

Before you start this...



**MINDS UNDER
CONSTRUCTION**

Make sure that you have completed the section on **WHAT IS PHYSICS?** on the **ACTIVINSPIRE** page.



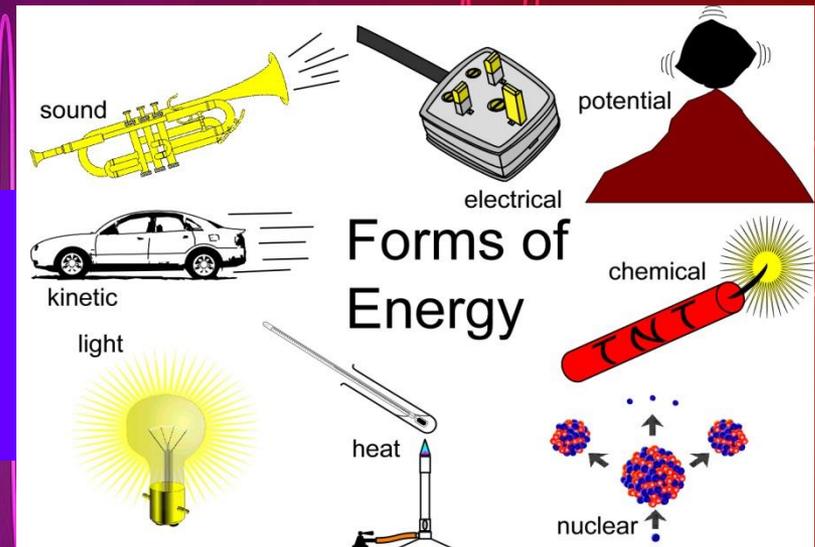
Energy & Sound

Physics Topic

Energy & Sound

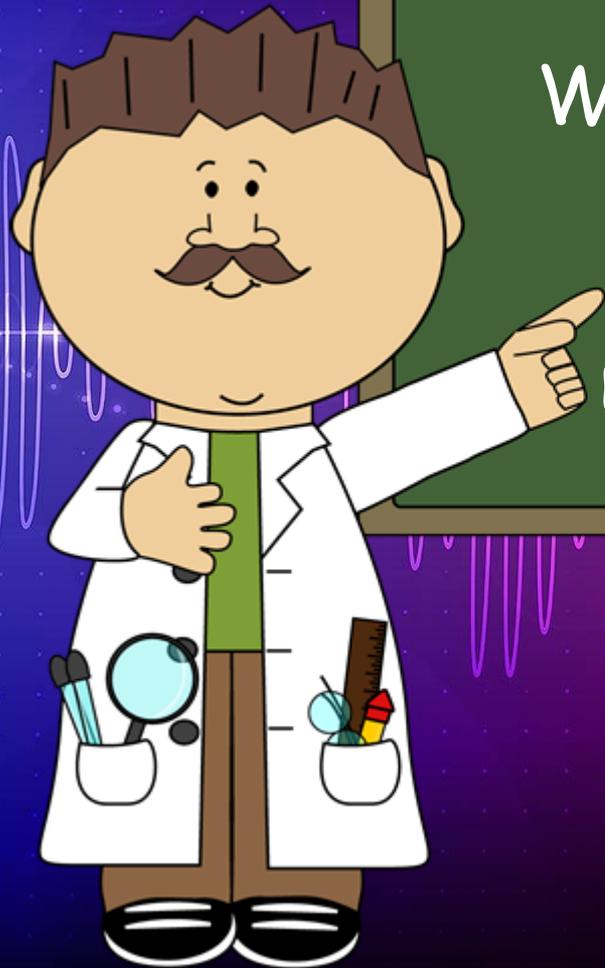
Lessons Group 1

Forms of Energy and Conservation of Energy



At the end of these lessons, I will know some different forms of energy and understand conservation of energy.

Forms of Energy



What is energy?
What unit is
energy
measured in?

Watch the film on TWIG
to find the answers

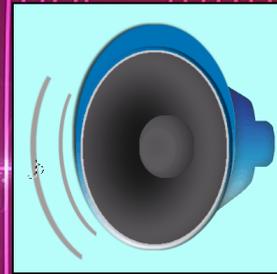
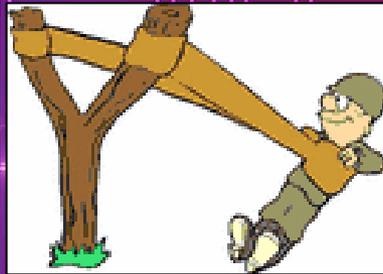
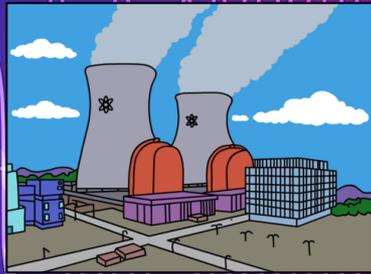
twigonglow/forms-of-energy

Forms of Energy



Questions

1. Write down as many types of energy as you can remember from the video clip

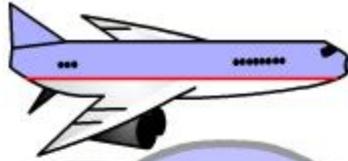


2. Copy and complete this sentence:
Energy is measured in _____. This is sometimes abbreviated as the letter, _____.

Forms of Energy



1



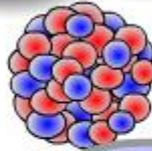
2



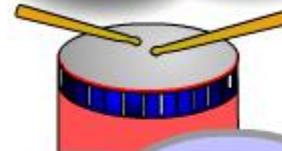
3



4



5



6



7



8



9

Reset

Show answers

Drag and Drop the following labels :

Light

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What is Energy?

Energy is needed to get jobs done, or make things work.

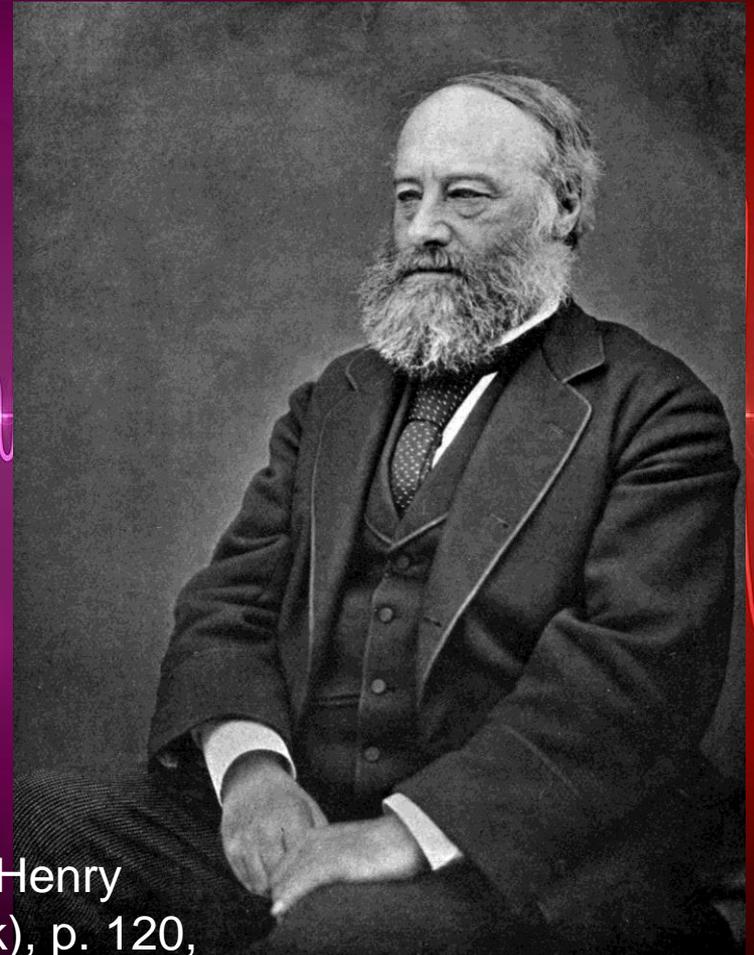
To get a job done, energy must be transferred from one place to another.



Energy
Conversion

Joule- the unit of energy

Energy is measured in units called JOULES (J) named after the famous scientist called James Prescott Joule, a Physicist and Brewer.



By Henry Roscoe - The Life & Experiences of Sir Henry Enfield Roscoe (Macmillan: London and New York), p. 120, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=3119134>

Energy Crisis? What Energy Crisis?



Hypothesise/
Express view

Have you heard people
talking about the
Energy Crisis?

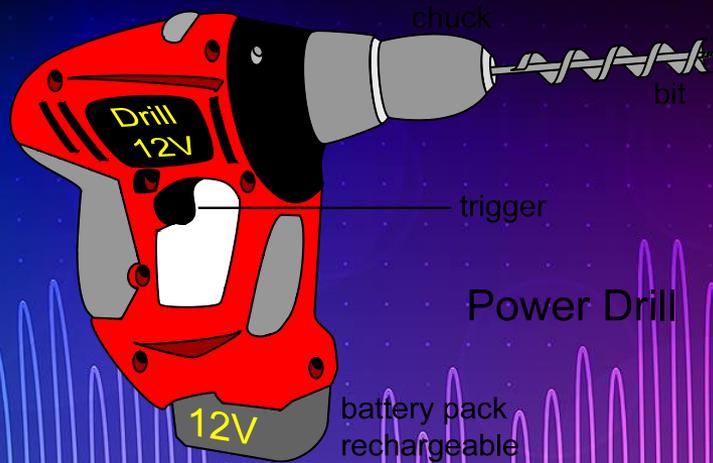
It concerns us all.

But there is EXACTLY
the same amount of
energy now as there
was at the beginning
of life on Earth.



Can you think of a
reason these two
statements seem to
be in conflict?

Forms of Energy



A machine is any object that converts one type of energy in to another.

The total energy that goes in to a machine is equal to the total energy that is given out by it. This principle is called the **conservation of energy** and it's a rule that applies all over the universe!

Forms of Energy



The sound energy being given off by an iPod has not been created. It has been converted from electrical energy.

The heat energy is a 'waste' energy because it is unwanted.

Forms of Energy

Energy is all around us but we can't create or destroy it.

The only thing that we can do with energy is change it from one form to another or transfer it from one object to another.



ENERGY LAW!

Energy cannot be created or destroyed we can only move it around. Eventually energy turns into heat which heats up our surroundings.

....in summary

Energy is converted or transferred it is never lost!

Forms of Energy

An iPod takes in electrical energy and turns it in to sound and light energy.

(Other brands of mp3 players are available!)

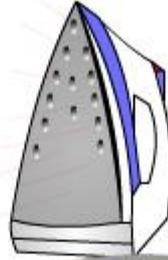


So, the energy change in an iPod is:
Electrical → Sound + Light + Heat

Energy transfers



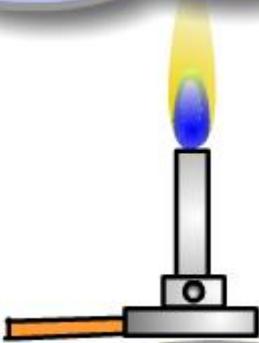
1



2



3



4



5



6

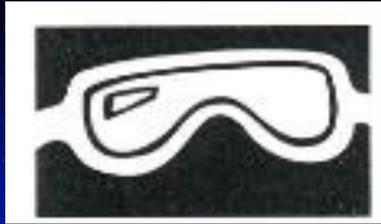
Reset

Show answers

Drag and Drop the following labels :

Sound → Electrical

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Energy Circus



All practical activities

Complete the energy circus. You have 5 minutes to complete and write up each task so get to it

[Star Wars theme music](#)

Classools.net Star Wars Theme (5m 37s) Countdown Timer
[Or just type your time into the box below!]
Time Left:
05:37
Minutes:Seconds
Countdown

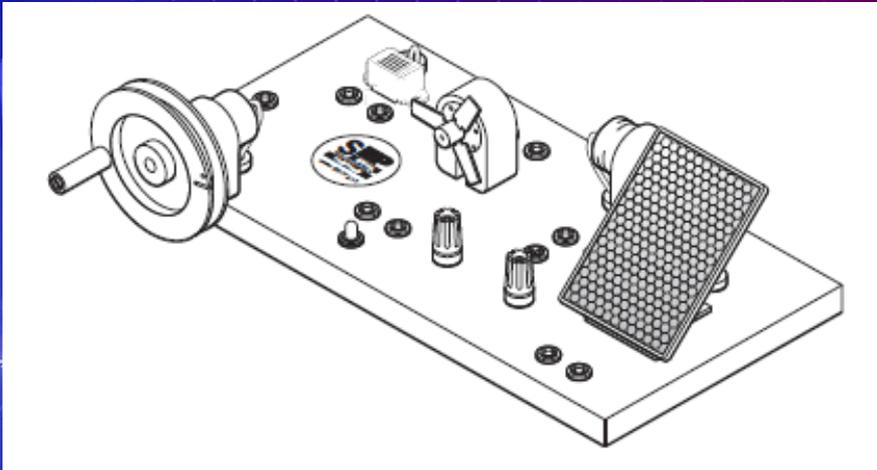
At the end of each star wars theme move around to the next station



Steam Engine & workshop



Energy Transfer Unit



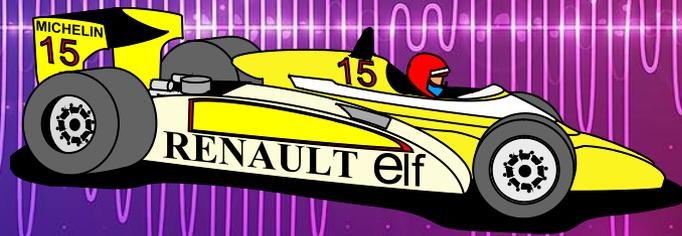
As a class look at the energy Transfer Unit.

Complete the work on the worksheet.



Practical Activities
Hypothesising

Here is a picture of a racing car. In the diagram 100 Joules of energy is stored in the fuel. This produces 30 Joules of energy to move the car forward. This means 70 Joules of energy has been wasted as heat. We can represent this in a diagram



100 J

potential energy
in fuel



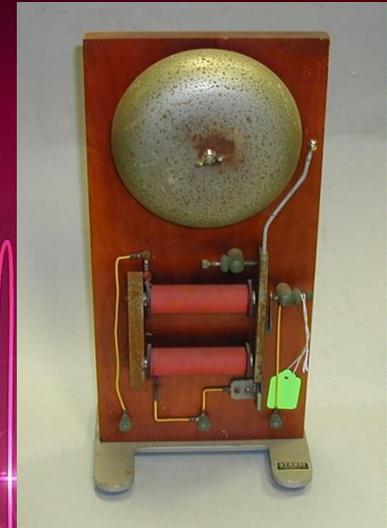
30 Joules kinetic energy

70 Joules heat

Energy Transfers (continued)

More examples –

Electrical Bell



Parachutist



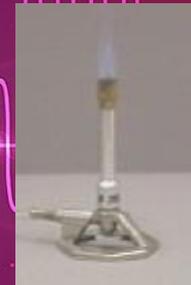
Energy Transfers (continued)

Write out energy transfer diagrams for the following situations, clearly showing what energy types are wasted in the transfer.

Clockwork toy



Bunsen Burner



Clapping hands



Vacuum cleaner



Energy Transfers (continued)

Energy transfers can have many stages too. A torch is a good example.



Roller coasters have lots of transfers too.



Energy Transfers (continued)

Draw energy transfer diagrams for the following situations



runner



racing car



bungee jumper



coal fire



catapult



generator

Energy efficiency



Processing Data

Only for the smart

For a kettle...



$$\begin{aligned} \text{Efficiency} &= \frac{\text{USEFUL energy OUT}}{\text{TOTAL energy IN}} \\ &= \frac{50,000\text{J}}{60,000\text{J}} = 0.83 \end{aligned}$$

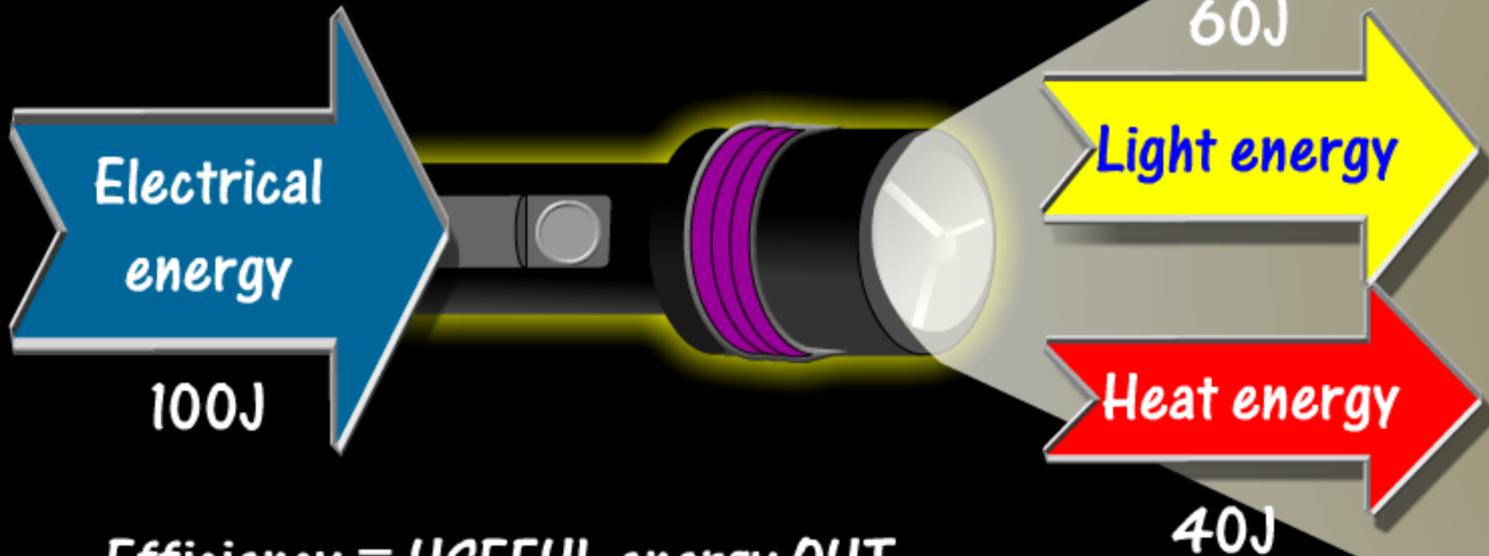
Energy efficiency



Processing Data

Only for
the smart

For a torch...



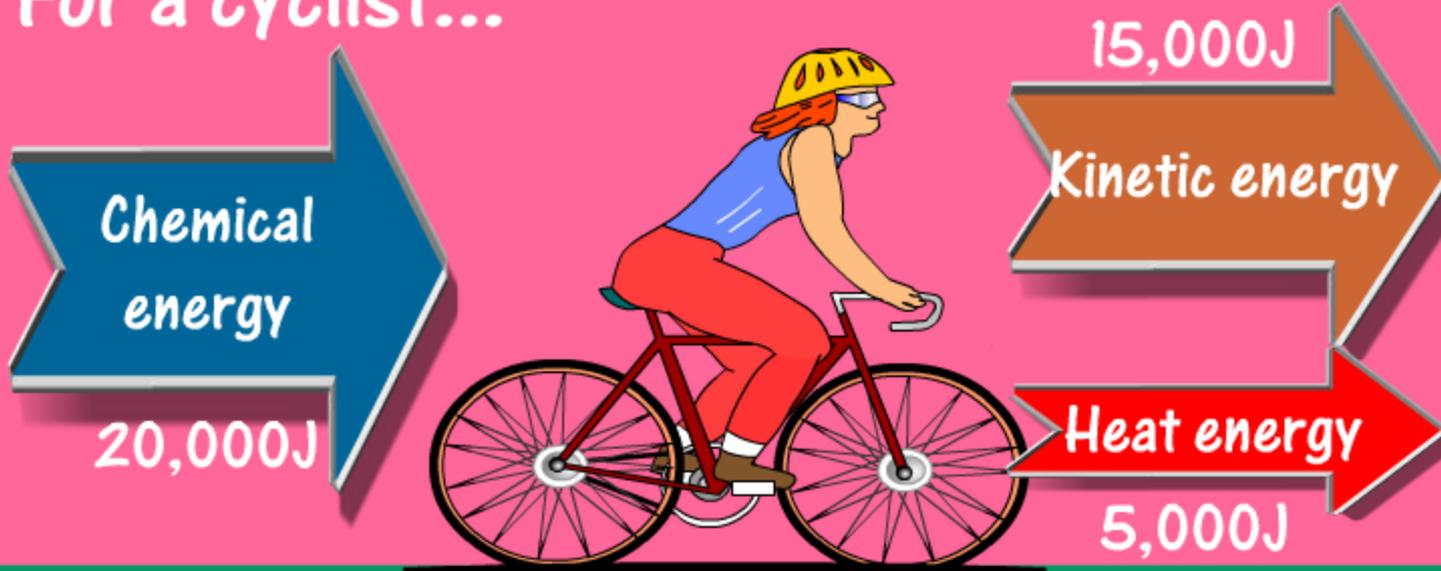
$$\text{Efficiency} = \frac{\text{USEFUL energy OUT}}{\text{TOTAL energy IN}}$$

$$= \frac{60\text{J}}{100\text{J}} = 0.6$$



Only for
the Smart

For a cyclist...



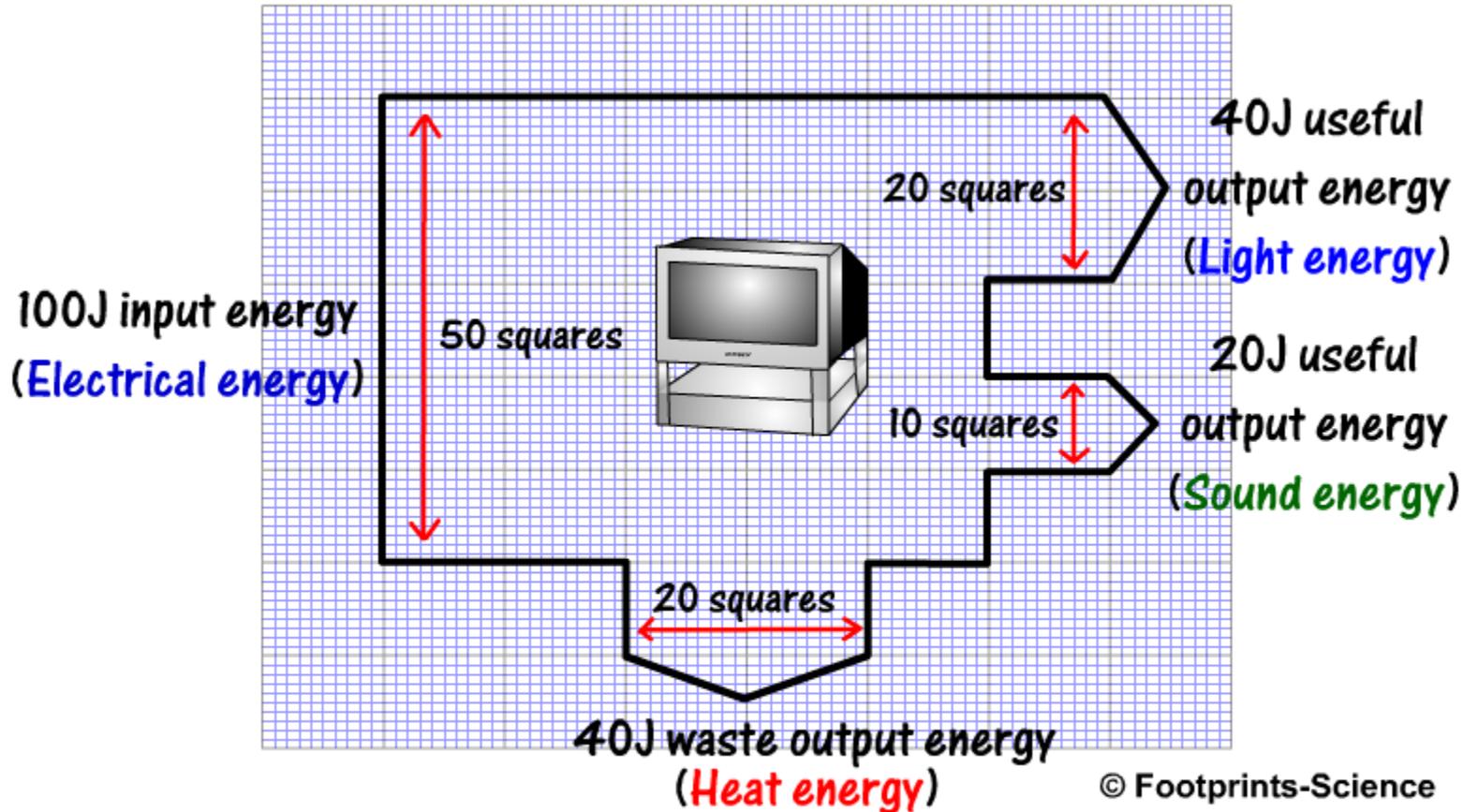
$$\begin{aligned} \text{Efficiency} &= \frac{\text{USEFUL energy OUT}}{\text{TOTAL energy IN}} \\ &= \frac{15,000\text{J}}{20,000\text{J}} = 0.75 \end{aligned}$$



Sankey diagram

Only for the smart

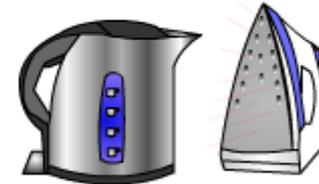
Processing Data



$$\text{Efficiency} = \frac{\text{USEFUL energy OUT}}{\text{TOTAL energy IN}} = \frac{60\text{J}}{100\text{J}} = 0.6$$

Electrical energy is the most useful form of energy in the home because it can be changed into...

1. e.g. in irons, kettles



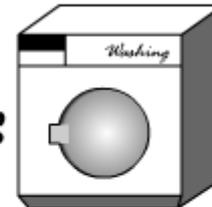
2. e.g. in stereos



3. e.g. in light bulbs



4. e.g. in washing machines



Reset

Show answers

Drag and Drop the following labels :

Sound energy

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Forms of Energy

REVISION

1

2

3

4

5

6

Reset
Show answers

Drag and Drop the following labels :

Sound → Electrical

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Forms of Energy

REVISION



Questions

1. Copy and complete this table to show the energy changes that takes place in different machines.

Machine	Energy Change
Power Station	
Catapult	
Loudspeaker	
Toaster	
Bulb	
Car	
Human	

Forms of Energy

ANSWERS



Questions

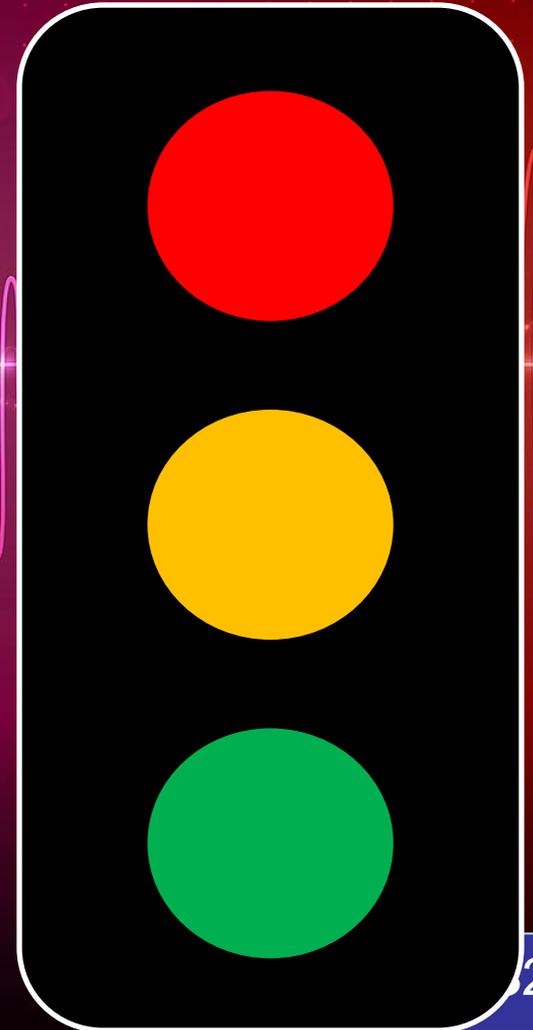
1. Copy and complete this table to show the energy changes that takes place in different machines.

Machine	Main Energy Change
Power Station	Nuclear/Chemical To Electrical
Catapult	Potential to Kinetic (+ sound)
Loudspeaker	Electrical to Sound (+ heat)
Toaster	Electrical to Heat (+ light)
Bulb	Electrical to Light (+ heat)
Car	Chemical to Kinetic (+ heat, sound, etc)
Human	Chemical to Heat + Kinetic + Sound

Forms of Energy

Learning Intention:

I know some different types of energy and understand conservation of energy.



WAVES

Part 2

At the end of this section you should know about the two types of waves and give examples. You should be able to use the correct words to describe waves



www.logos.co #3664



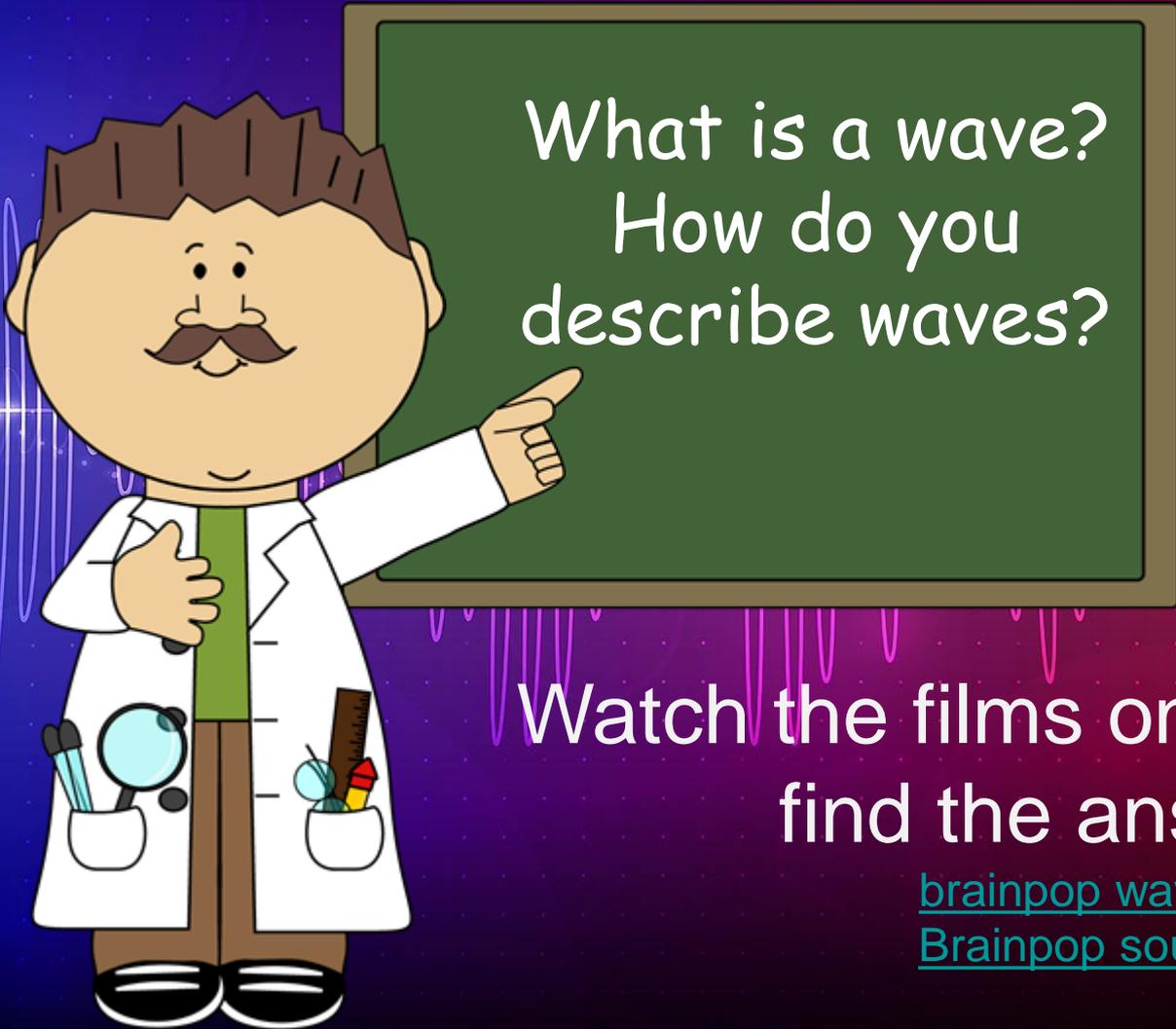
What do you know about waves?

Express views
Written

A large, light blue five-pointed star is centered on the page. The word "waves" is written in a bold, black, sans-serif font across the center of the star. The background of the slide is a gradient from dark blue on the left to dark red on the right, with a white horizontal line representing a wave axis. The wave itself is a series of oscillations that change in frequency and amplitude from left to right, with colors transitioning from blue to purple to red. The background also features a grid of small white dots.

waves

Waves



What is a wave?
How do you
describe waves?

Watch the films on Brainpop to
find the answers

[brainpop waves](#)

[Brainpop sound](#)

Slinky demonstration

Move into the corridor and complete the slinky demonstration

- What is a transverse wave? Watch one piece of the slinky, which way does it move?
- What is a longitudinal wave? Watch one piece of the slinky, which way does it move?
- Do waves catch each other?
- How do the waves reflect?
- Do the waves pass through each other or join each other?
- What happens when the wave reflects?
- What happens to the amplitude (height of the wave) as the wave moves along?
- Can a longitudinal wave and transverse wave pass?
- Can you make a standing wave? How is this done?

Find out about Transverse and Longitudinal waves

The screenshot shows a Flash application window with a menu centered around the word "Waves". The menu items are:

- Interactive summary
- Introduction
- Example problem
- Speed of sound
- Electromagnetic spectrum
- Example problem
- Transverse and longitudinal waves

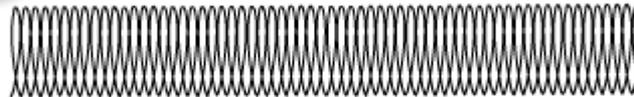
The application window has a menu bar with "File", "View", "Control", and "Help". The Windows taskbar at the bottom shows the time as 19:57 on 03/10/2016. A copyright notice "Copyright Physics Support Materials 2002" is visible in the bottom right of the application area.

Transverse & Longitudinal

1 waves are those in which 2
are at 3 to the direction of 4



5 waves are those in which the vibrations
are in the 6 as the direction of travel



Reset

Show answers

Drag and Drop the following labels :

Longitudinal

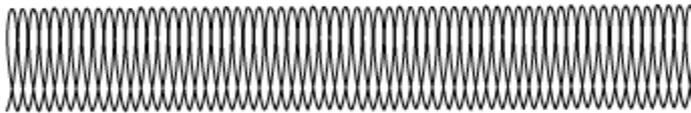
© Footprints-Science

Transverse & Longitudinal



Transverse

Vibrations are 90° to direction
of movement



Longitudinal

Vibrations are along direction
of movement

Drag and Drop the following labels :

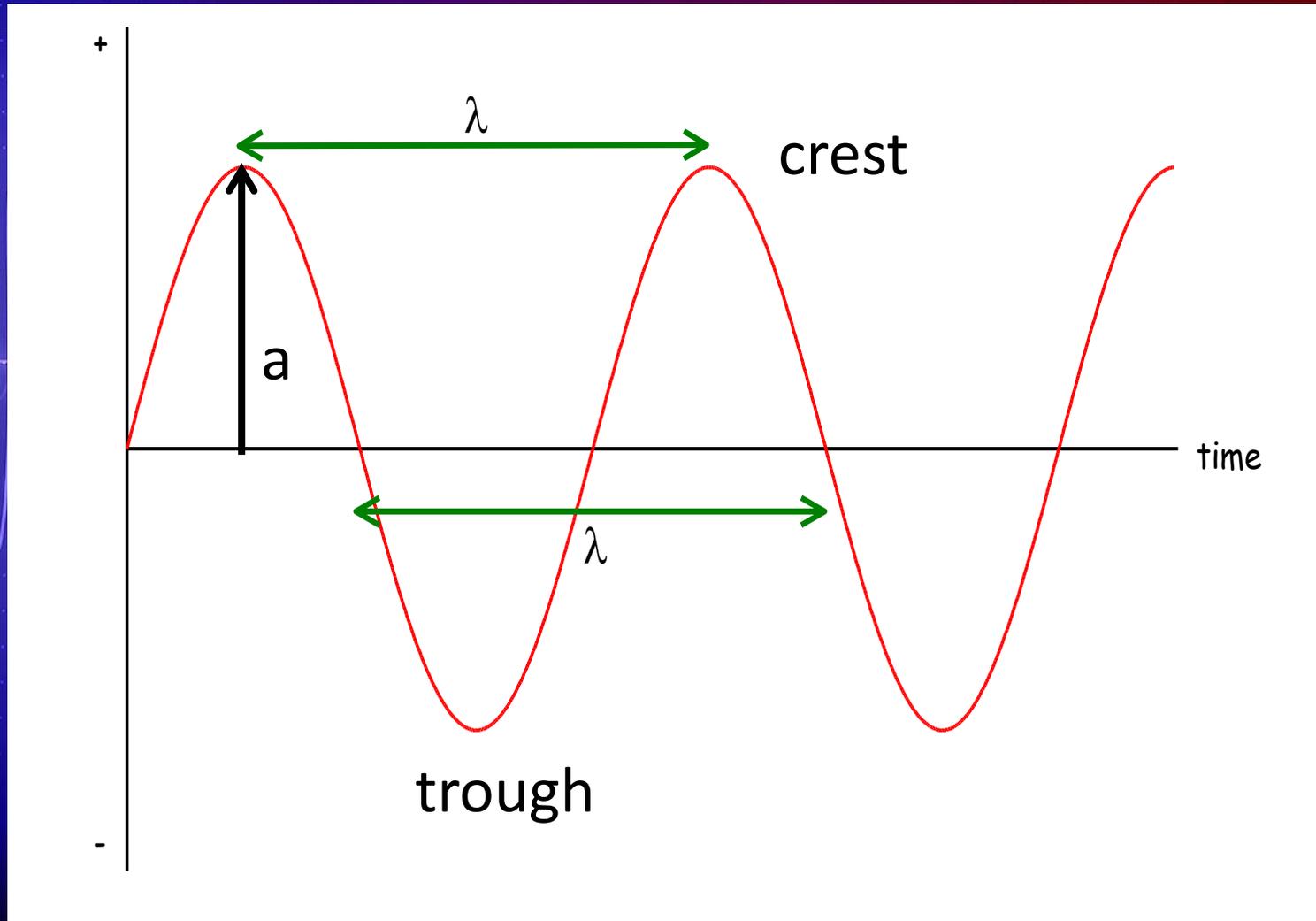
UV rays

© Footprints-Science

Describing waves



Draw a diagram



Amplitude, A , the height of the wave from the middle to the top, measured in metres.

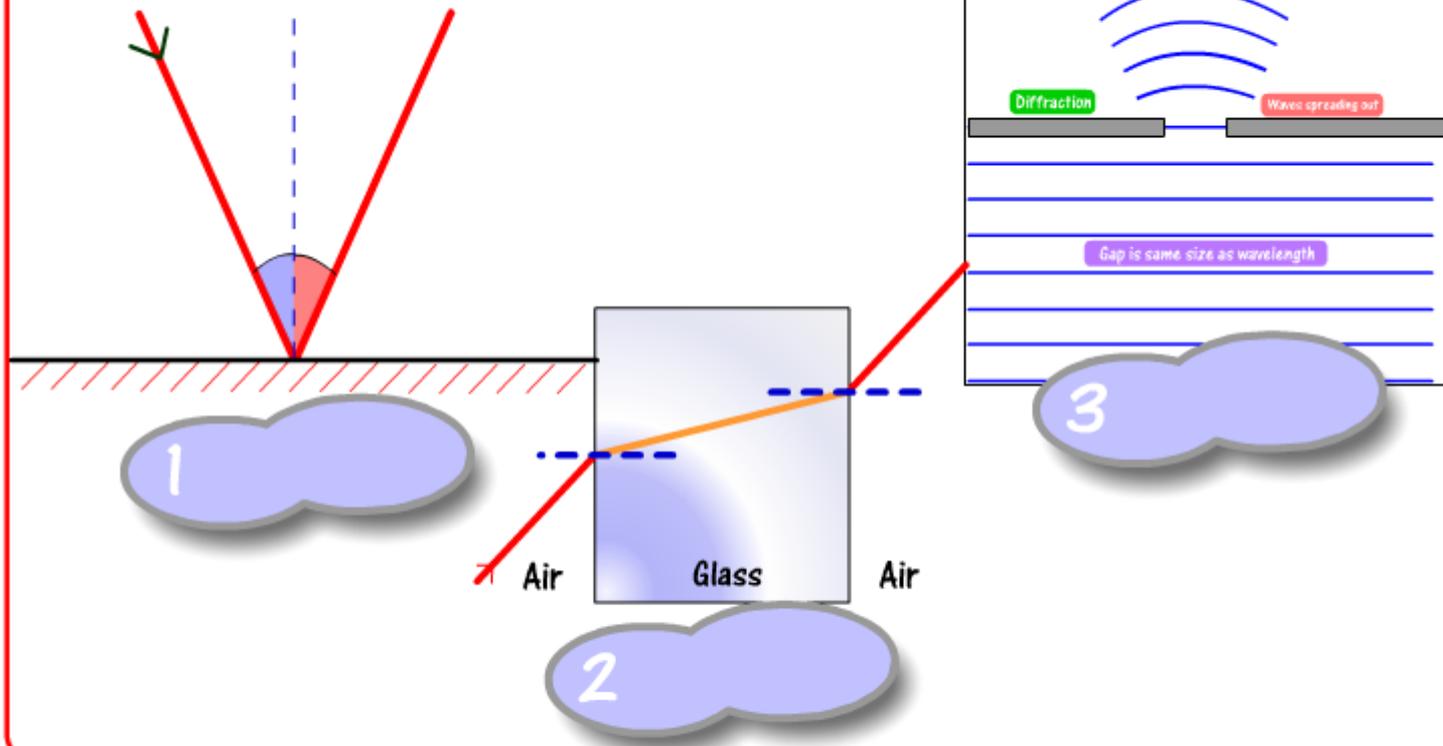
(The amplitude is the distance from the undisturbed position to the crest.)

Wavelength, λ the distance between the same point on successive waves (next to each other)

Frequency, f is measured in Hertz.
Frequency is the number of waves produced or passing a point per second.

Properties of Waves

All waves, including sound, can be...



Reset

Show answers

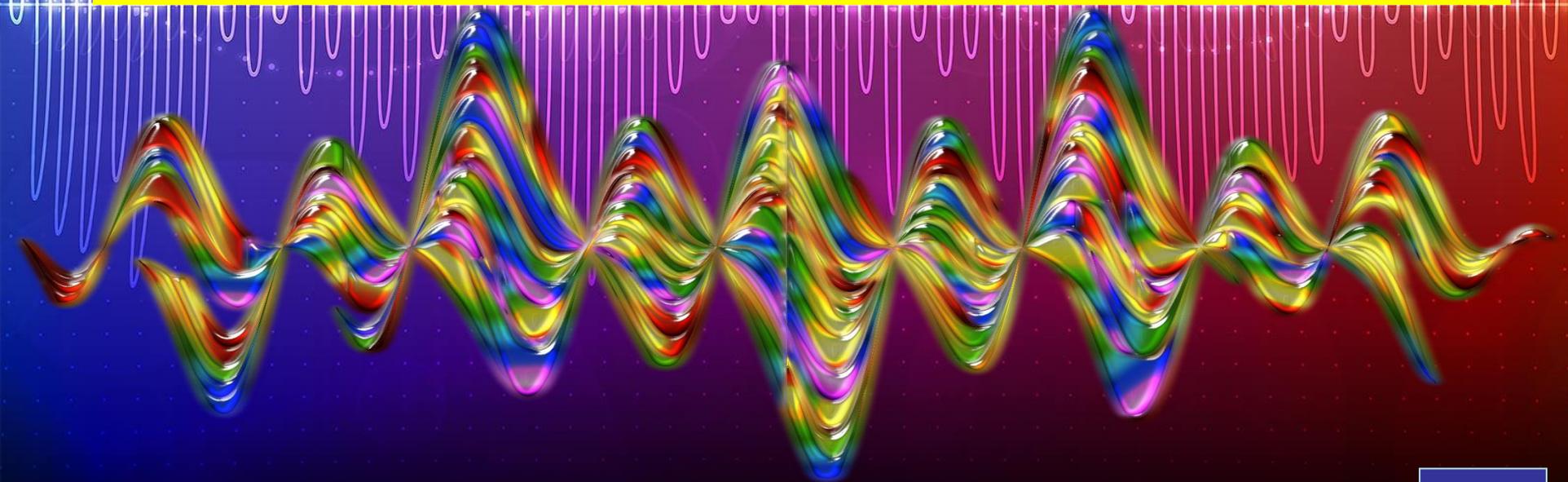
Drag and Drop the following labels :

Refracted

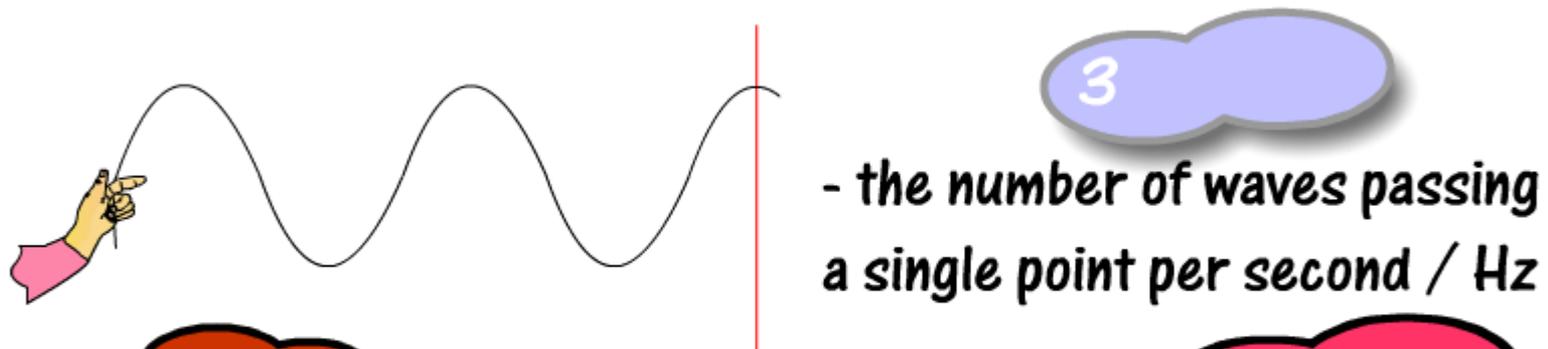
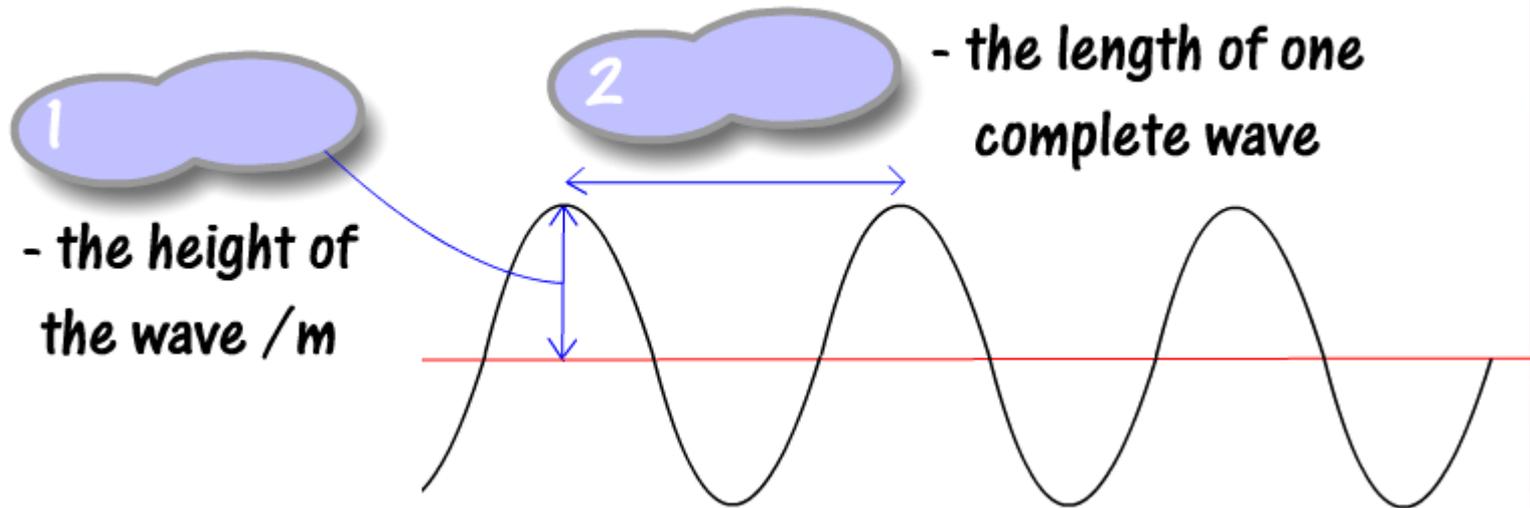
© Footprints-Science

We know all waves

- Carry energy
- Are either transverse or longitudinal
- All have crests troughs and an amplitude



Describing Sound Waves



Reset

Show answers

Drag and Drop the following labels :

Amplitude

Wave Equations

For the super clever amongst you see if you can go through the material on

Speed = frequency x wavelength

$$v = f\lambda$$

If this is too hard, research one type of wave

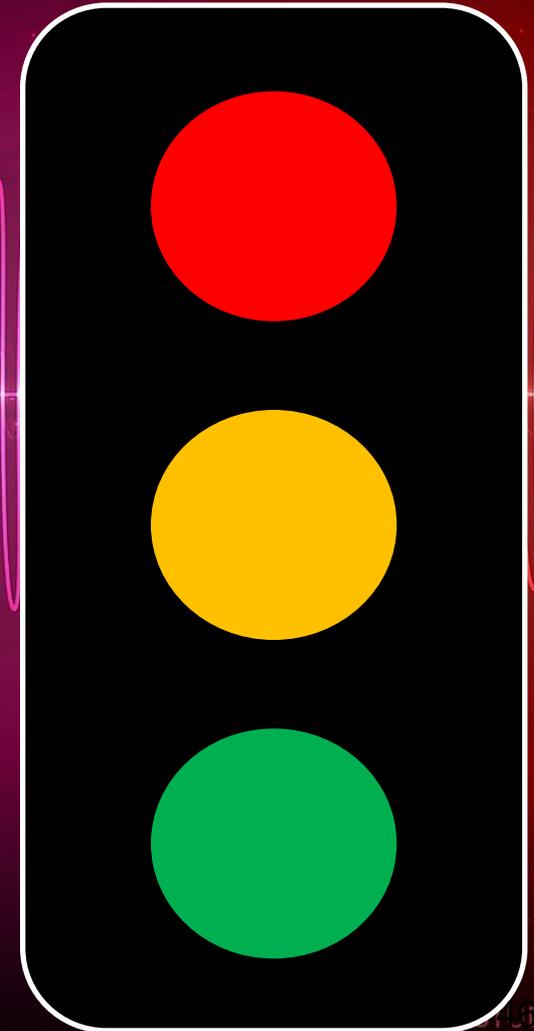
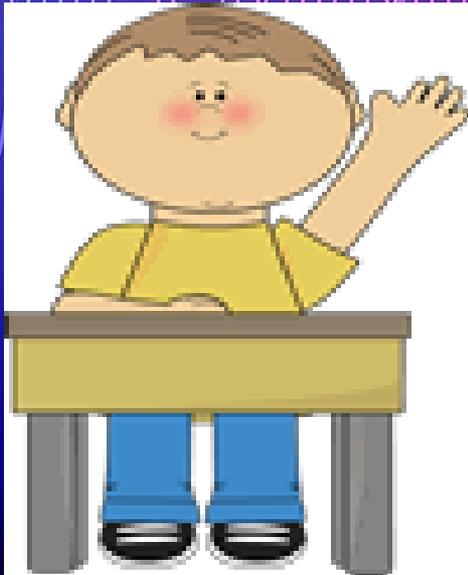


Processing Data

Waves

Learning Intention:

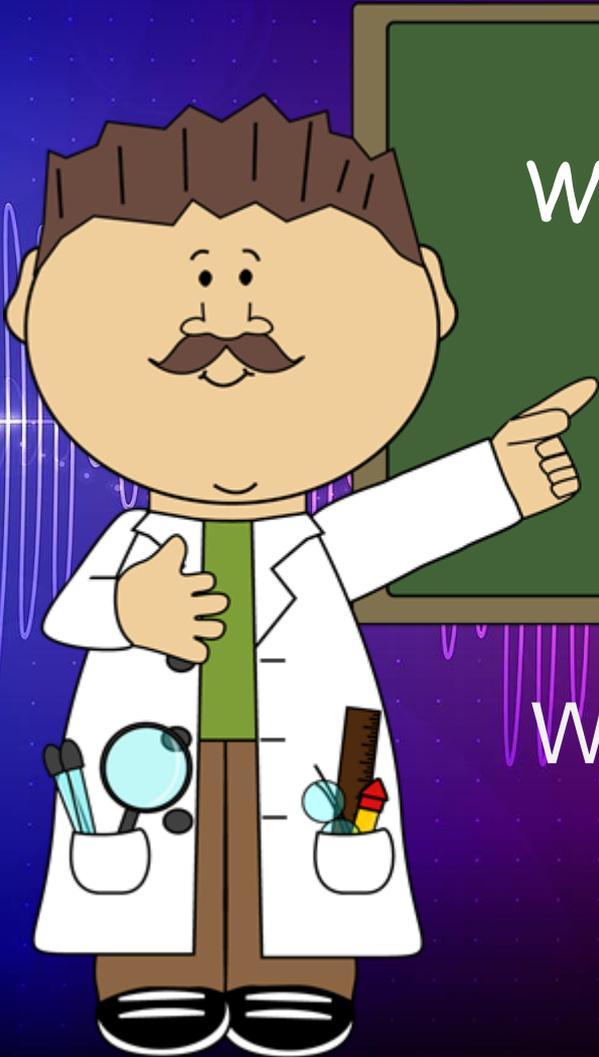
I understand what is meant by waves.



Sound



Express an opinion



What is sound?

A cartoon scientist with a mustache, wearing a white lab coat and a green tie, stands to the left of a green chalkboard. He is pointing his right hand towards the chalkboard. The chalkboard has the text 'What is sound?' written on it. The background is dark blue with a grid pattern and sound wave graphics in blue, red, and purple.

Watch the films on Brainpop to find the answers

[Brainpop sound](#)

What is Sound?

Sound demonstration



Describing Sound Waves

1 is the 2 of a wave
(maximum disturbance)

3 is the 4 of one complete
wave



5 is the number of 6 waves
passing a 7 per second. Frequency is
measured in 8 (Hz)

Reset
Show answers

Drag and Drop the following labels :

complete



Research

Find out about sound

Virtual Int 1 Physics



When you see this sign switch on your sound.

Interactive summary

Introduction

Slide whistles and air columns

Frequency and pitch

Guitar and strings

Octaves

Sound waves

Oscilloscope traces



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Sound is a wave



Research
Observing

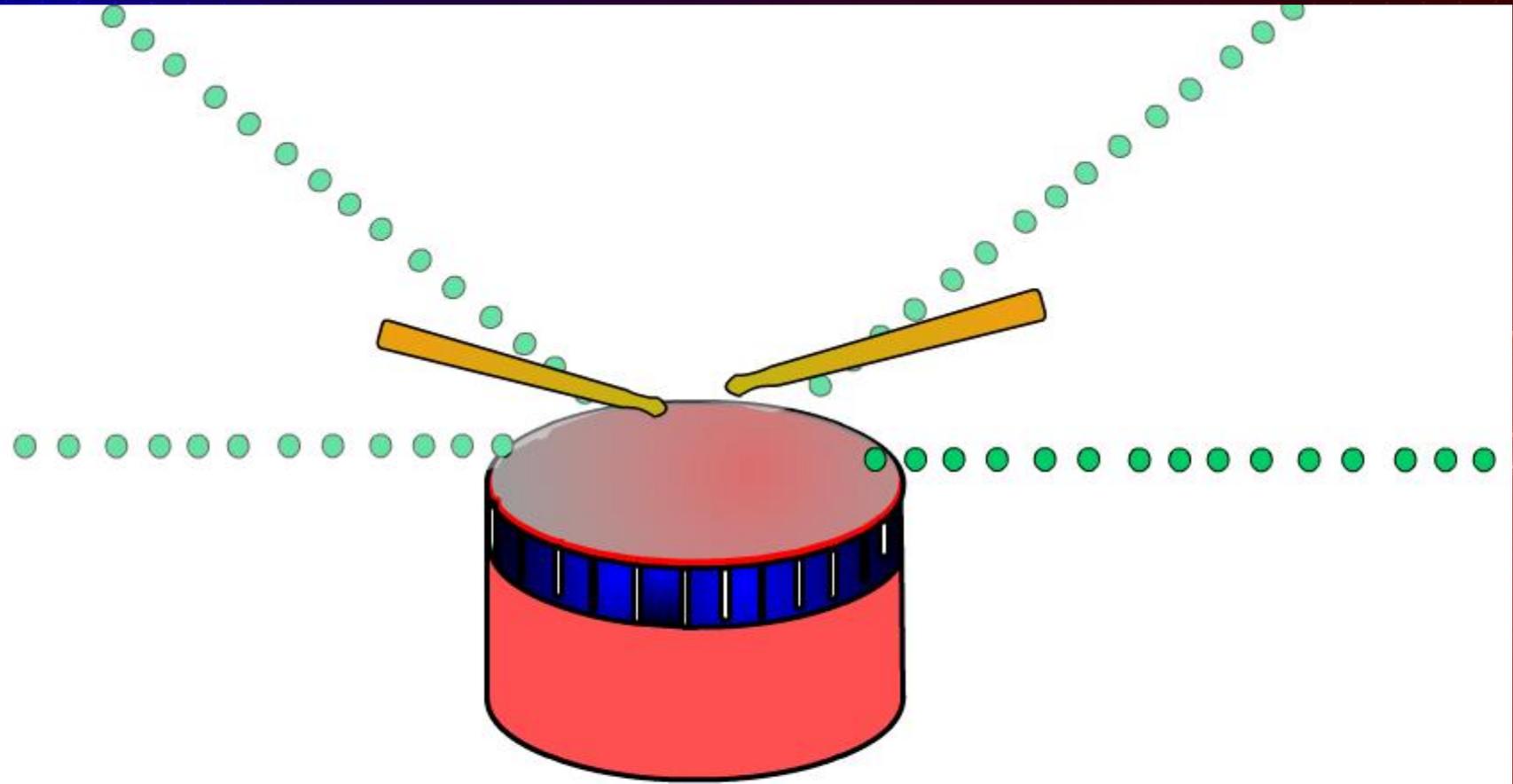
Reubens Tube

Complicated explanation of Reuben's Tube

Get a sound playing from the smart board, walk across the room and you should hear places where the sound is loud and places where the sound is quiet. This is the waves from the two speakers interfering.

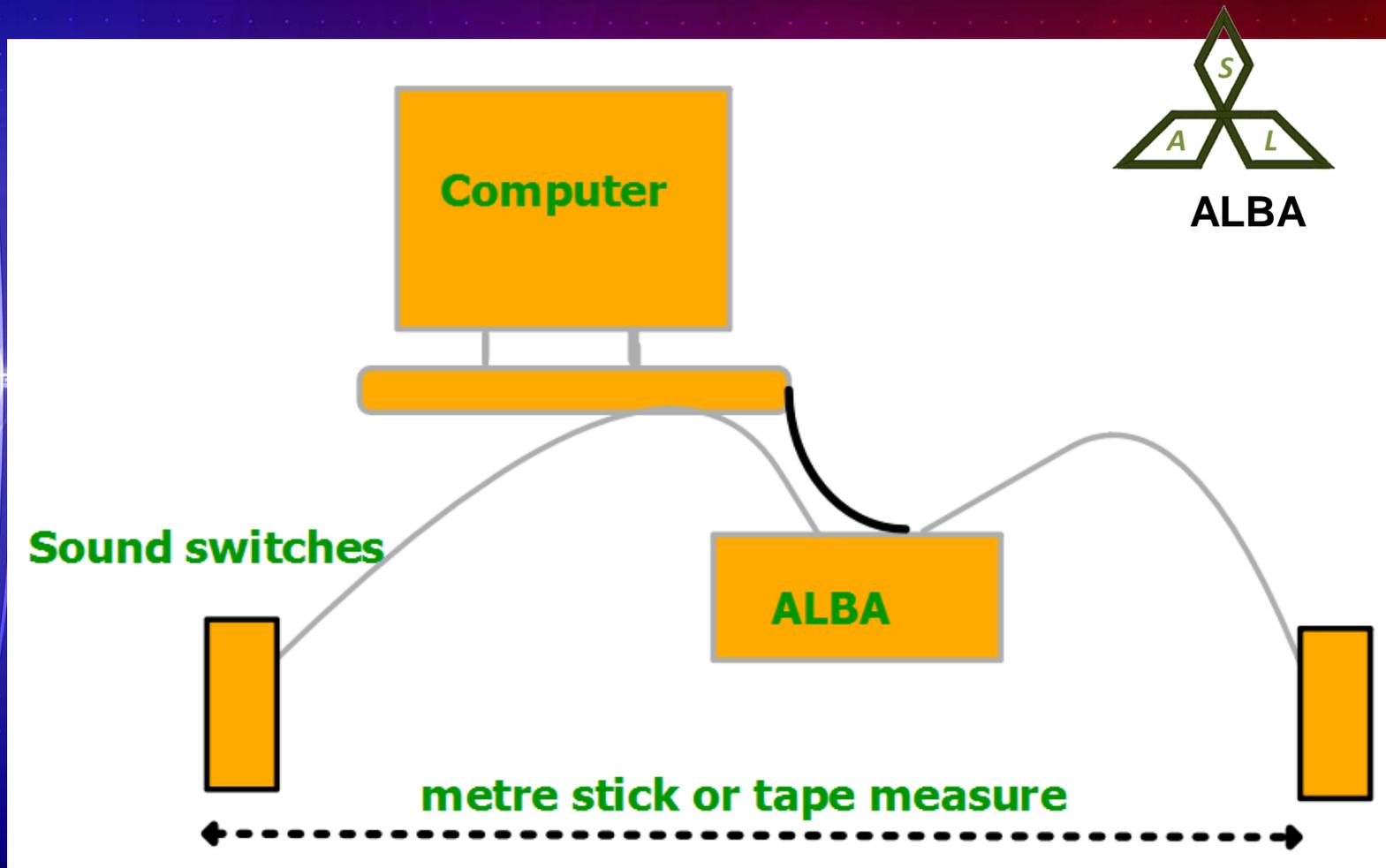
If you want to be a sound engineer you would have to sort this out for a concert!

Vibrations to the Ear

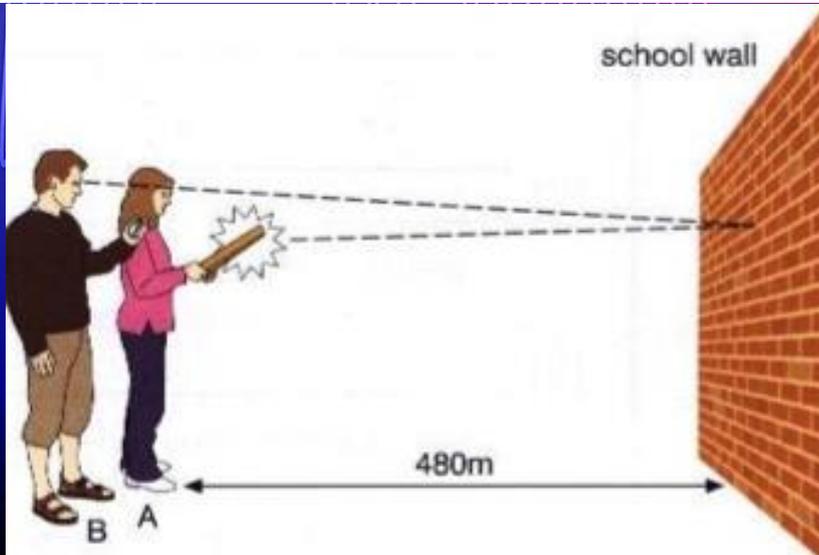
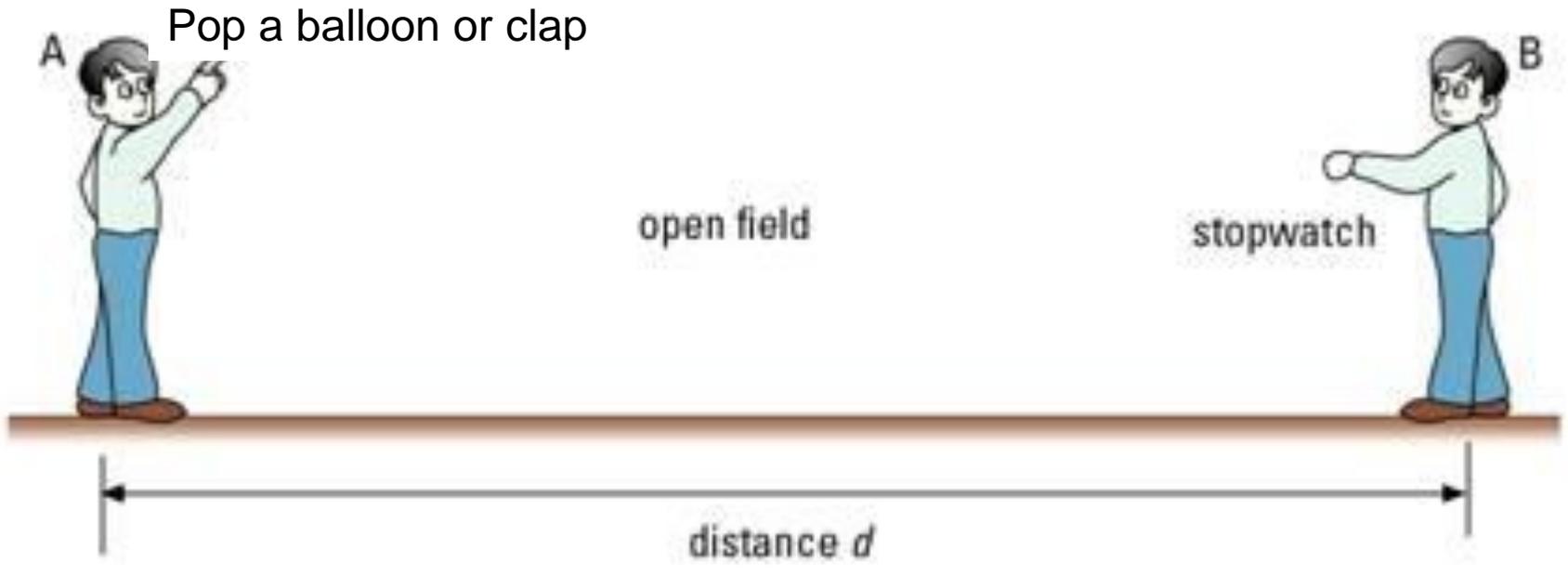


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Measuring the speed of sound



Measuring the speed of sound



If the weather is good go and measure the speed of sound in air outdoors



Practical Activities/
Processing data

Calculations



IESSUU

Try some calculations on

$$\text{speed} = \text{distance} \div \text{time}$$

Please use

$$\mathbf{v = d / t}$$

For the most able try answering the sound questions for the others try something simpler,

Virtual Int 1 Physics

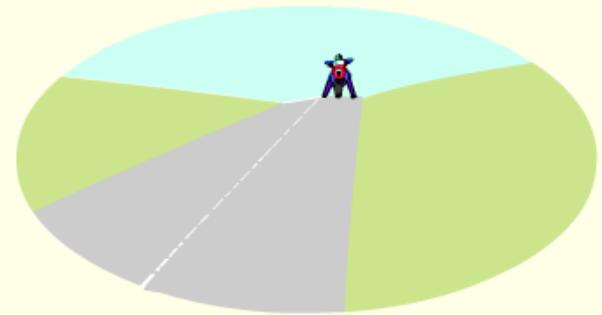


Speed of sound - example

The speed of sound can be calculated using:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

(speed = distance \div time).



To replay click on the biker.

A motorcyclist is stopped at the top of a hill 800 metres away.

He switches on his headlight and sounds his horn at exactly the same time.

The time between seeing the light and hearing the horn is 2.5 seconds.

Calculate the speed of sound.

Does sound travel through a gas?

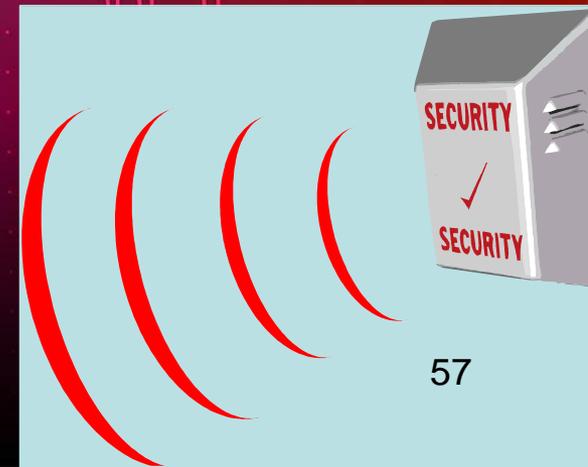
Does sound travel through a liquid?

Does sound travel through a solid?

What evidence is there for this?



Express views-V



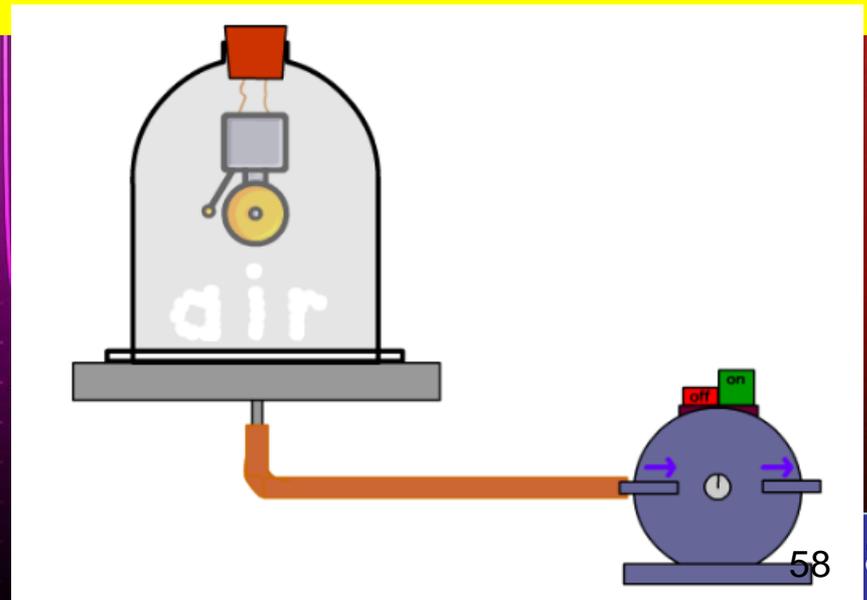
Does sound travel through a vacuum?

What evidence is there for this?

no sound doesn't travel through a vacuum and can't travel in space. (The films are all wrong!)

STAR WARS Bell Jar Experiment

Virtual Animations



- What kinds of materials can sound travel through?
- What can sound not travel through?

- Sound can travel through

- ✓ solids,

- ✓ liquids, and

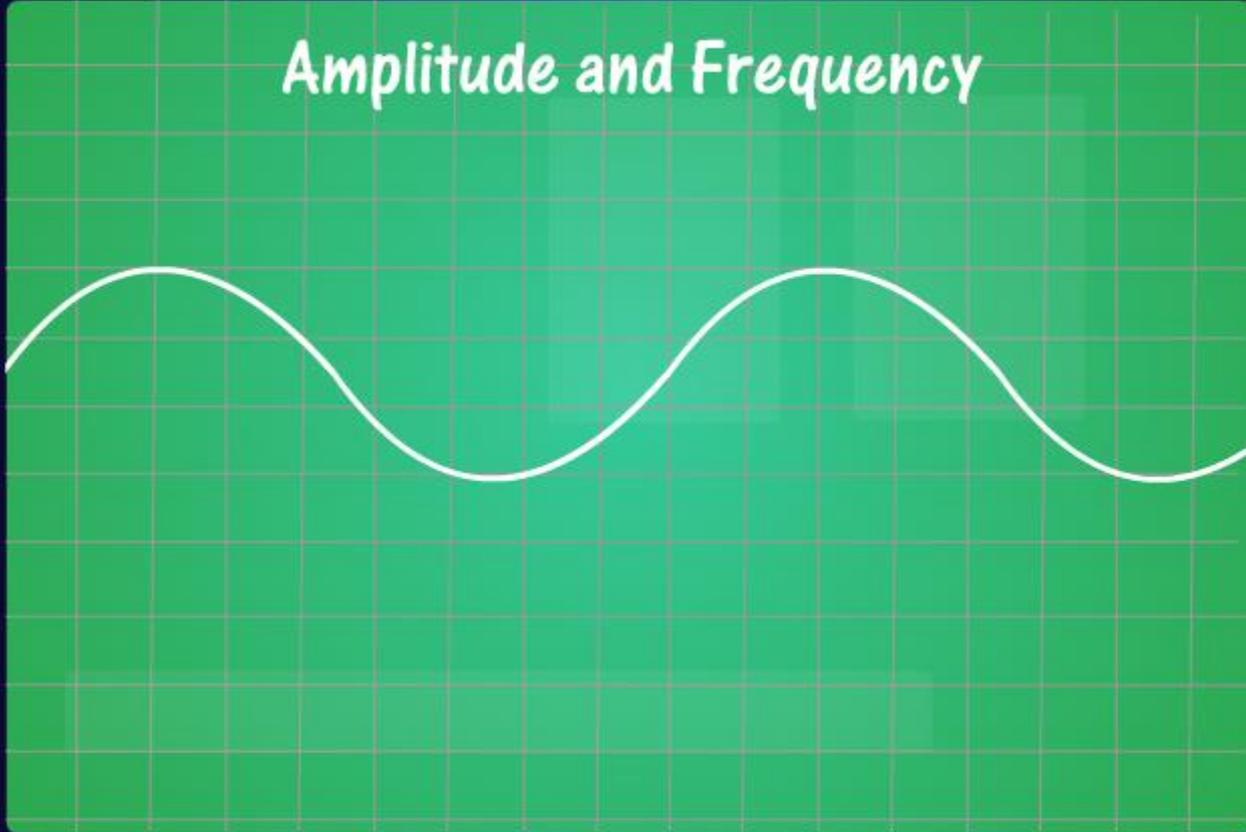
- ✓ gases.

- X Sound cannot travel through empty space (a vacuum).

Sound Energy

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Amplitude and Frequency



Amplitude :

High

Low

Frequency :

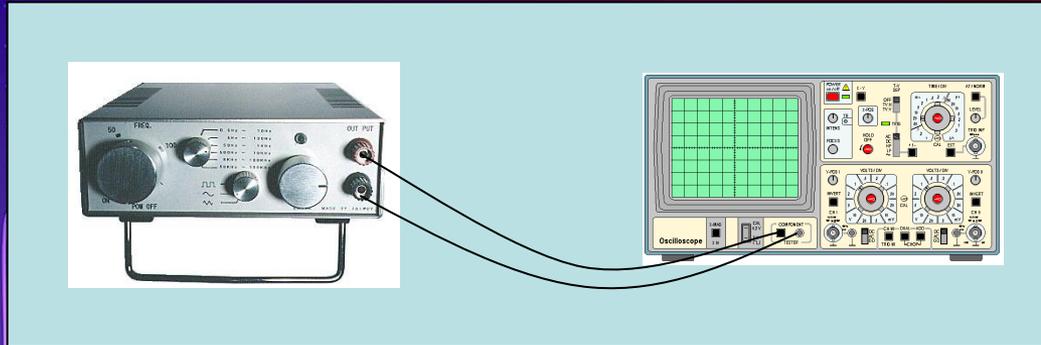
High

Low

Describing Sound Waves



Research



Collect a '**Describing Sound Waves**' worksheet.

Fill in the different oscilloscope screens to show what happens to sound waves as they are changed.

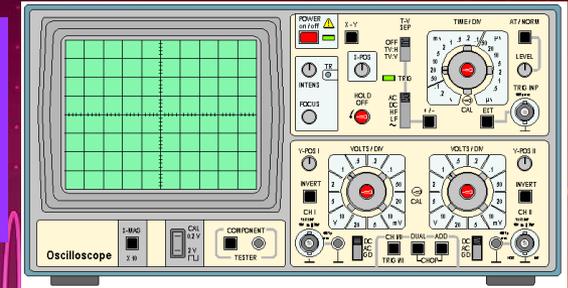
<http://www.youtube.com/watch?v=TLNSknAMsbI>

Describing Sound Waves



Observing

We can use an oscilloscope to help get an image of sound waves.

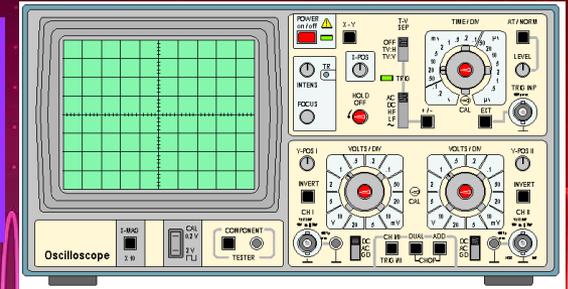


The frequency of a sound wave is the number of waves that are produced every second. The closer together (or more bunched up) the waves are, the higher the frequency is.

Frequency is measured in hertz (Hz).

Describing Sound Waves

We can use an oscilloscope to help us visualise sound waves.



Frequency is the scientific word for pitch.

Wavelength is the distance from the top of one wave to the top of the next.



Oscilloscope



Loudspeaker



Signal Generator

Lead to microphone →

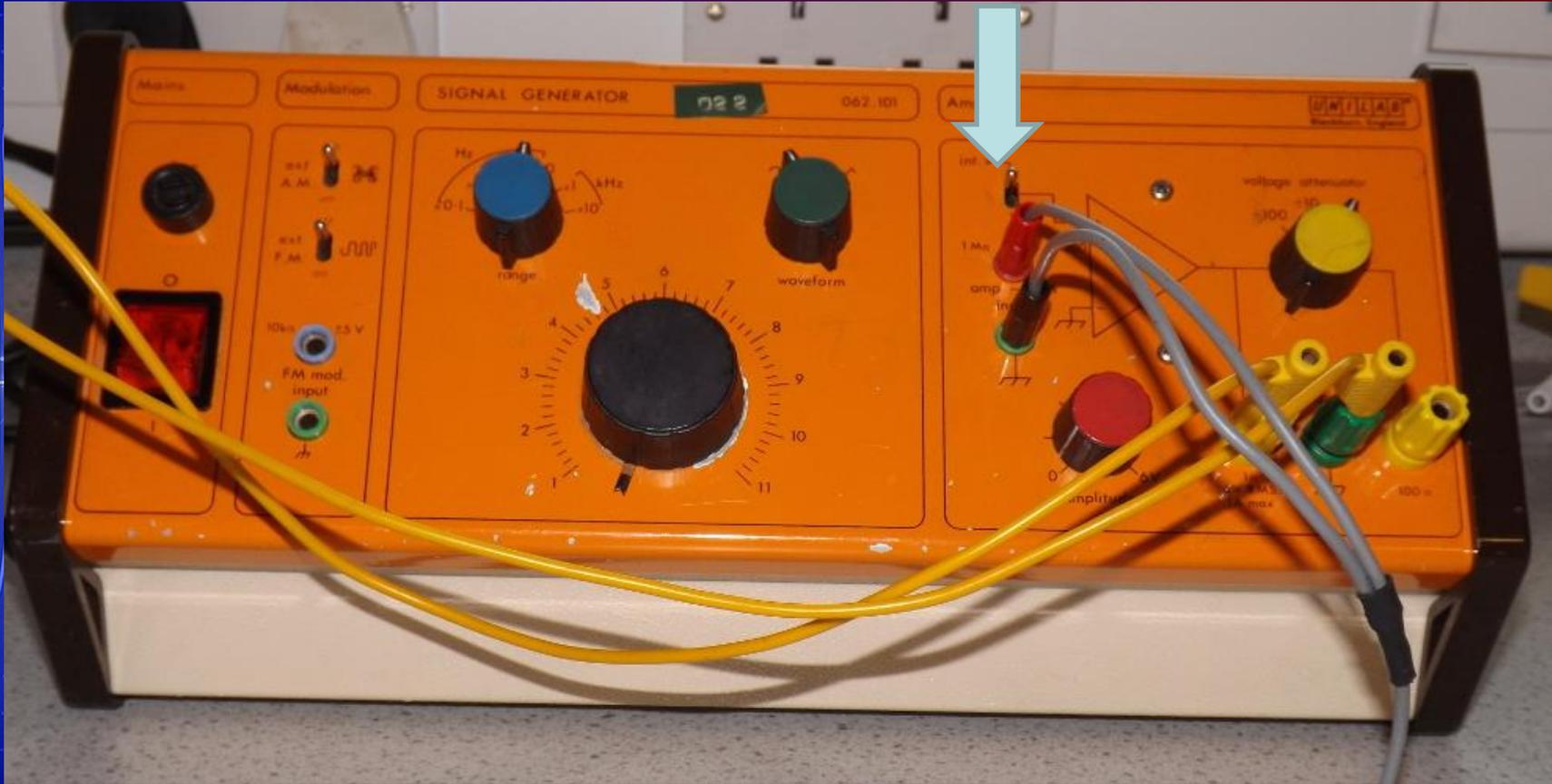


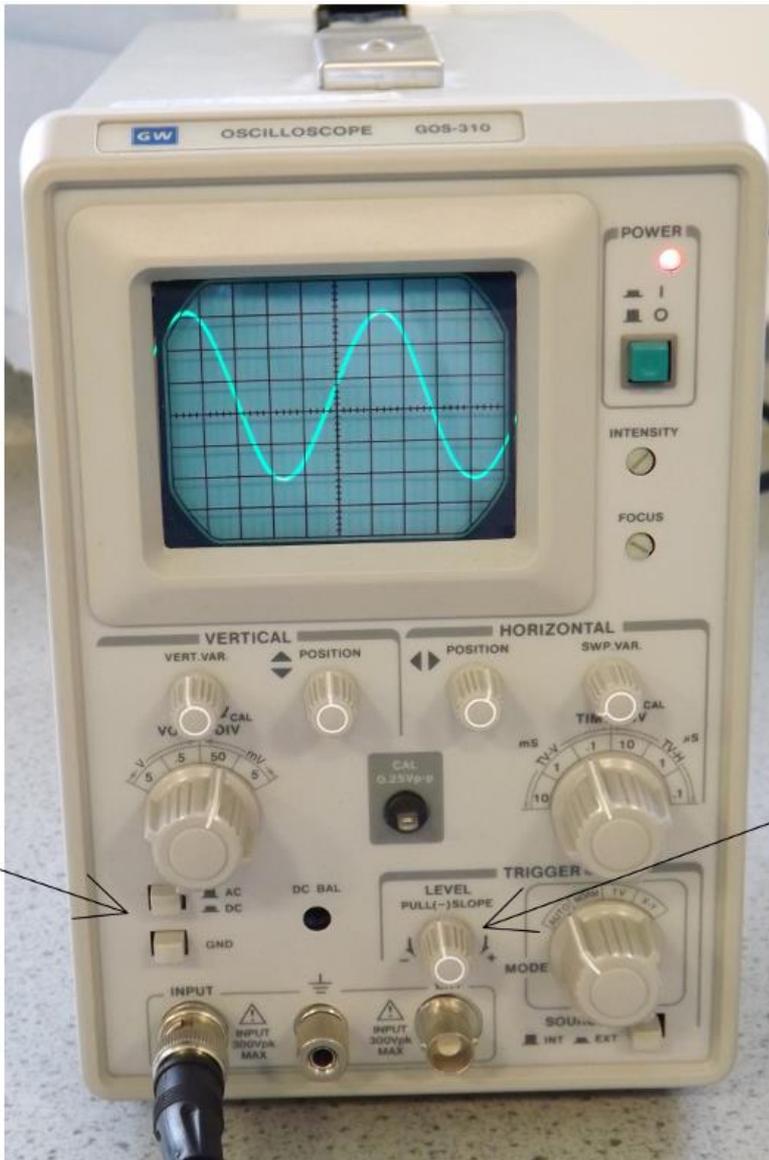
Observing. RA

This switch

Up for signal generator

Down for the microphone



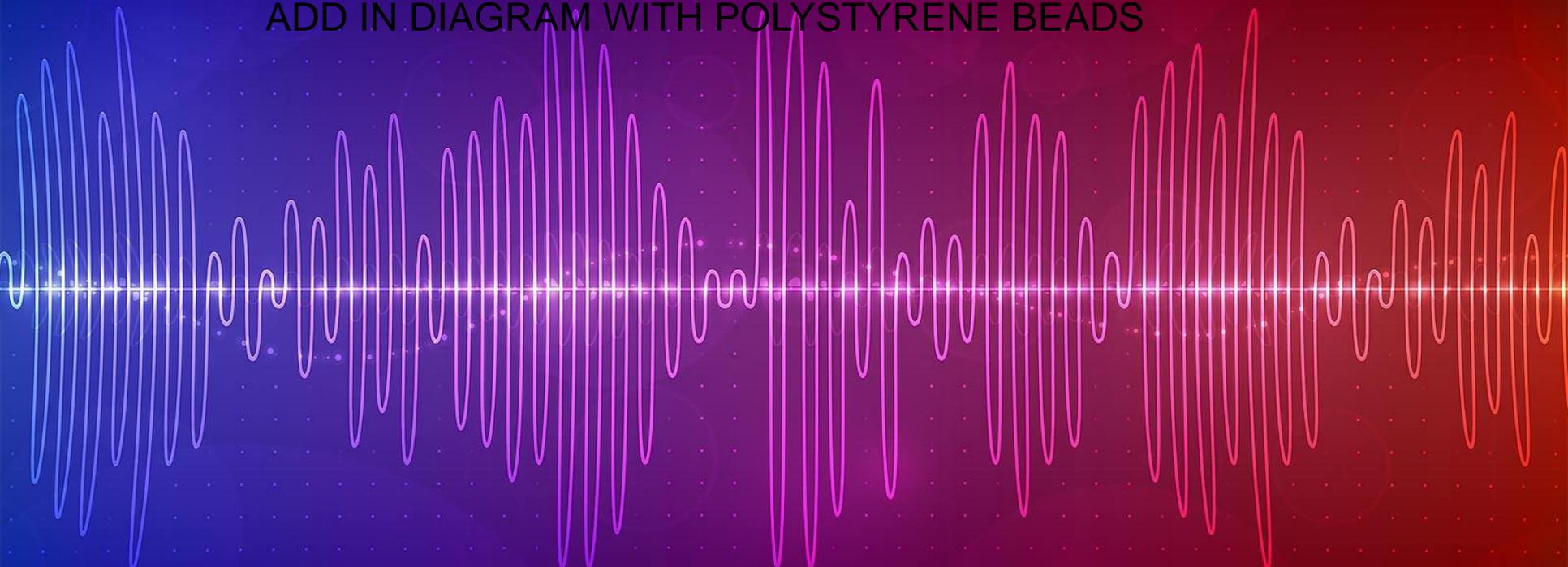


Both these buttons should be OUT

This button should be IN

Low frequency vibrations and polystyrene beads

ADD IN DIAGRAM WITH POLYSTYRENE BEADS



Low frequency sounds are called **INFRASOUNDS**.
Research uses of Infrasound or do the $v=f\lambda$
calculations

Sound waves

1. **Sound is made whenever an object vibrates**
2. **Amplitude is given by the height of the vibrations**
3. **The greater the amplitude, the more energy a wave has.**
4. **The greater the amplitude, the louder the sound**
5. **Frequency is the number of complete vibrations per second**
6. **The greater the frequency, the higher the pitch of the sound**
7. **Frequency is measured in Hertz, Hz**
8. **Amplitude is measured in metres m**

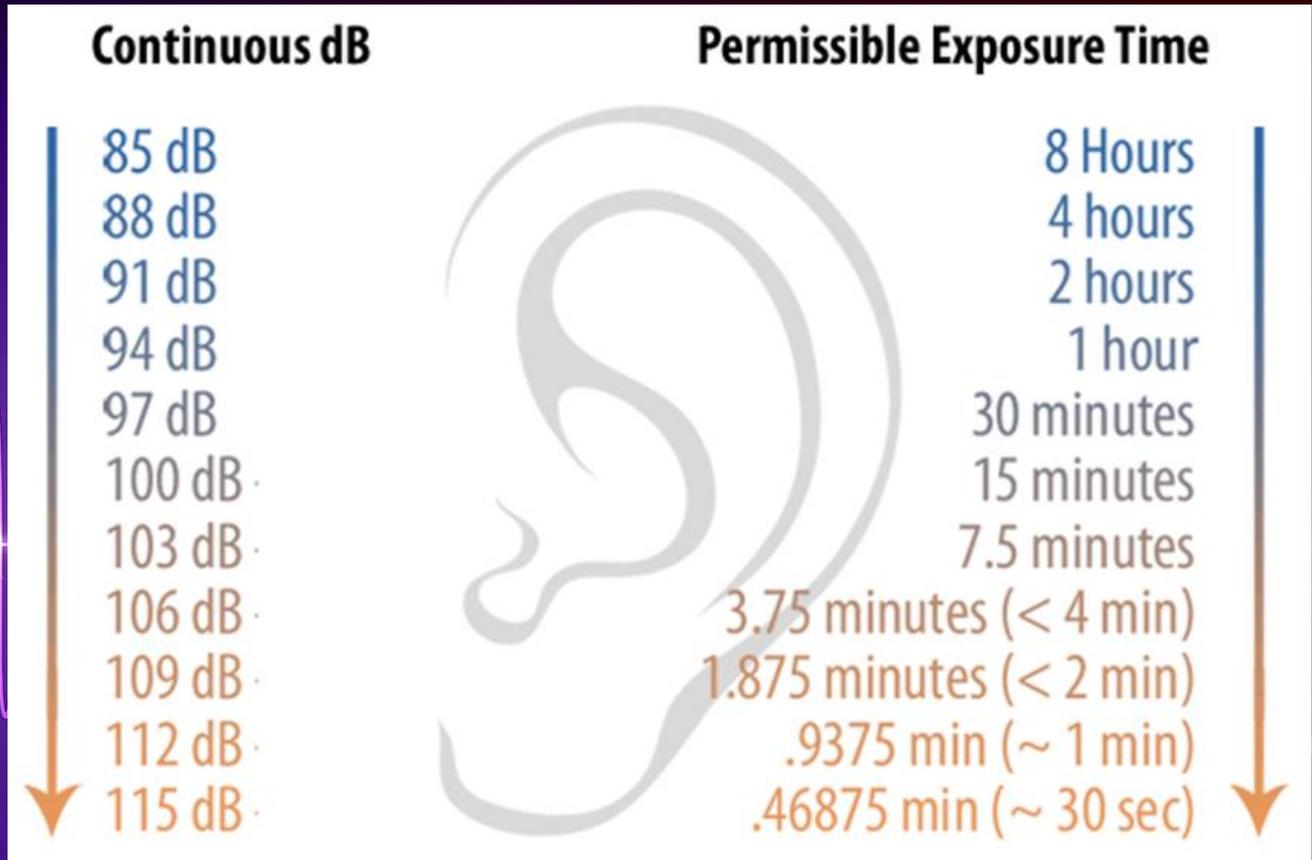
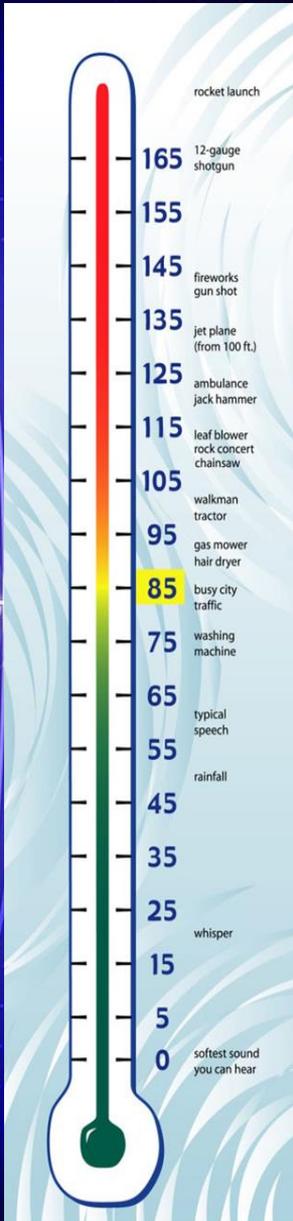
Measuring sound levels



Practical Activities
Evaluating

Task	Distance (m)	Sound Level dB

Loud sounds can permanently damage hearing

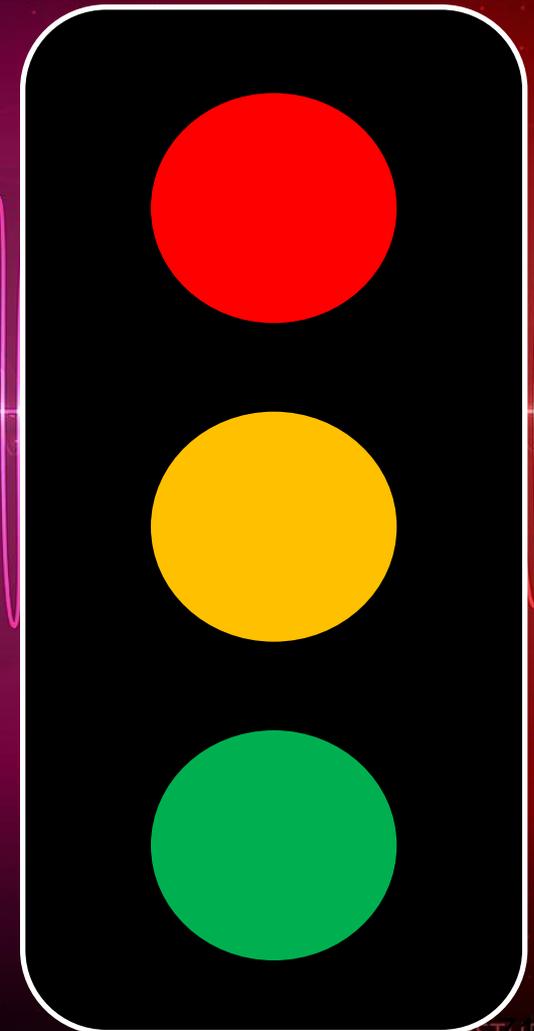
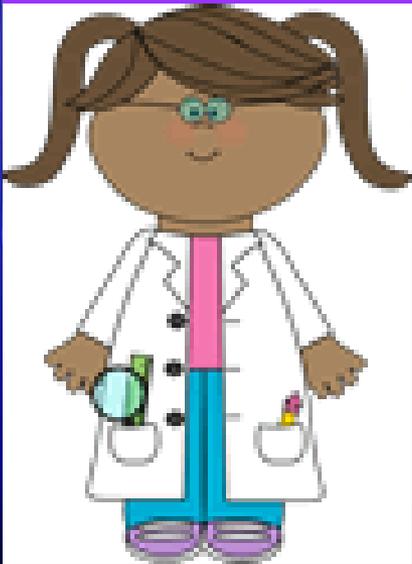


Moral ethical reflection

Describing Sound Waves

Learning Intention:

I can draw the effect that volume and pitch have on oscilloscope traces of sound waves.



OUR EARS



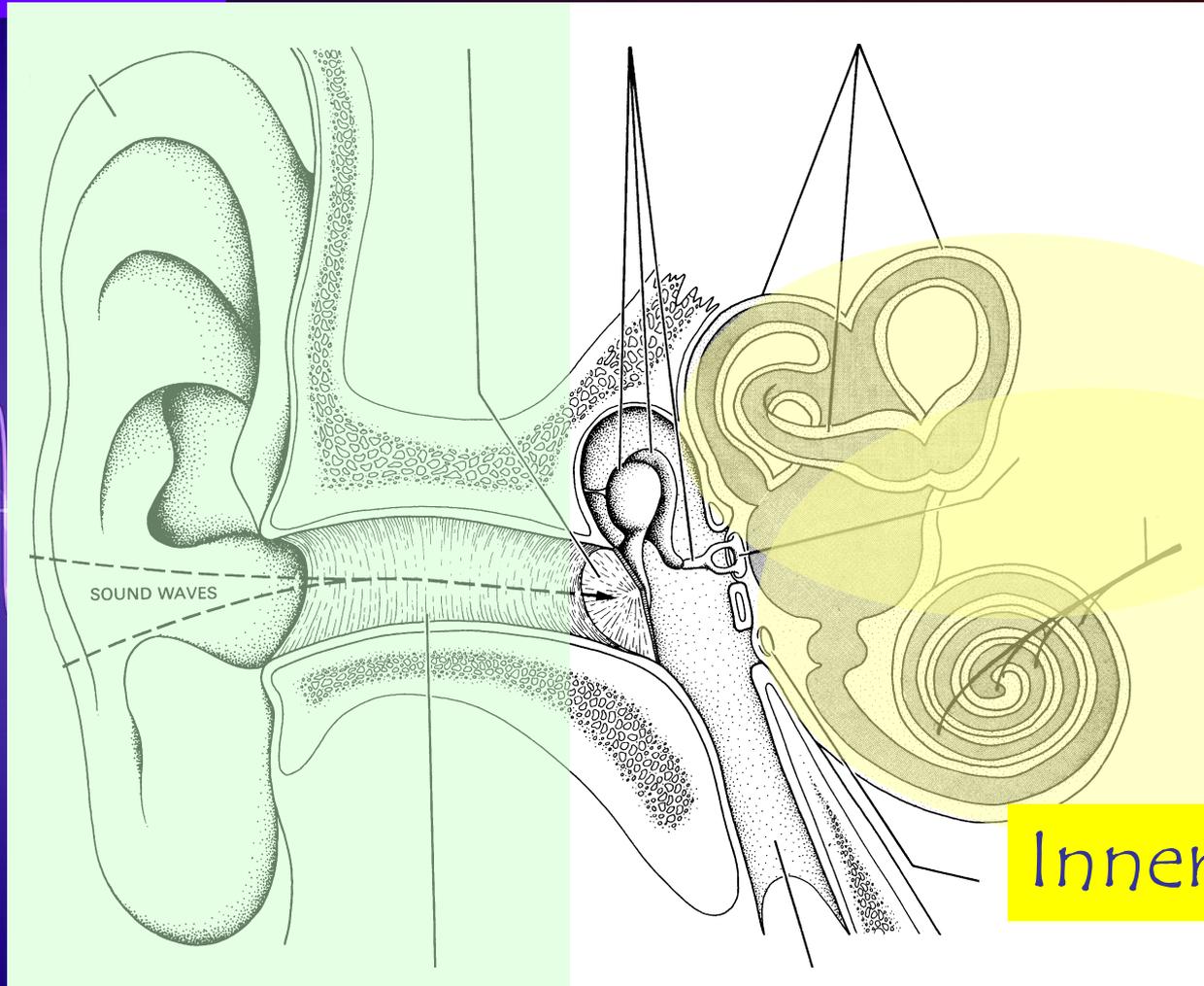
Diagram



- Structure of ear
- Using Brainpop
- Stick in a diagram & label it
- What some parts of the ear do (function)
- How good is our hearing?

- If we've time, how do ears help us balance?
- Using devices to improve hearing

Our Ears



Outer Ear

Middle Ear

Inner Ear

pinna

Ear drum

Small bones

Semi circular canals

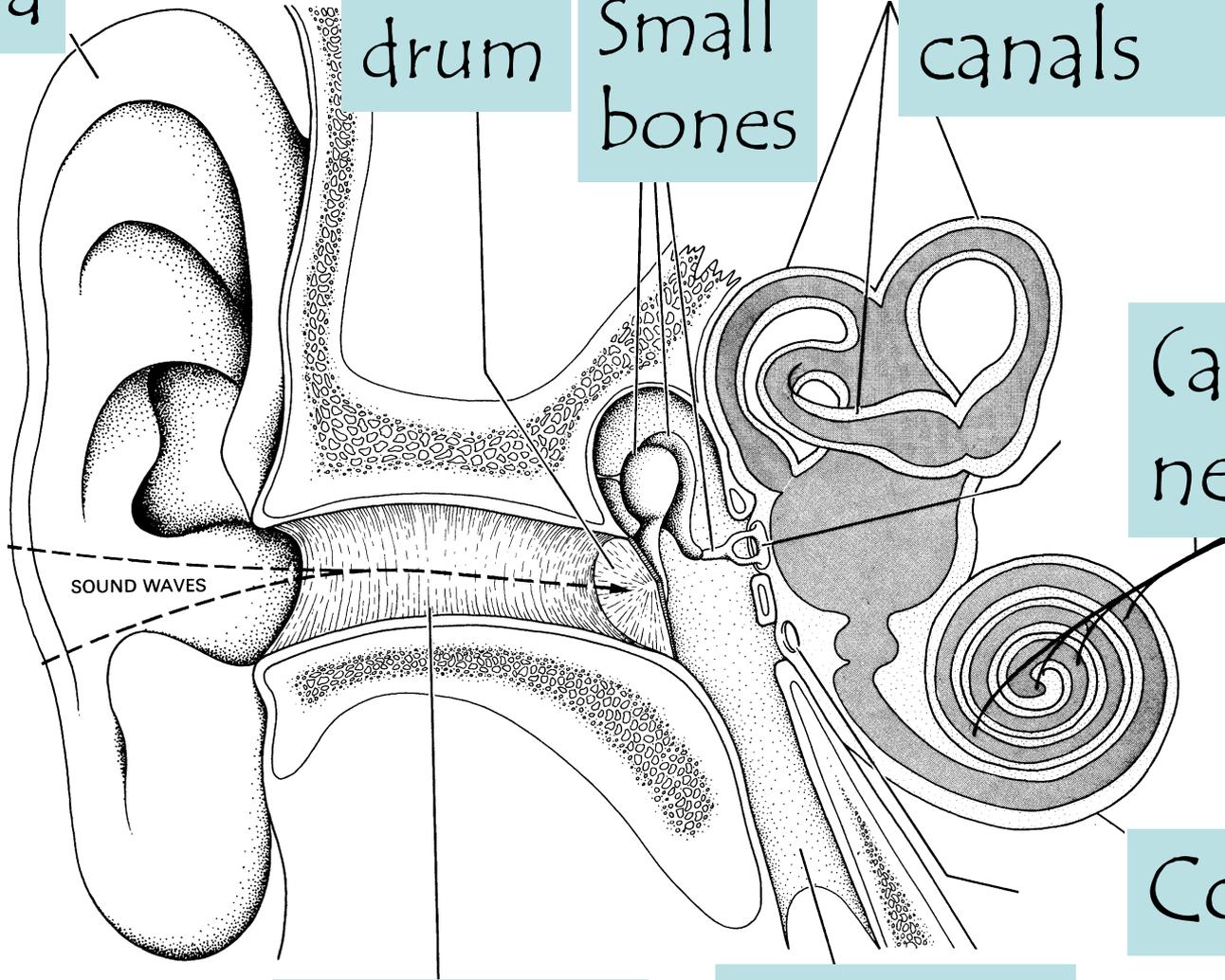
(auditory) nerves

Cochlea

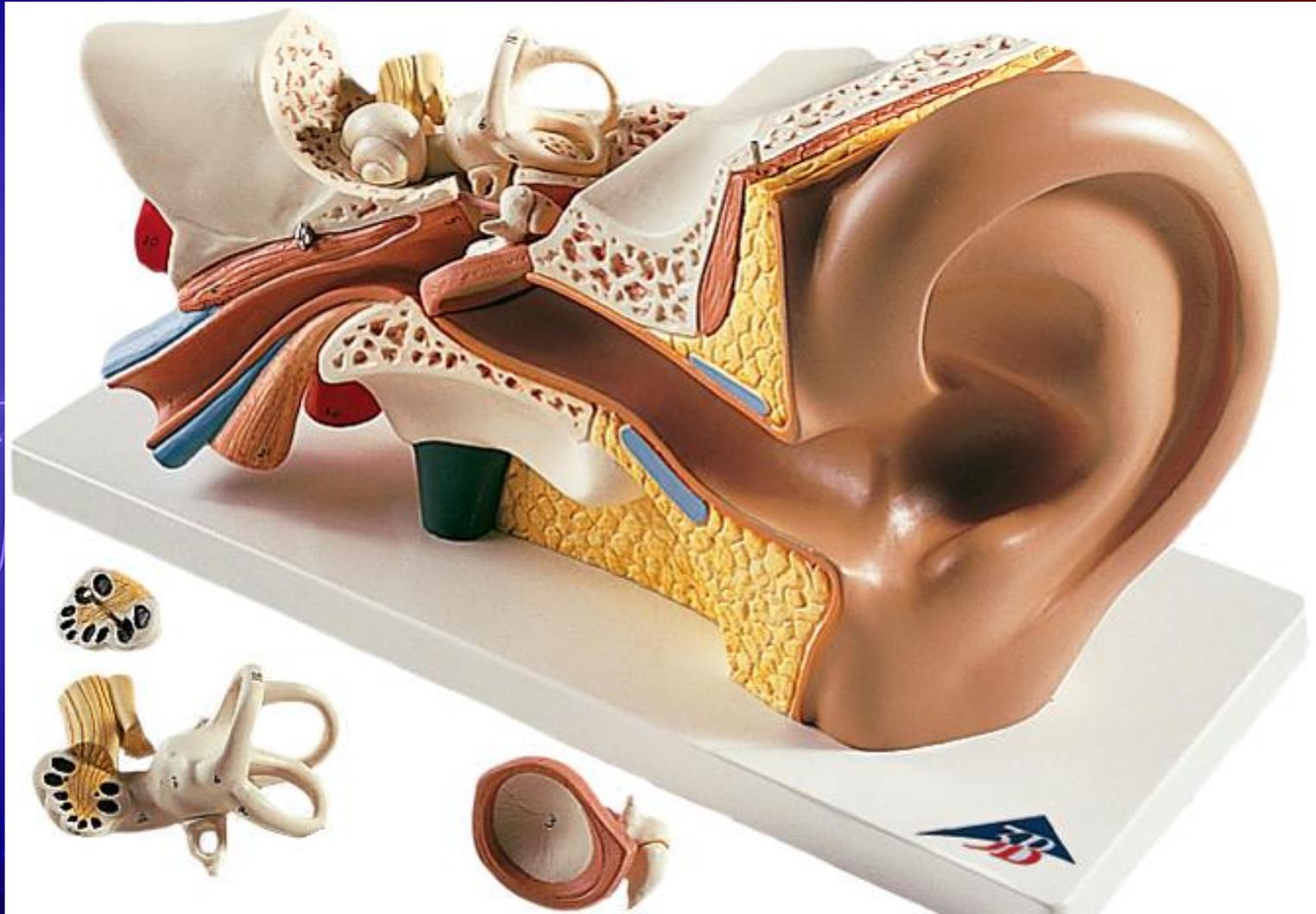
Ear canal

Tube to throat

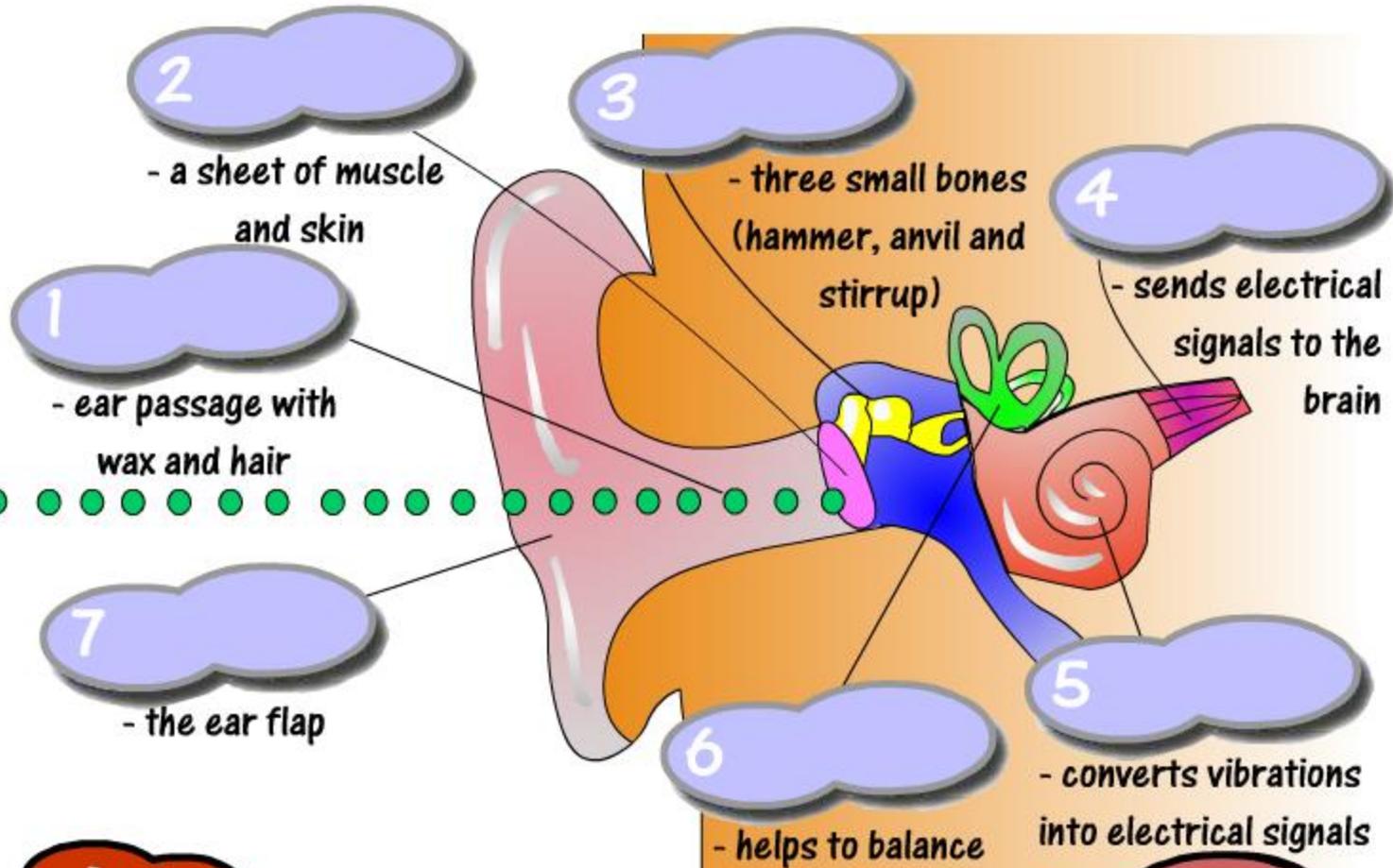
SOUND WAVES



View the ear model- which bits are missing?



The Ear



Reset

Show answers

Drag and Drop the following labels :

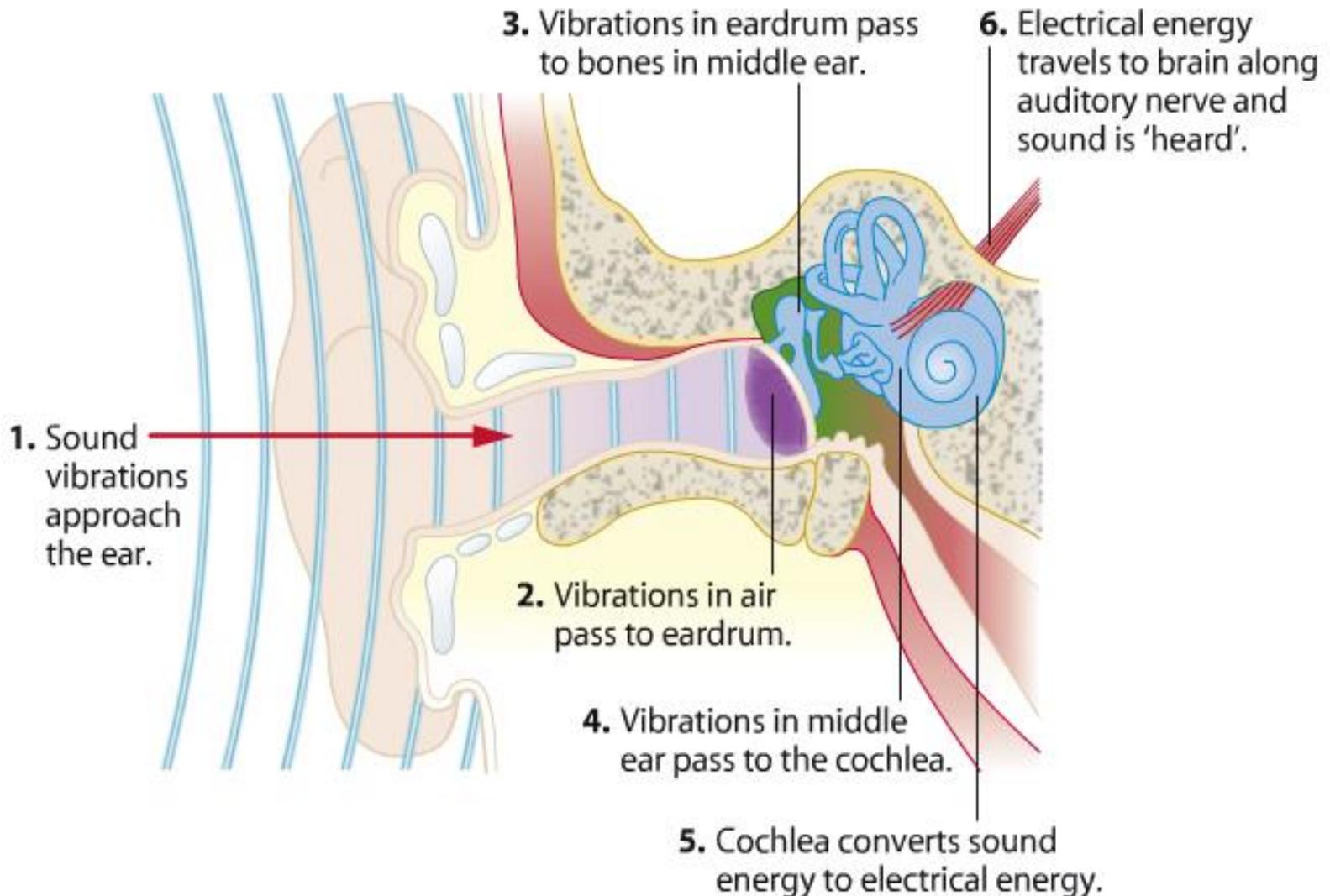
Auditory Nerve

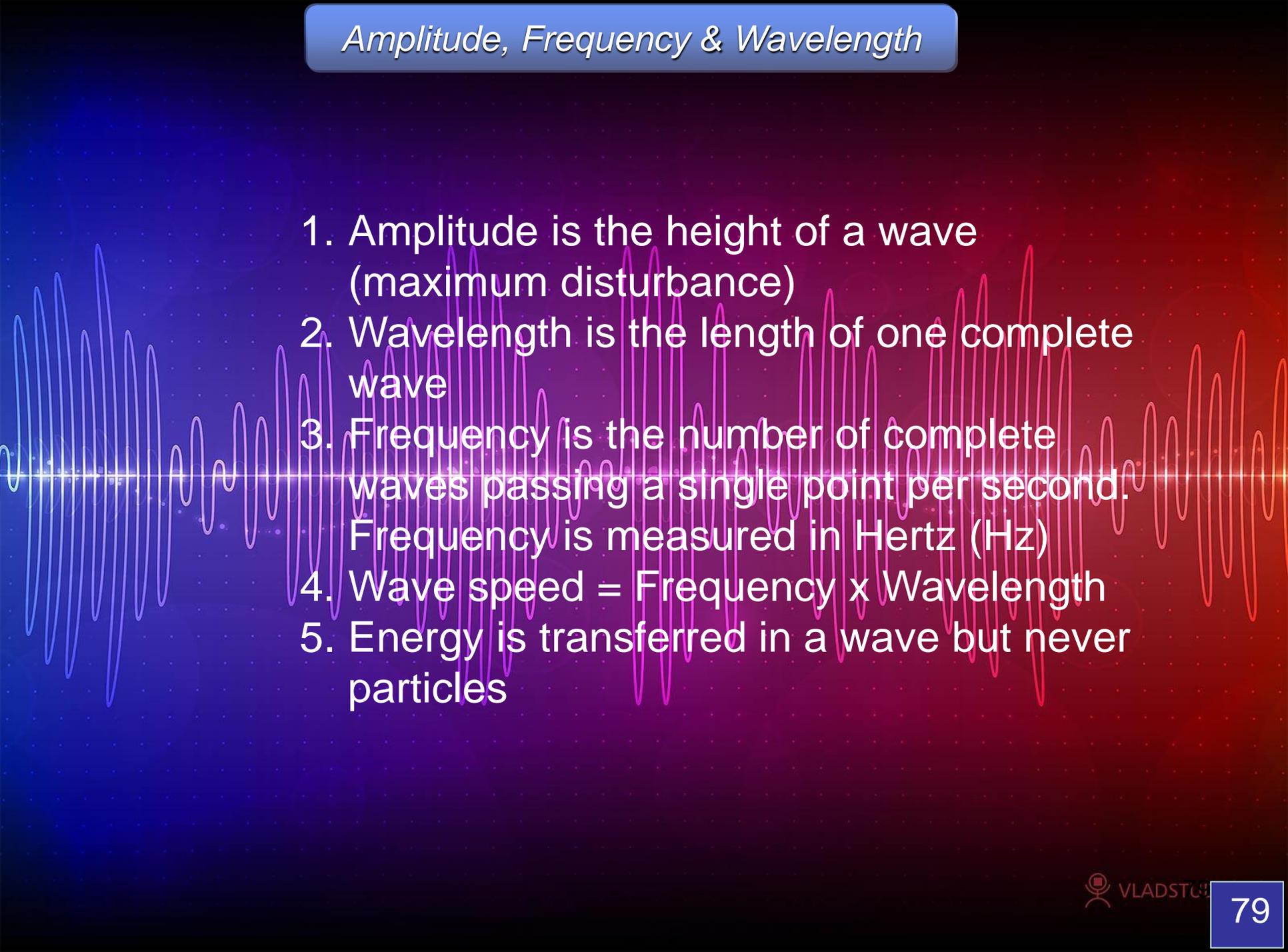
© Footprints-Science

Human Ear Answers

Part of Human Ear	What It Does
Pinna	Collects as many sound waves as possible.
Ear Drum	Detects sound waves by vibrating.
Stirrup, Anvil and Hammer	Amplifies the vibrations.
Cochlea	Has a liquid that vibrates which makes cilia create an electrical signal.
Auditory Nerve	Passes electrical signals to the brain.

Physics of Hearing



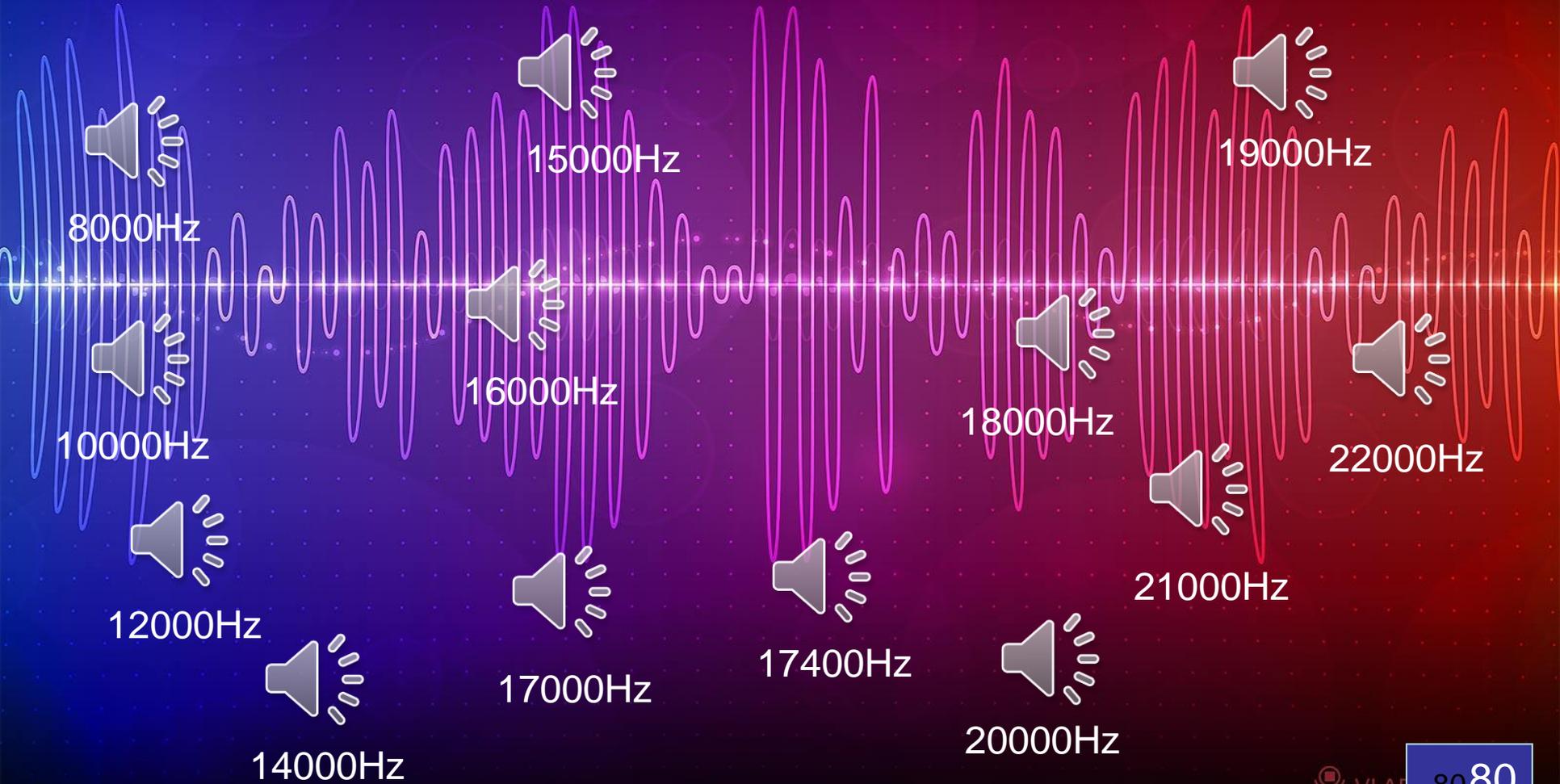
- 
1. Amplitude is the height of a wave (maximum disturbance)
 2. Wavelength is the length of one complete wave
 3. Frequency is the number of complete waves passing a single point per second. Frequency is measured in Hertz (Hz)
 4. Wave speed = Frequency x Wavelength
 5. Energy is transferred in a wave but never particles



LET'S TEST OUR EARS!

[Sound Files](#)

Risk Assessment



Human Ear

childrensuniversity.manchester.ac.uk/ear/

Watch the video on how the ear works

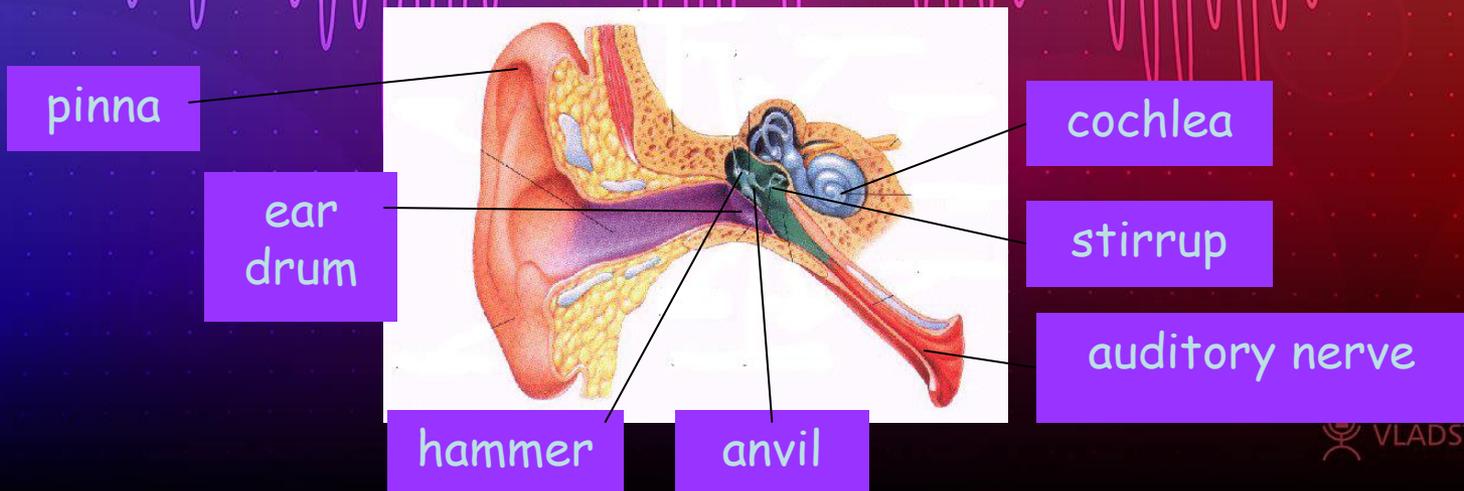
Hearing Sounds- Our ears are the detectors of SOME sound



Read

We have already found out that waves travel by vibrations through any medium that has particles in it - solids, liquids and gases.

When sound reaches the human ear, the pinna (outside of the ear) is specially shaped to ensure that as much sound as possible makes in to the ear itself.



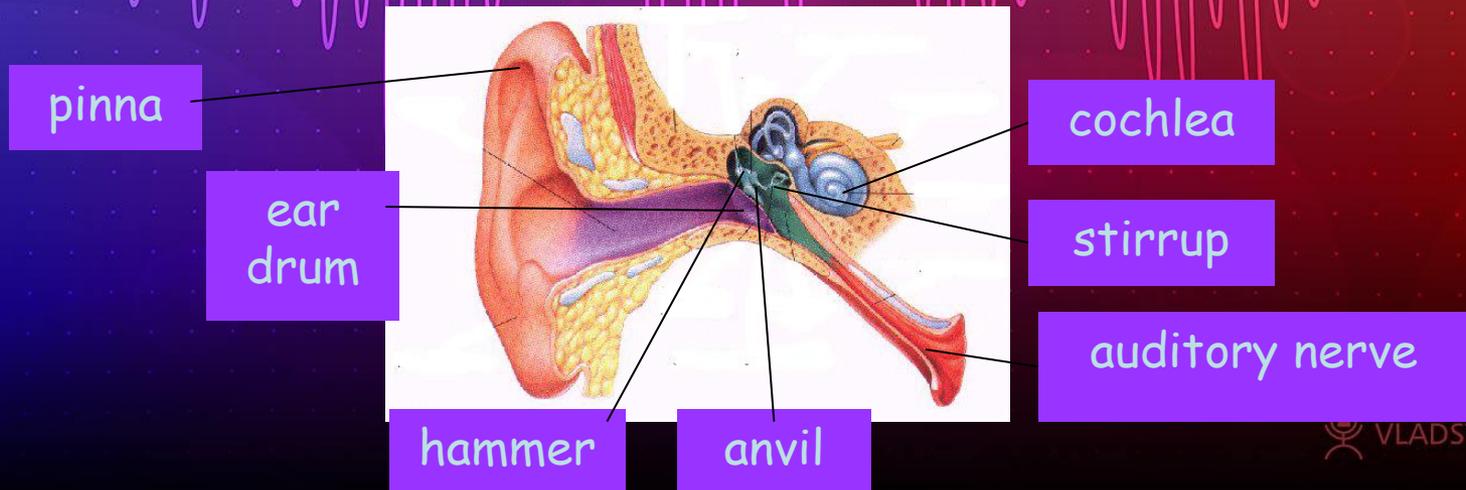
Hearing Sounds



Read

The sound then passes in to the ear canal to the ear drum. The sound causes the ear drum to vibrate just like the skin of a drum.

These vibrations are then amplified (made stronger) by the three smallest bones in the human body - the hammer, the anvil and the stirrup.

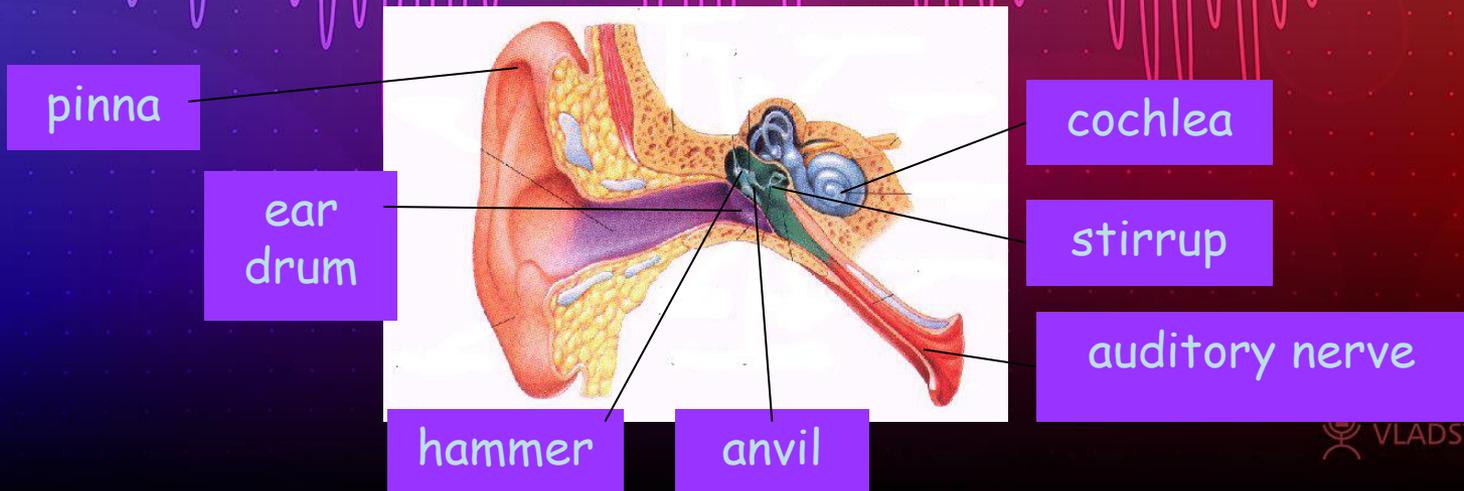


Hearing Sounds



Read

The larger vibrations then pass to the cochlea. The cochlea is shaped like a snail's shell and is filled up partially with a liquid. The vibrations make the liquid vibrate which are picked up by special little hairs (cilia).



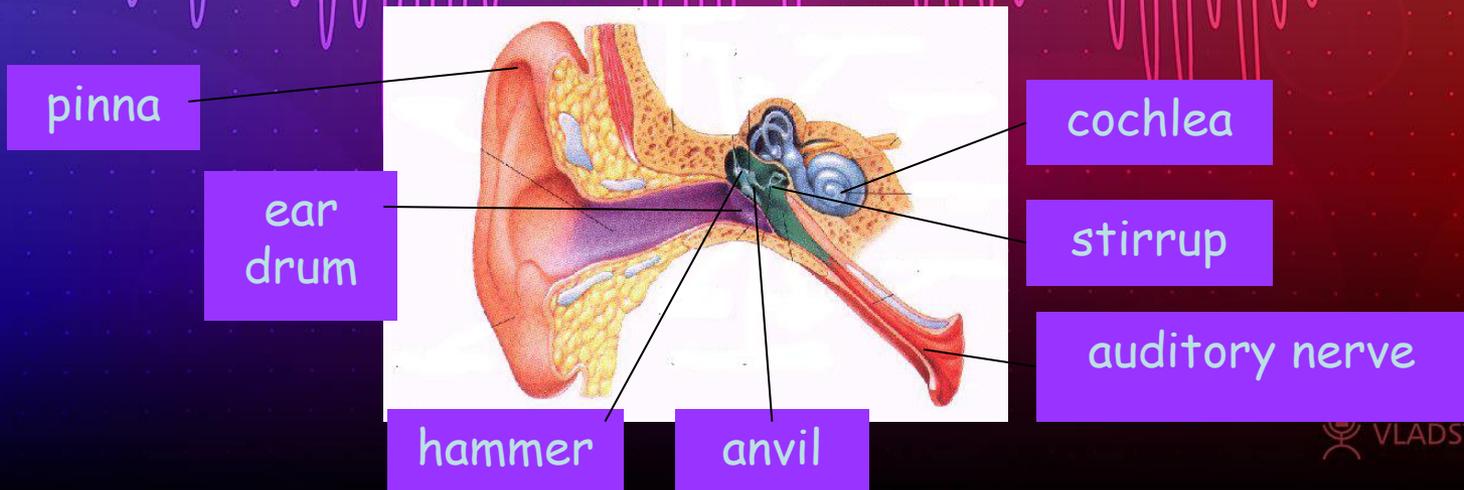
Hearing Sounds



Read

The auditory nerve detects the movement of the cilia and creates an electrical signal to the brain.

The brain then recognises the electrical signal as sound, and we can hear.





Research
Hypothesizing
Planning
Measuring
Evaluating

Do all sounds seem the equally loud??

Test it and see!



CHECK KNOWLEDGE!

1. The names of the smallest bones
2. What collects the sound waves?
3. What part(s) vibrate?
4. How are the waves translated?
5. What part is for balance? (ext)
6. What part has the sense cells?

Investigate our ears

What happens if we make our pinnas larger? Can we hear more or less or doesn't it make a difference to what we can hear?

What happens if we cup our hands in front of our pinnas? Can we hear more or less or doesn't it make a difference to what we can hear?

Making your ears more efficient



Observing
Evaluating



Describe how
cupping your
hand over your
ears works to
make sounds
appear louder

Reducing sounds in your ears



Why is cupping your ear better than putting your fingers in your ears to reduce noise levels?

NB Your hands should “reflect” the sound away, not cover your ears.



Reflection and Curved Reflectors



Are you damaging your ears?

iphone earbuds

Sound level apps for your phone

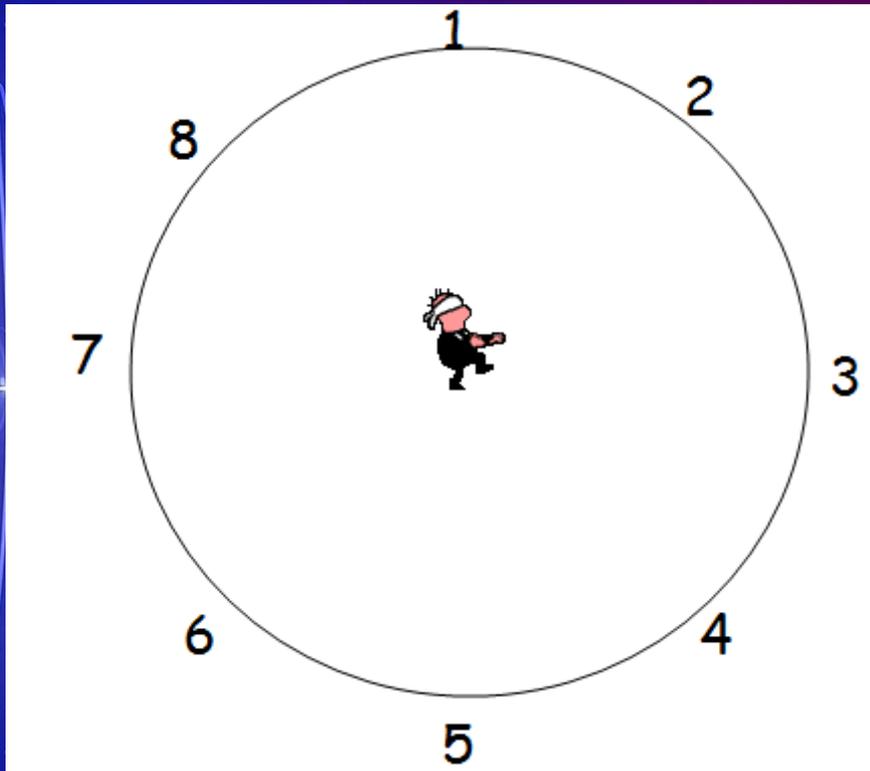


**Research
Literacy task**

There are two levels of exposure at which specific action must be taken, the first action level of 85dB and the second action level of 90dB. When the first action level is reached, employers must give their employees information and training, and offer them ear protection (for example, earplugs) but the employees don't have to wear the protection if they don't want to. However when the second action level is reached, the employees are breaking the law if they don't wear the ear protection; and the employer must also do what they can to reduce the noise level.

Of course some sounds, such as close gunfire, can cause damage almost instantaneously, so the regulations also limit the instantaneous maximum sound that people can be exposed to. Luckily music on earphones is extremely unlikely to reach this level¹, although it is not impossible under fault conditions which could apply a high voltage to the earphones.

Why do we need two ears?



Why do we need two ears?
We need two ears to be able to detect the direction the sound is coming from. When one ear is covered it is much harder to tell where the sound is coming from although you can still detect the sound. Some people are better at detecting direction than others. With two ears it is still hard to detect some directions especially around the sides.



Conclusions

We use our _____ for hearing

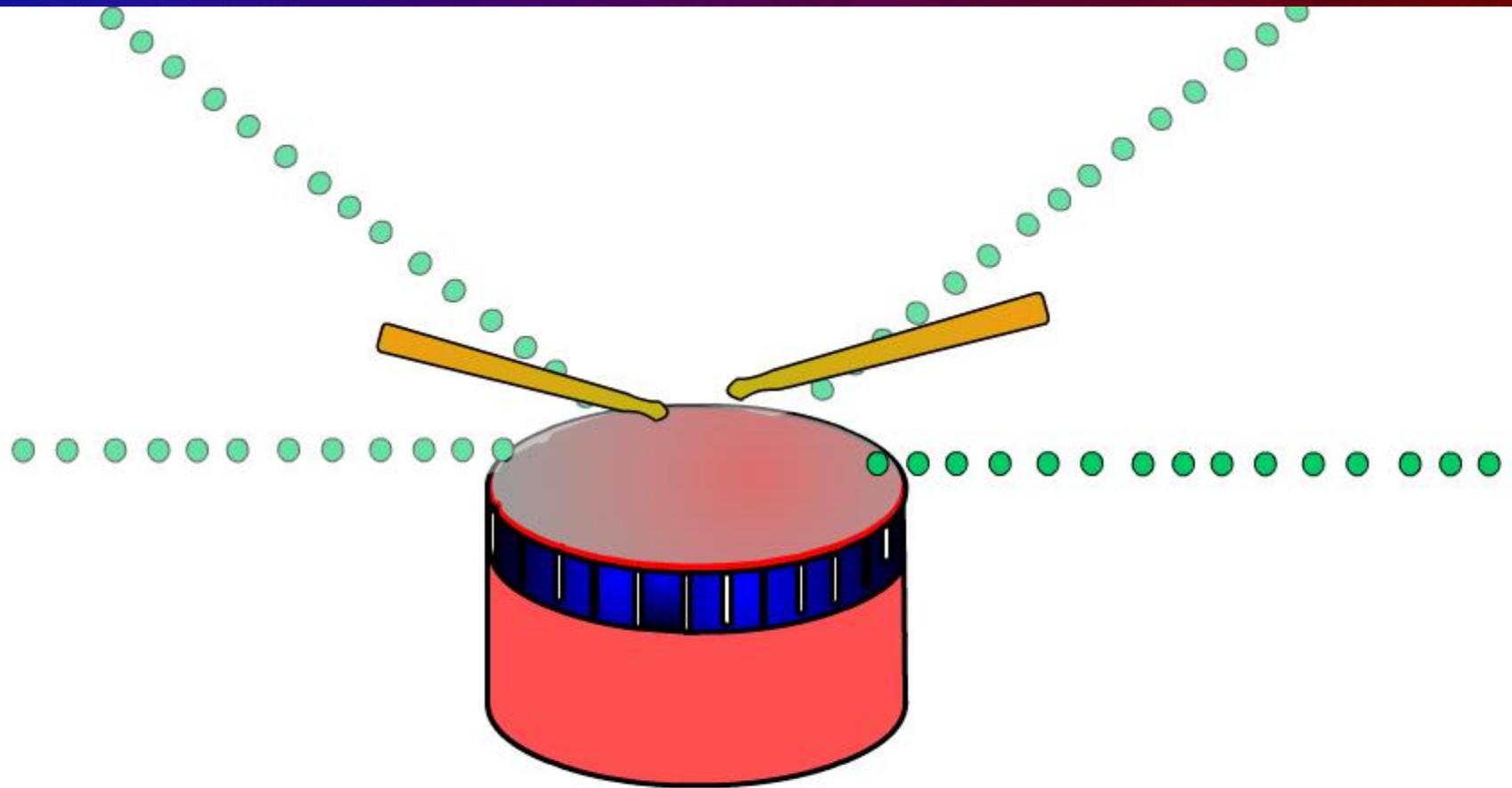
Our ears are divided into this number of sections.

The sections are called.....

Our ears contain the smallest WHAT!

Humans can hear sounds that vibrate between.....

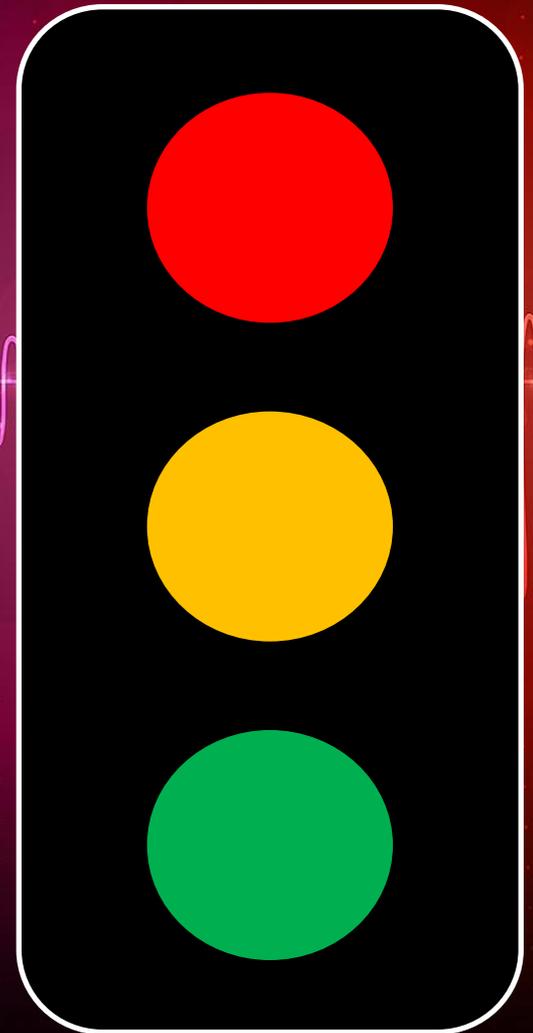
Hearing Sounds



Hearing Sounds

Learning Intention:

I know how the human ear picks up sound.



- 1. A signal generator can produce electrical signals which can be converted to sound waves by a speaker. The sound waves can be greater than the hearing range for humans (ultrasonic waves).**
- 2. Ultrasonic waves can be used in industry for cleaning, quality control, and for pre-natal scanning**

Ultrasound- RESEARCH



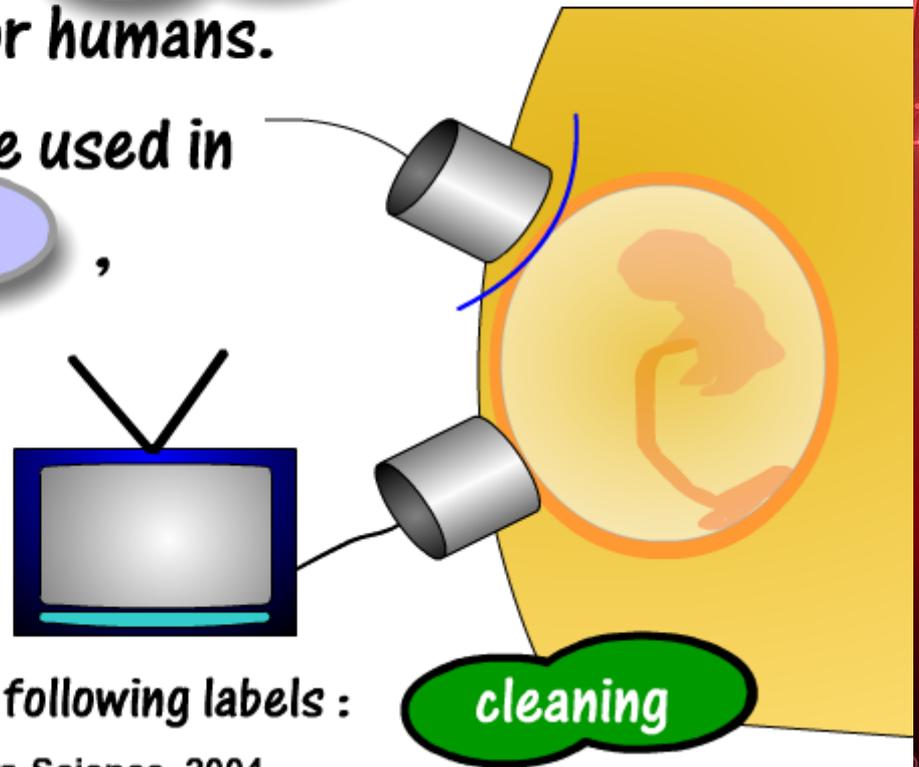
Research
Literacy Task

What is ULTRASOUND?
Uses for ultrasound

Ultrasound Energy

1 waves are 2 waves
that have a frequency 3 than the
4 range for humans.

Ultrasonic waves can be used in
industry for 5 ,
quality control, and for
6 scanning.



Reset

Show answers

Drag and Drop the following labels :

cleaning

Sound Energy

REVISION

M O Q S E V A W G H H A
H C T I P Z B D I Z T M
E Z L R Y C W J G H G P
V I B R A T I O N S N L
C I M S I E S E C L E I
L O U D N E S S V Q L T
E S R E V S N A R T E U
Y C N E U Q E R F U V D
I N W M P E R I O D A E
K D P U J C S S Q F W T
S O U N D T N Z G X H Z
S O Q J Q X K V Y D Q V

AMPLITUDE
FREQUENCY
LOUDNESS
PERIOD
PITCH
SEISMIC
SOUND
TRANSVERSE
VIBRATIONS
WAVELENGTH
WAVES

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Reset