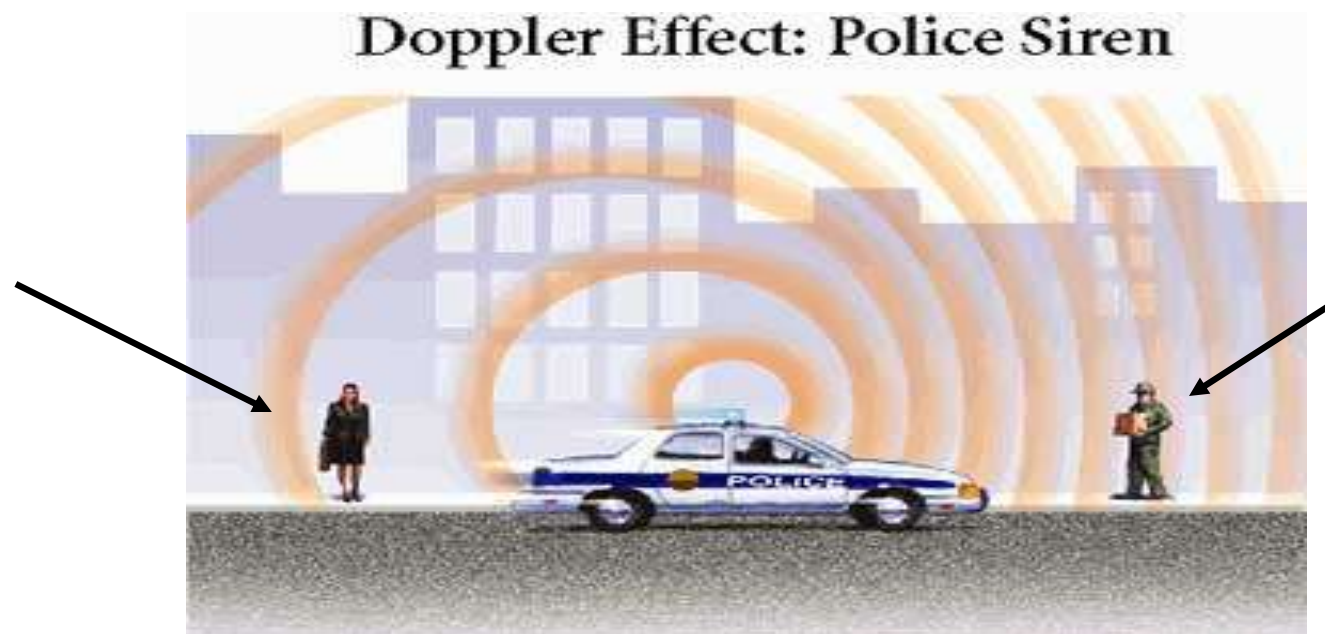
# Properties of sound:



- Loudness: Describes your perception of the energy of the sound.
  - Depends on distance from the source and energy used to make the sound.
  - Measured in decibels (dB).
- Intensity: The amount of energy a sound wave carries through an area each second.

# Doppler Effect:

- Definition: The change in frequency of a wave as its source moves in relation to an observer.



# HOW IS SOUND TRANSMITTED?



**Transmission of sound requires matter (air, liquids, solids) as transmitting medium, unlike light which can travel through matter and space.**

# Sound Travels Through Matter



## Gases

Most of the sounds we hear travel through gases, such as air.

For example:  
Sound from a bell, a horn, or an alarm clock travels through the air.

## Liquids

Some sounds that we hear travel through water.

Sonar is the way to use sounds to locate objects under water.

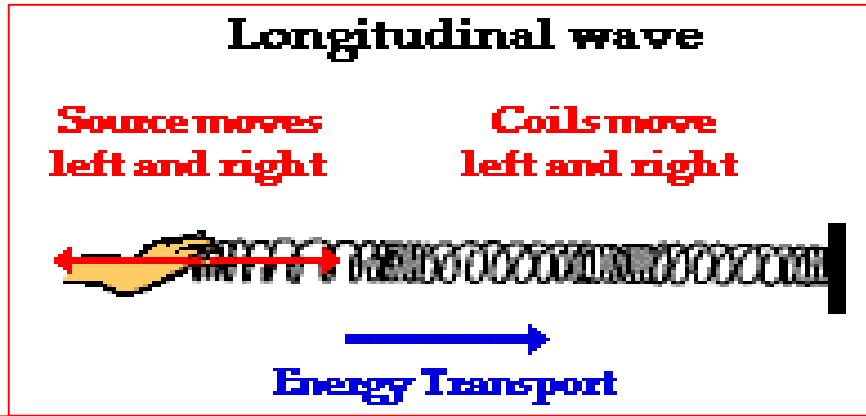
What animals use sonar?

## Solids

Some sounds that we hear travel through solids.

For example: When you hit a drum, it vibrates, then the sound travels through the air, to your ears.

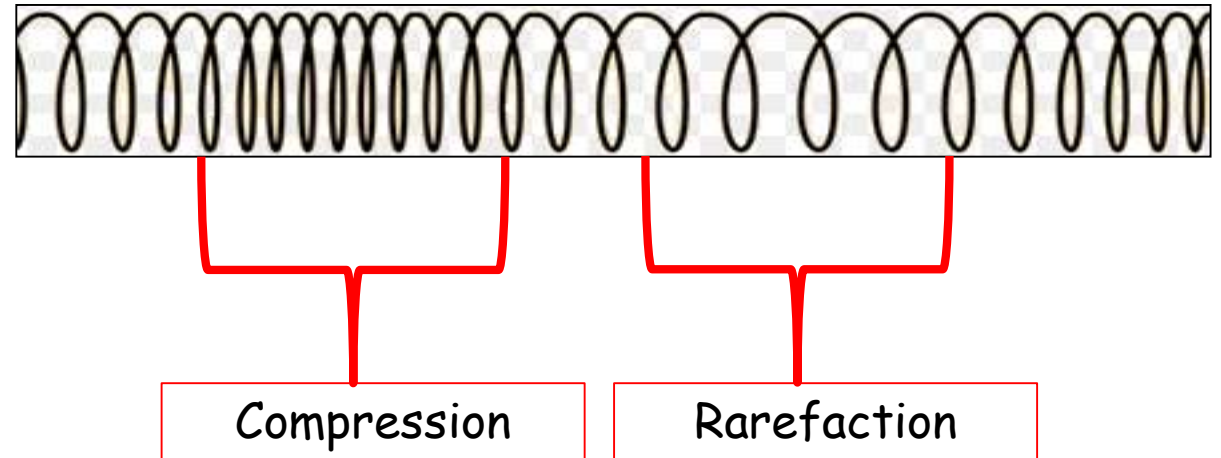
# Longitudinal Waves



<http://www.physicsclassroom.com/class/sound/Lesson-1/Sound-as-a-Longitudinal-Wave>

In **longitudinal waves** the oscillations (vibrations) are **backwards** and **forwards**. The different sections are known as **compressions** and **rarefactions**.

## Eg. Sound



The **oscillations** in **longitudinal waves** are in the **direction** of travel.

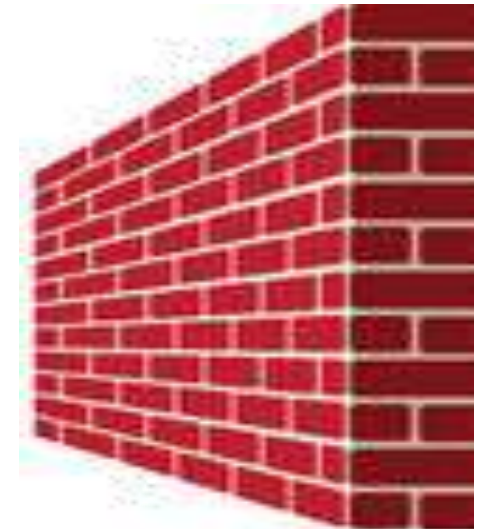
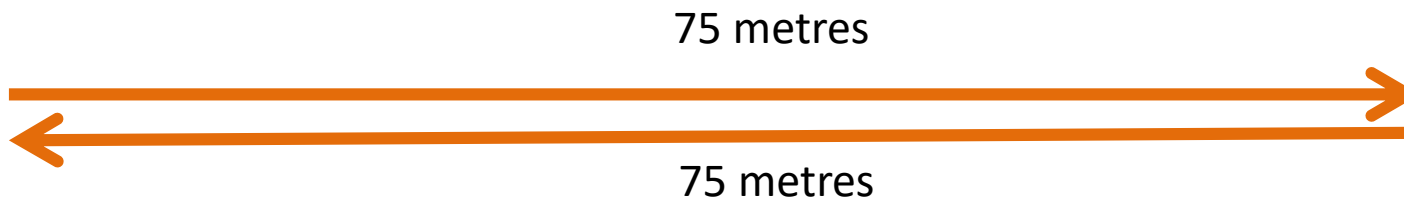
**Sound waves** are longitudinal waves.





# How could we calculate the speed of sound in air?

$$\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}}$$



Time



**Intensity:** The amount of energy that flows through a certain area in a specific amount of time

- Louder sound waves carry more energy
- Intensity decreases as distance increases.

# WHAT IS PITCH?



- **The pitch of a sound is how high or low it is.**
- **A sound with a high frequency has a high pitch.**
- **Frequency is the number of vibrations per second.**

# HOW DO WE USE SOUND?



- For human beings, sound is one of the most important ways to communicate by:
- *expressing himself through speech*
- *obtaining information through listening*
- *obtaining stimulation (music)*

**Do You Have  
Any Questions?**