

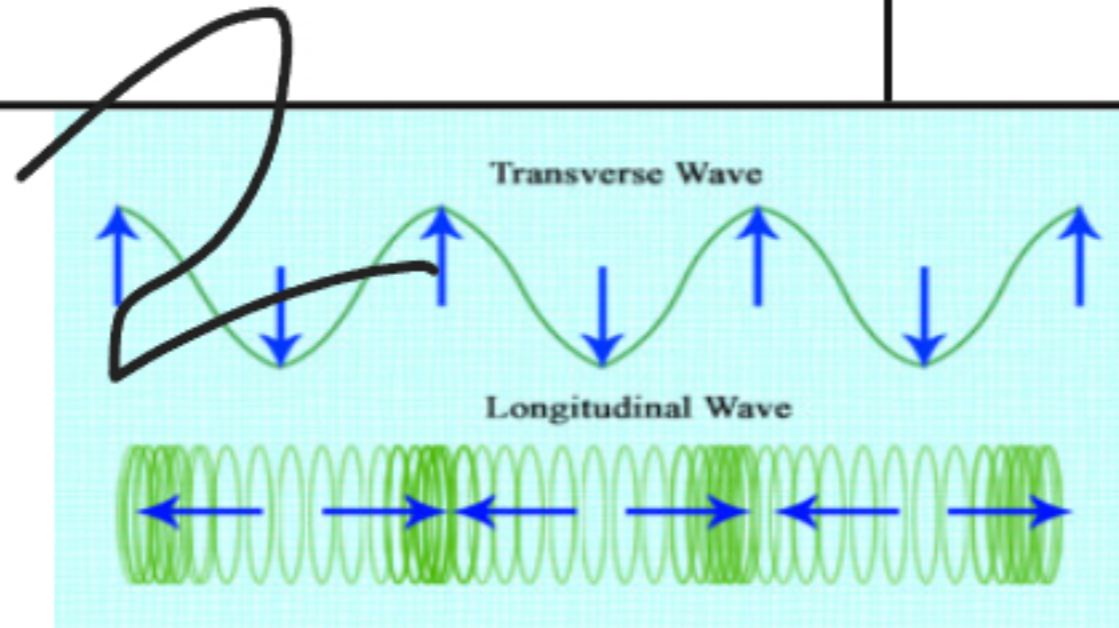


EXPERT GUIDANCE

TRANSVERSE AND LONGITUDINAL WAVES

Waves are oscillations or disturbance that transfer energy from one point to another

TRANSVERSE WAVES	LONGITUDINAL WAVES
<p>In transverse waves, the oscillations move perpendicular to the direction of the wave.</p> <p>eg <u>Light Waves</u> <u>Seismic S Waves</u></p>	<p>In longitudinal waves, the oscillations move parallel to the direction of the wave.</p> <p>eg Sound Waves Seismic P Waves</p>

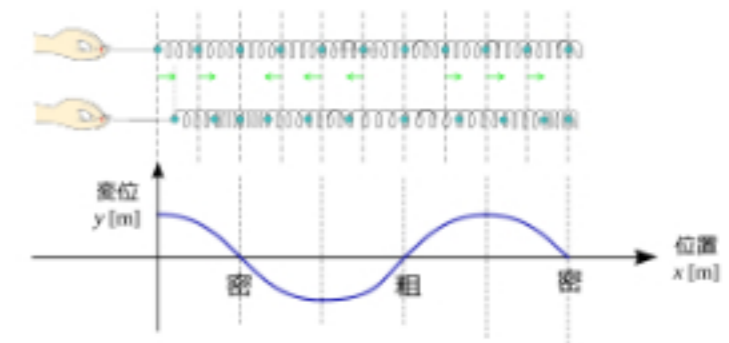
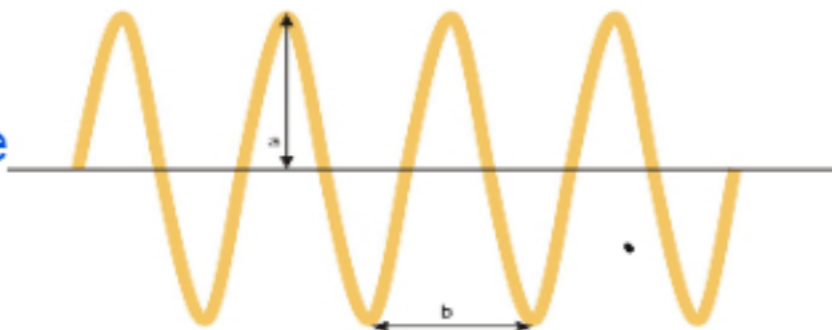


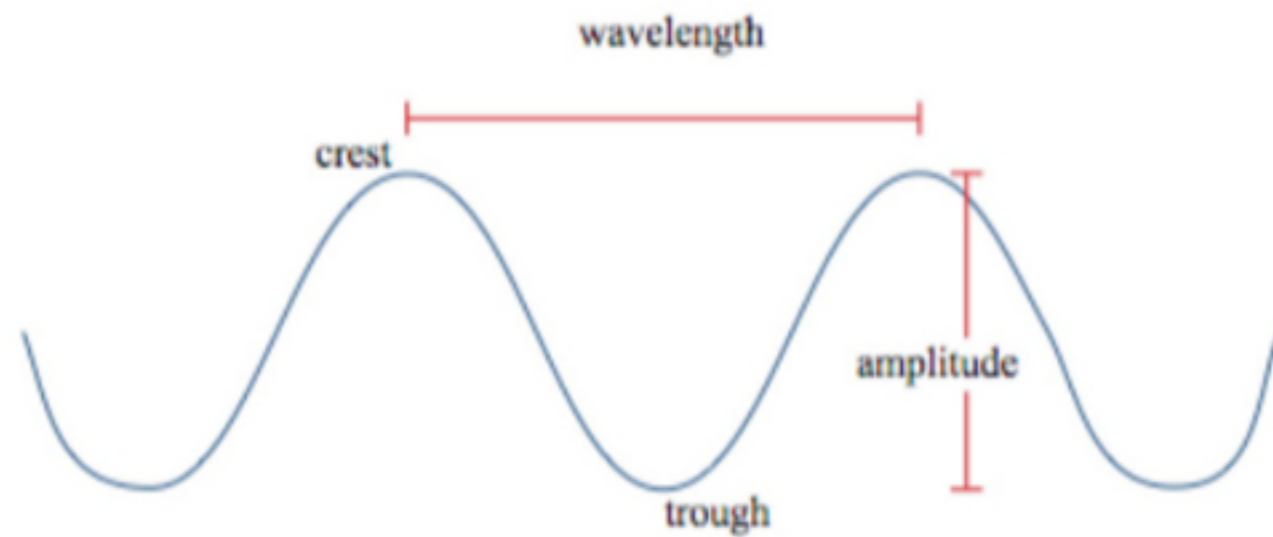
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	Transverse	Longitudinal
Vibrations of particles	The particles vibrate perpendicular to the direction of the wave.	The particles vibrate parallel to the direction of the wave
Medium	They do not require a medium to travel.	They require a medium to travel
Speed	They travel fast eg light wave travels at $3 \times 10^8 \text{ m/s}$	They travel slowly like sound waves travel at 330 m/s.
Wave characteristics	Wave consist of crests and troughs.	Wave consist of compression and rarefaction.
Polarization	They can be polarised	The cannot be polarised
Example	Light Waves Seismic S Waved	Sound Waves Seismic P Waves

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Transverse and Longitudnal Waves

Properties of Waves

Reflection of Waves

Refractions of Waves

Sound Waves

Ultrasound

Electromagnetic Waves

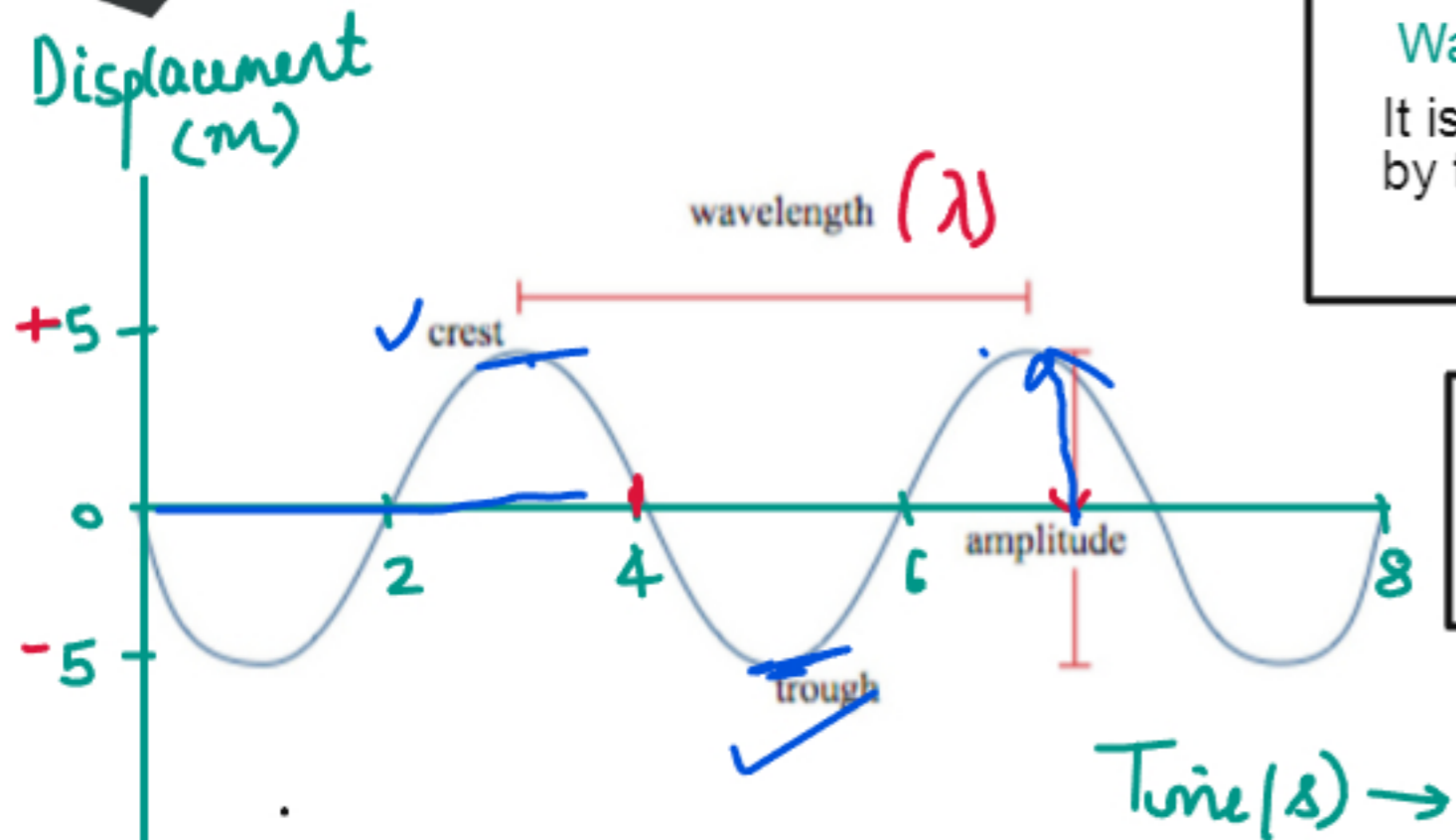
Lenses

BlackBody Radiation



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PROPERTIES OF WAVES



WaveSpeed

It is the distance travelled by the wave each second.

Amplitude

It is the maximum displacement of the wave from the mean position.

In the example it is 5 m

Crest

It is the height of the wave

Frequency

It is the number of waves passing each second. It is measured in Hertz (Hz)

$$F = \frac{1}{T} \quad \frac{1}{4} = 0.25 \text{ Hz}$$

Wavelength

The distance between two consecutive crests or trough.

Time Period

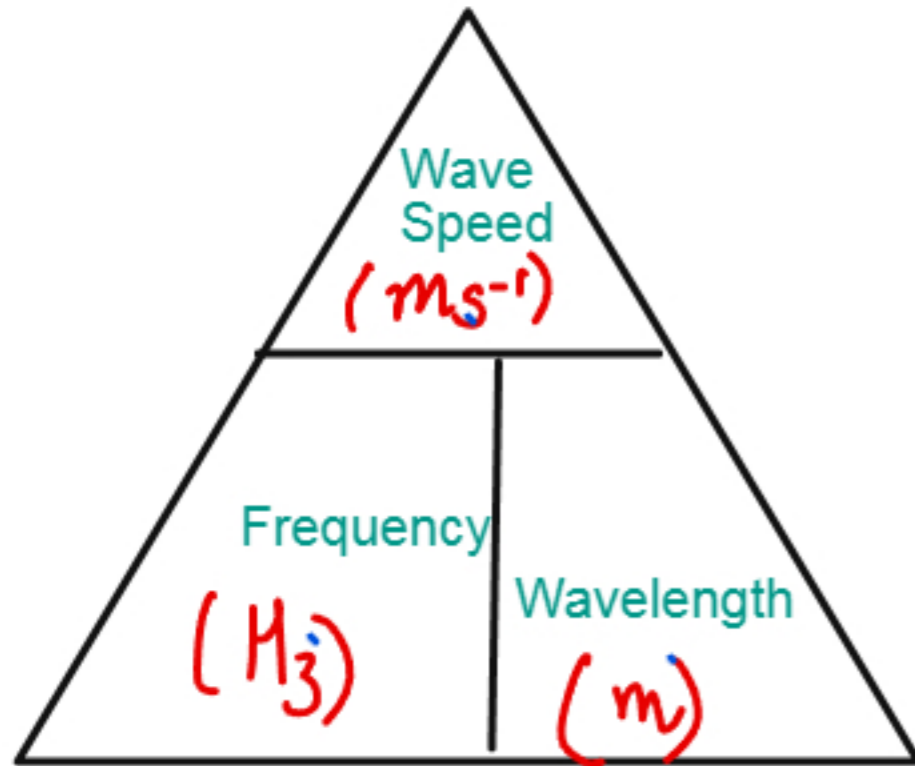
The time it takes for one wave to travel.

In the example, one wave is completed in 4 second.

Trough

It is the depth of the wave.

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$$F = \frac{1}{T}$$

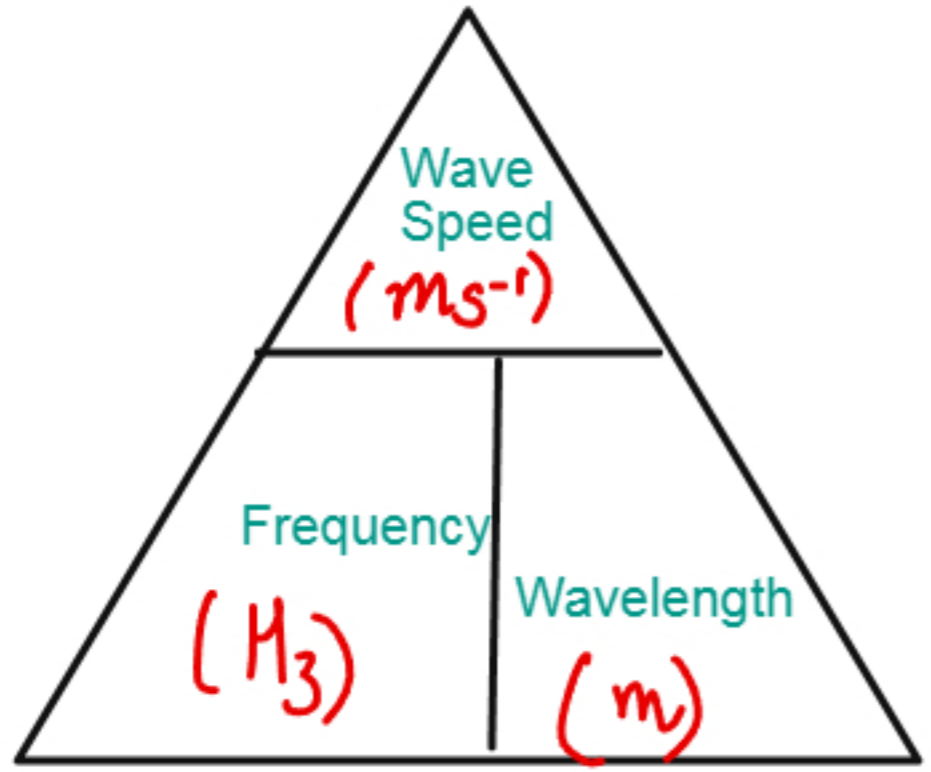
(Frequency) (Hz) (Time Period) (s)

Q1 The speed of the sound waves is 330 m/s.

Calculate the wavelength if its frequency is 25 Hz

Q2 How long it will take light to travel a distance of 50 m?

WAVE SPEED



$$F = \frac{1}{T}$$

(Frequency) (Hz) (Time Period) (s)

Q1 The speed of the sound waves is 330 m/s.

Calculate the wavelength if its frequency is 25 Hz

$$\lambda = \frac{\text{Speed}}{\text{Frequency}} = \frac{330}{25} = 13.2 \text{ m}$$

Q2 How long it will take light to travel a distance of 50 m?

$$\text{Frequency} = \frac{\text{Speed}}{\lambda} = \frac{3 \times 10^8}{50}$$

$$= 6 \times 10^7 \text{ Hz}$$

$$\text{Time} = \frac{1 \times 10^7}{6} = 1.6 \times 10^6 \text{ s}$$



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REFLECTION

It is the line perpendicular to the surface where reflection occurs

Normal

Reflection is the phenomenon of bouncing off the wave when it hits a medium.
eg: Reflection of light wave when it hits a plain mirror.

Incident ray

It is the ray incident on the surface

Reflected ray

It is the ray which is reflected from the surface.

LAWS OF REFLECTION

a) Incident ray, reflected ray and normal are in the same plane

b) The angle of incidence is equal to the angle of reflection.

$$\angle i = \angle r$$

Angle of reflection is the angle between the reflected ray and the normal.

θ_i

θ_r

θ_R

Refracted ray

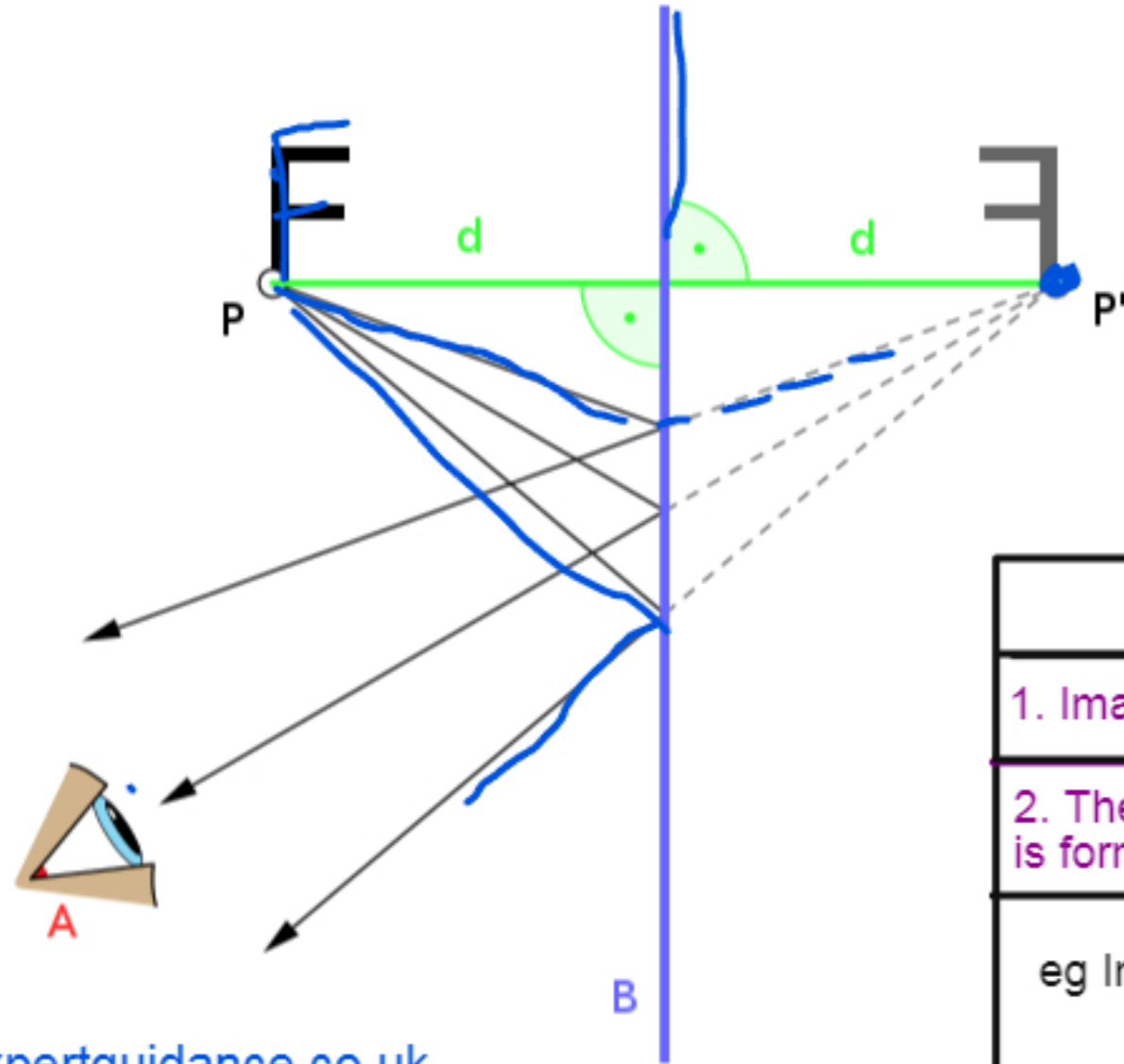
Angle of incidence is the angle between the incident ray and the normal.

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IMAGE OF A PLANE MIRROR



It is a virtual image

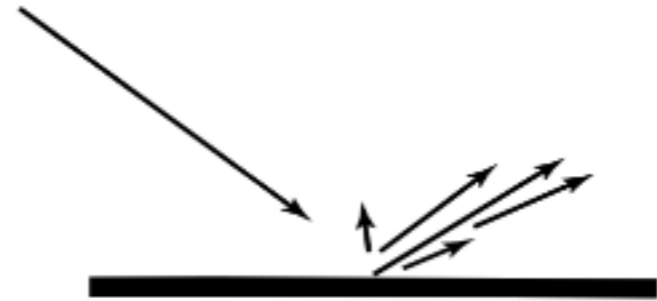
Laterally Inverted

Upright

The same distance from the source.

REAL IMAGE	VIRTUAL IMAGE
1. Image can be obtained on a screen.	1. Image cannot be obtained on a screen
2. The rays actually meet where the image is formed.	2. The rays happen to meet where the image is formed.
eg Images of the cinema	

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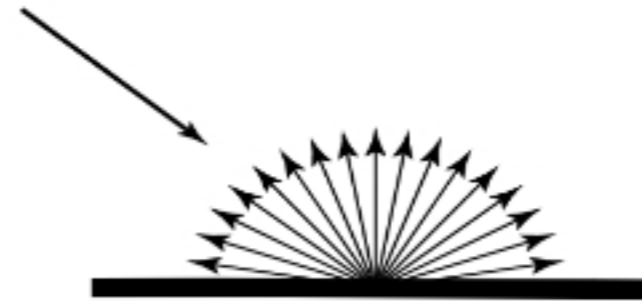
**Specular
Reflection**



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Author: <http://commons.wikimedia.org/wiki/User:Arbuck>

Reflection on a smooth surface

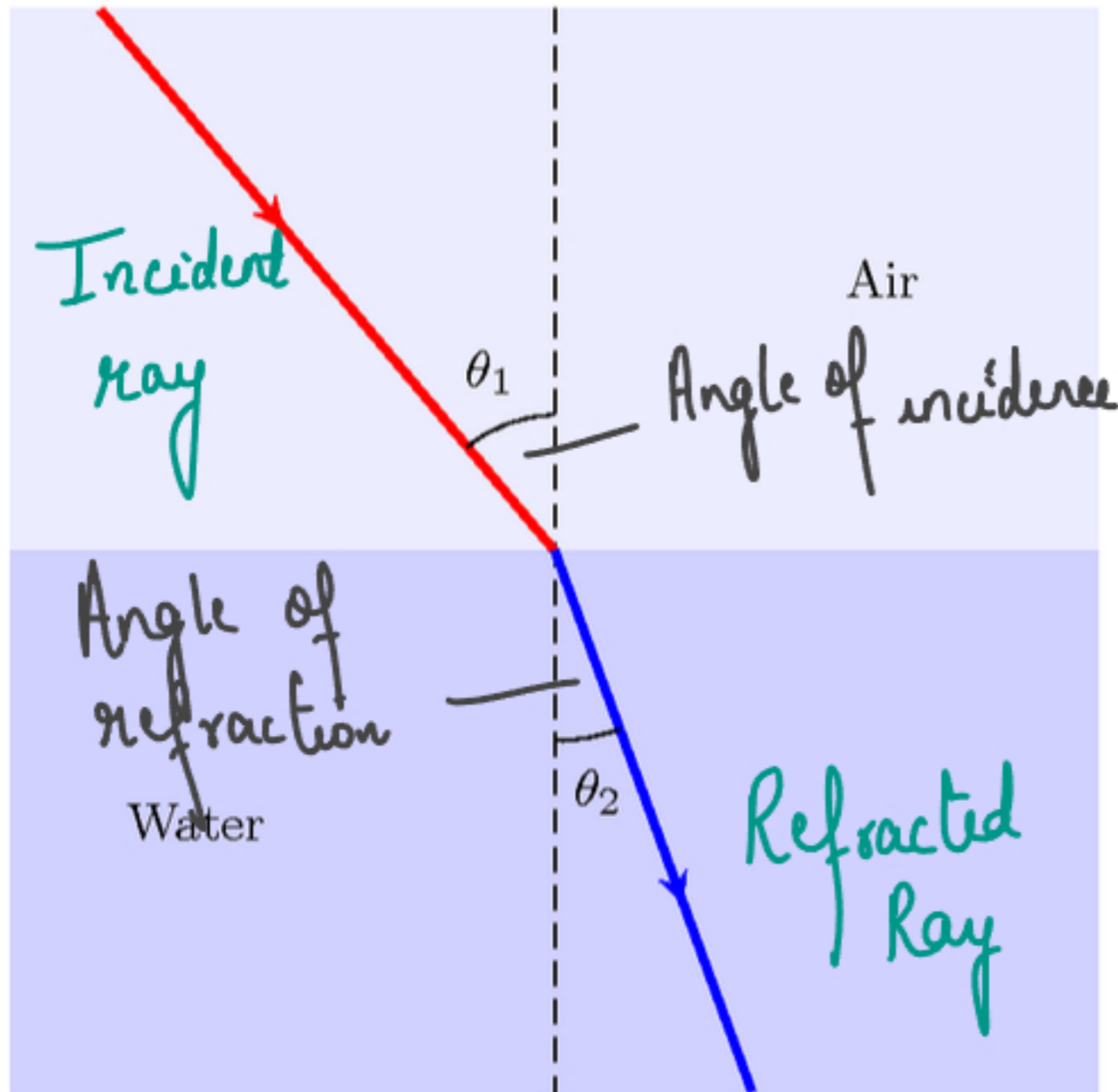
Reflected rays are parallel beams



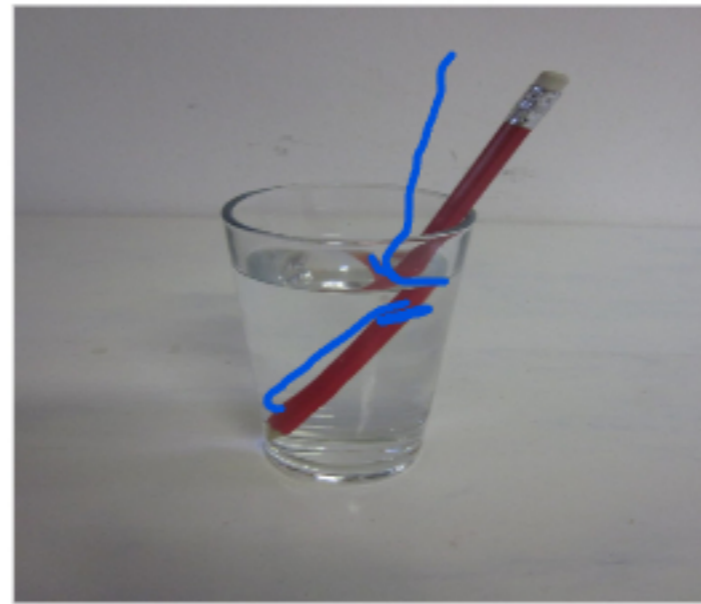
**Diffuse
Reflection**

Reflection on a rough surface.

Reflected rays are bunch of diverging rays.

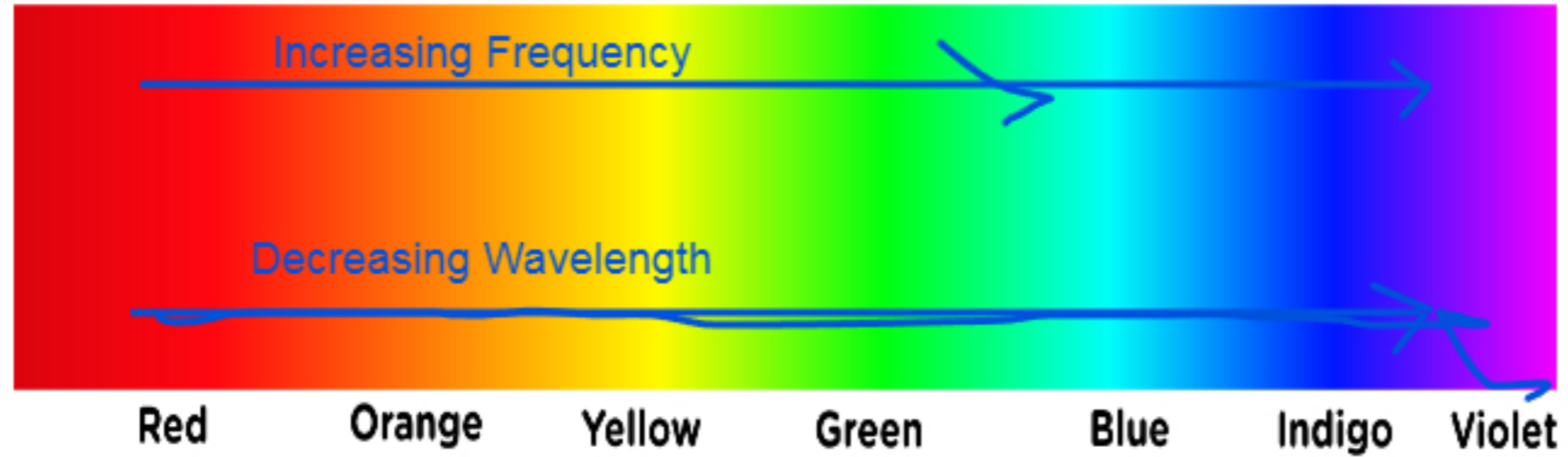


- Bending of light as it travels from one medium to another.
- Light bends because speed of light is different in different medium.
- If the light is travelling from rarer to denser medium then it bends towards the normal. $\angle r < \angle i$
- If the light is travelling from denser to rarer medium then it bends away from the normal. $\angle r > \angle i$



The pencil appears to be broken as the light is refracted in water.

Visible light is a spectrum of 7 colours VIBGYOR



Each colour has its own frequency and wavelength.

The visible colour of the object will be the colour that is reflected by the object

Opaque Object

Opaque objects does not allow the light to be transmitted but absorb all the light.

eg Book,

Translucent Object

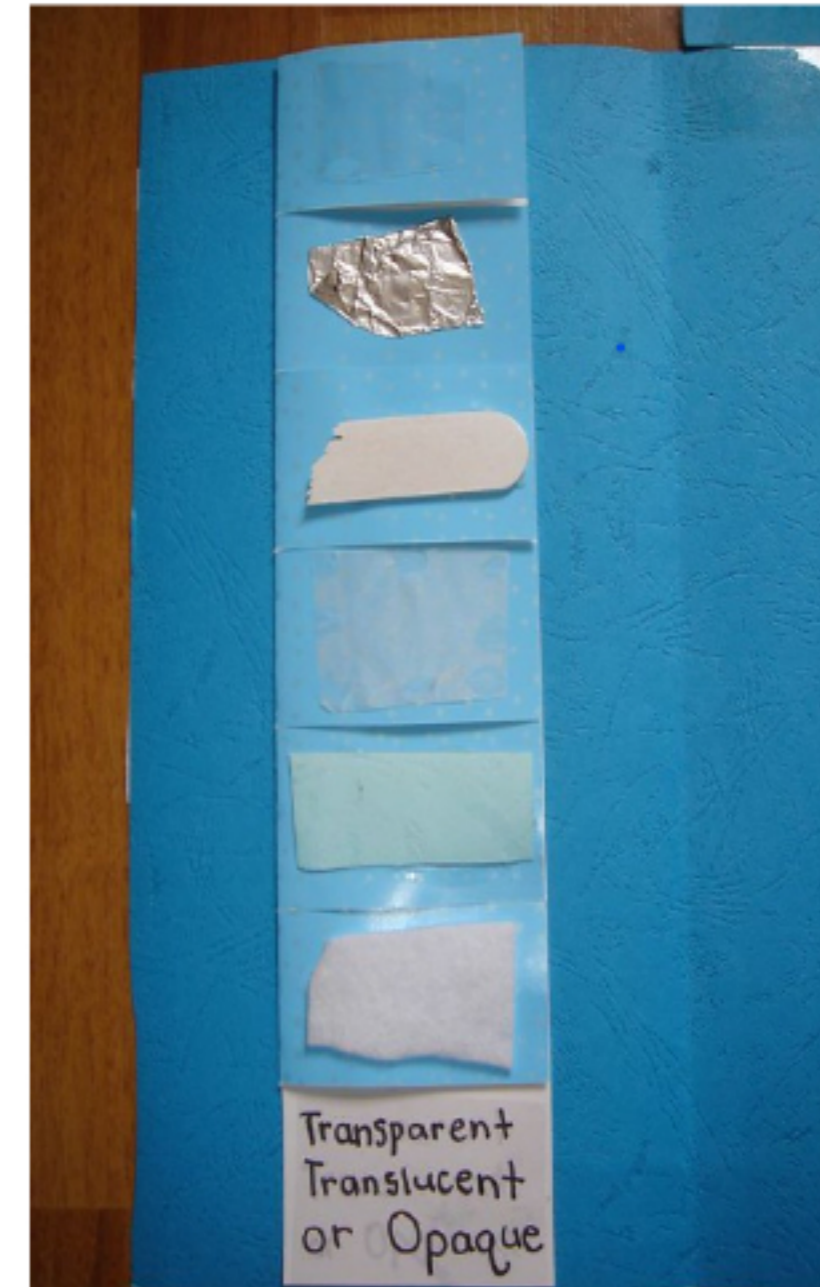
These objects allow some part of the light to be transmitted.

eg Plastic

Transparent Object

They allow the light to be transmitted through them without any absorption

eg glass



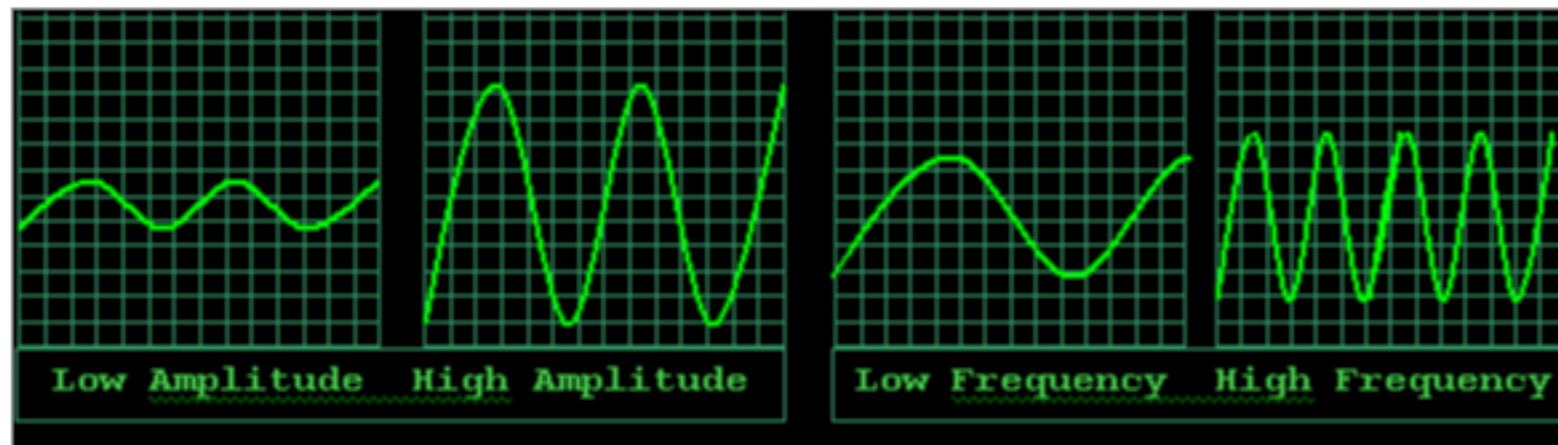


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SOUND WAVES

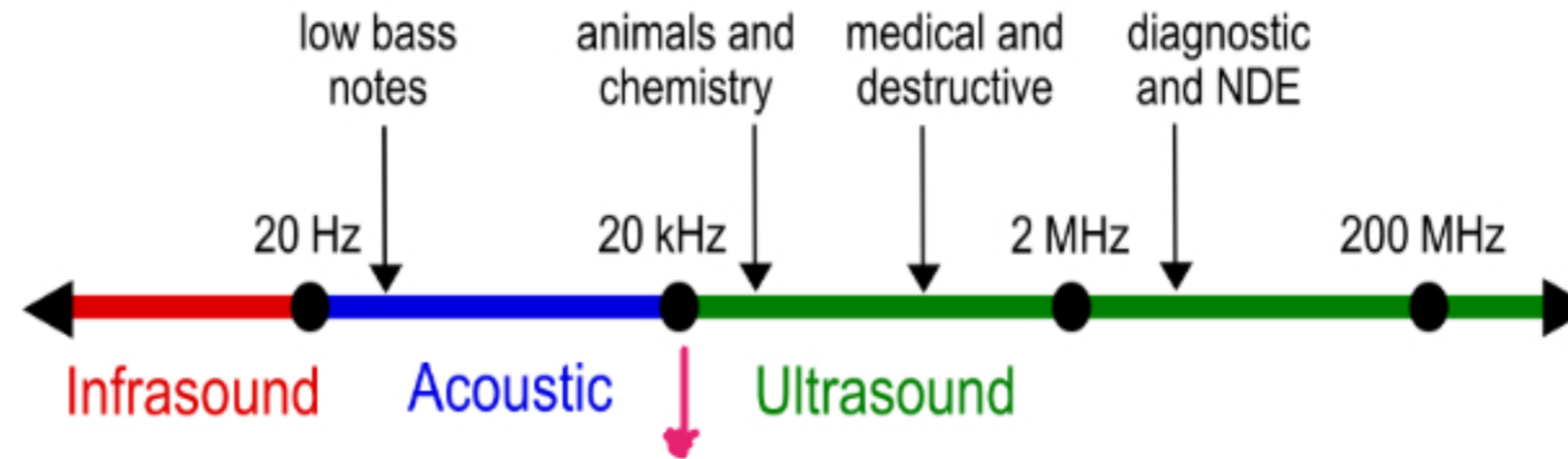


- They are longitudinal Waves.
- Sound does not travel through a medium.
- Sound requires a medium to travel.
- Sound wave is characterized by compression and rarefaction.
- In sound waves, particles vibrate parallel to the direction of the wave.



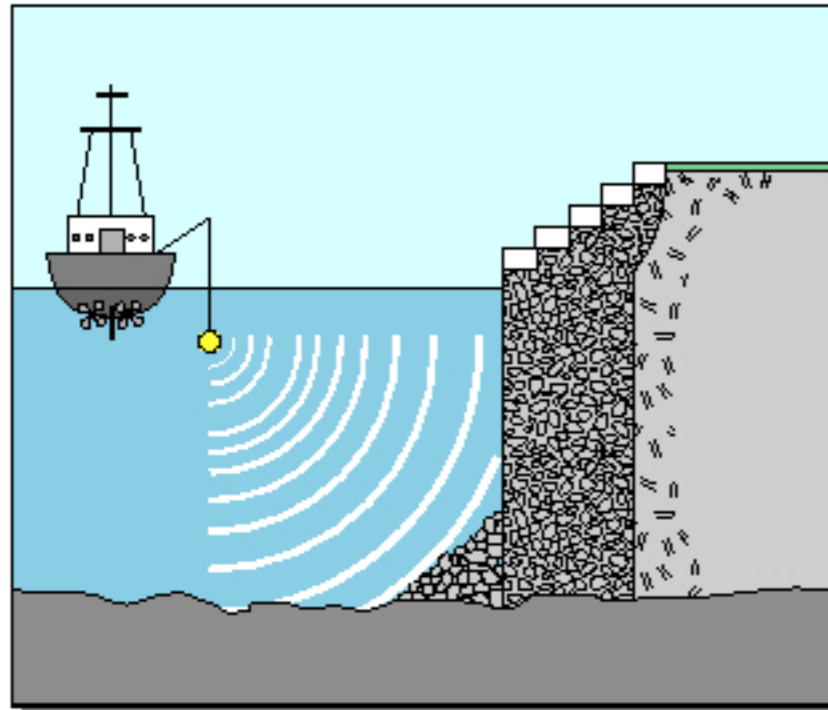
The speed of the sound wave is 330m/s.

SOUND WAVES



Human hearing range
20 Hz to 20,000 Hz

ECHO SOUNDING



In Echo sounding, high frequency sound waves are sent to determine the depth or find any object.

The time taken by the sound to come back is noted for the known speed of sound.

$$s = \frac{vt}{2}$$

ULTRASOUND

It is the frequency of sound greater than 20,000 Hz.



ADVANTAGES

1. They are non ionizing and harmless.
2. They are partially reflected at the boundaries between different tissues, so they can scan even the soft tissues

USES

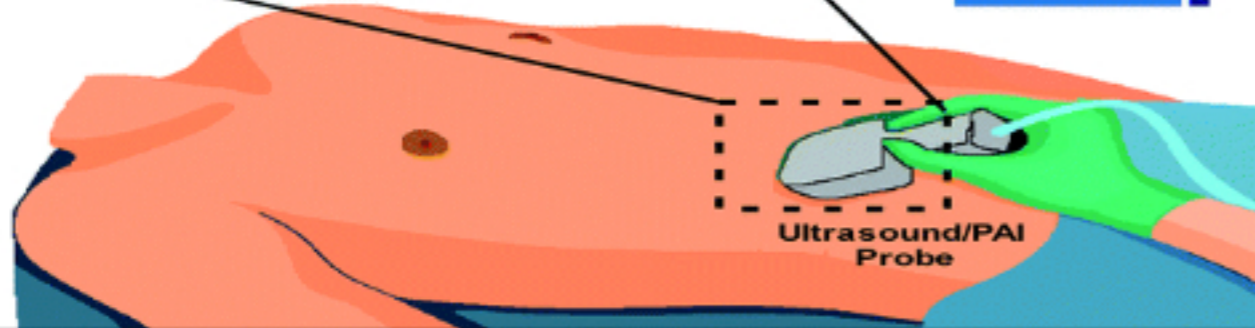
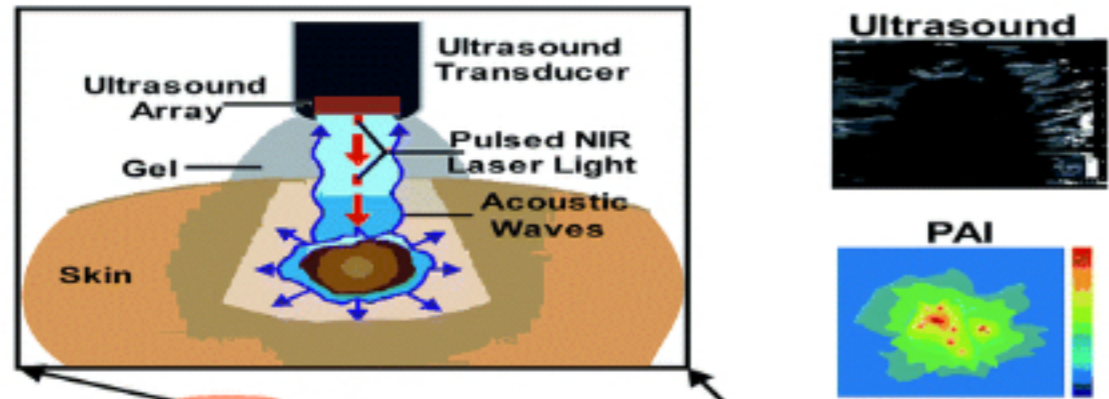
1. Used in prenatal scanning
2. Used to determine the depth of the sea or the obstacle inside water.
3. Industrial Imaging
4. Detecting flaws in metal castings.



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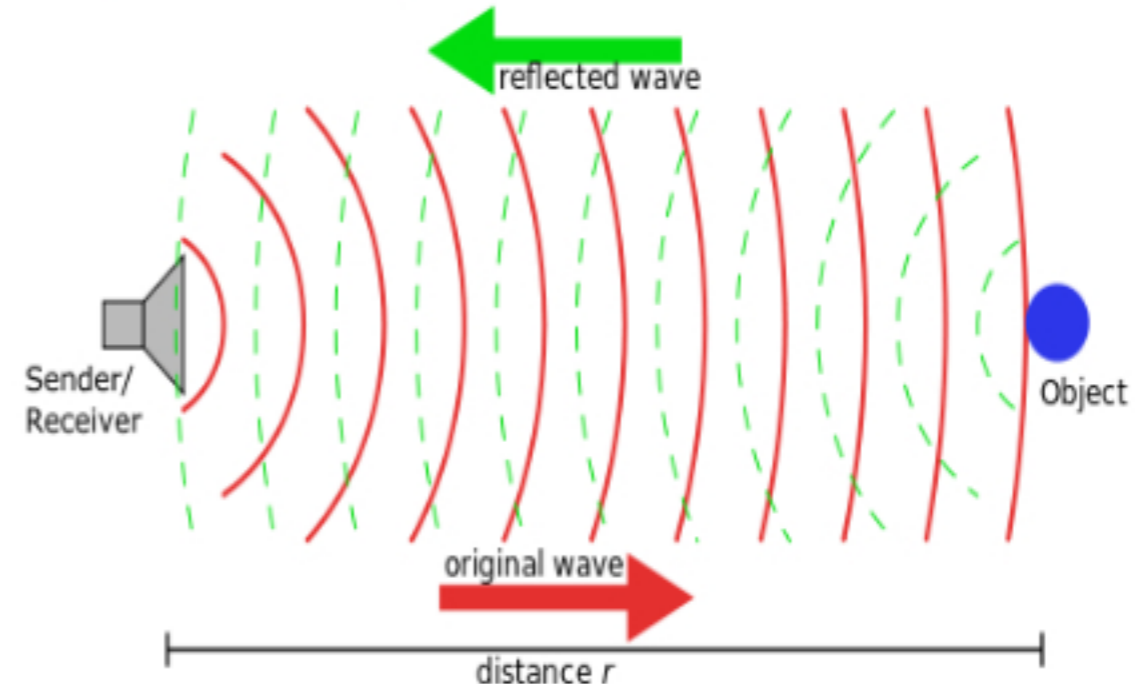
USES OF ULTRASOUND

ULTRASOUND SCANNER

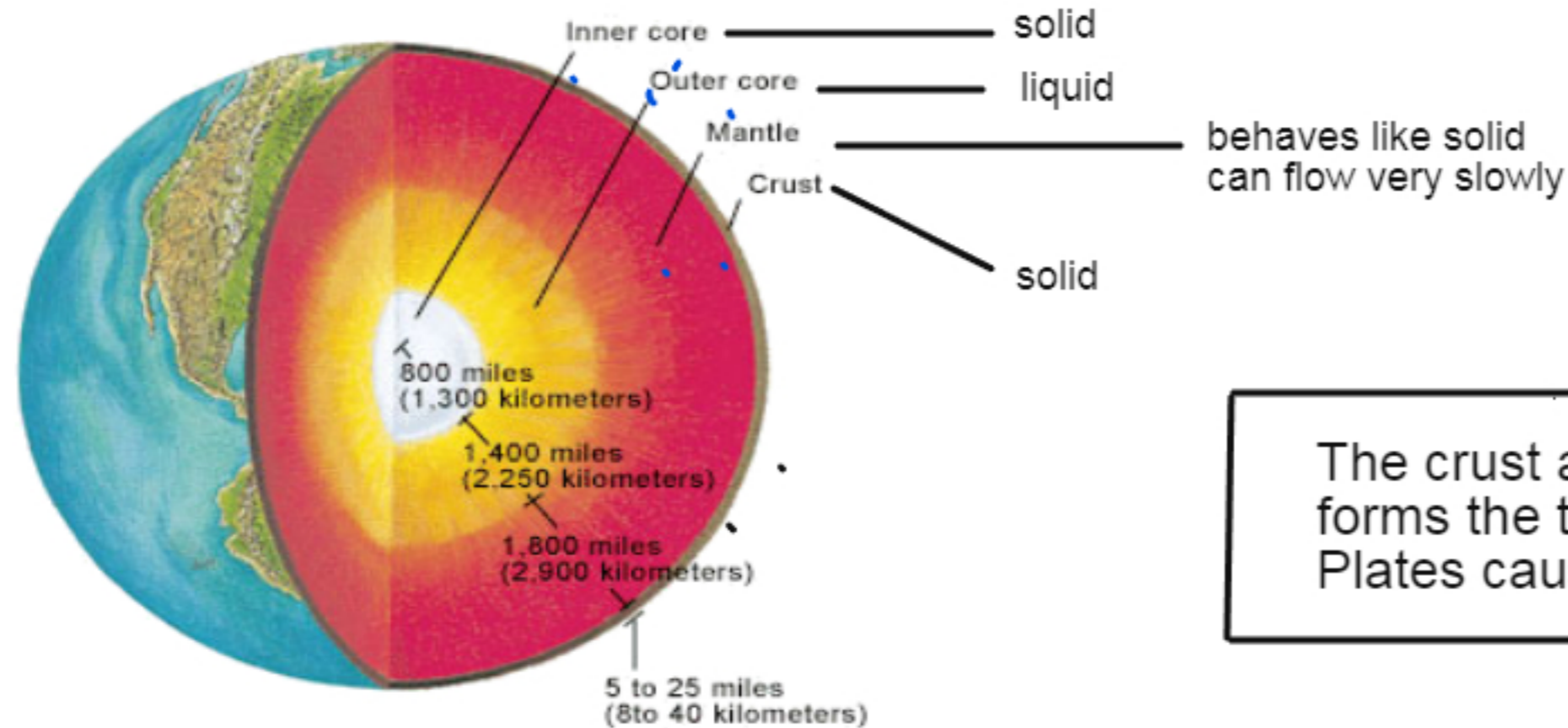


Transducer sends ultrasound waves. It crosses the body and reflected from the tissues. The Transducer detects the waves reflected from the tissues and the image is displayed on the screen in the form of scans.

SONAR



- Ultrasound waves are used to measure the depth of the sea or find the obstacle under water.
- In SONAR, ultrasound is sent to determine the depth or find any object.
- The time taken by the sound to come back is noted for the known speed of sound.



The crust and the upper mantle cracks and forms the tectonic plate. The Tectonic Plates causes Earthquake.



Earthquake takes place when the rocks or the tectonic plates in the Earth's Crust or the upper Mantle Moves due to forces inside the Earth.

The focus is the point from where the Earthquake originates.

Seismic Waves are the shock waves which originate when the forces inside the earth moves the rocks or the tectonic plates. These waves travel through the Earth and also across its surface.

Seismology is the study of Seismic Waves.

The Earthquake are detected by Seismometer

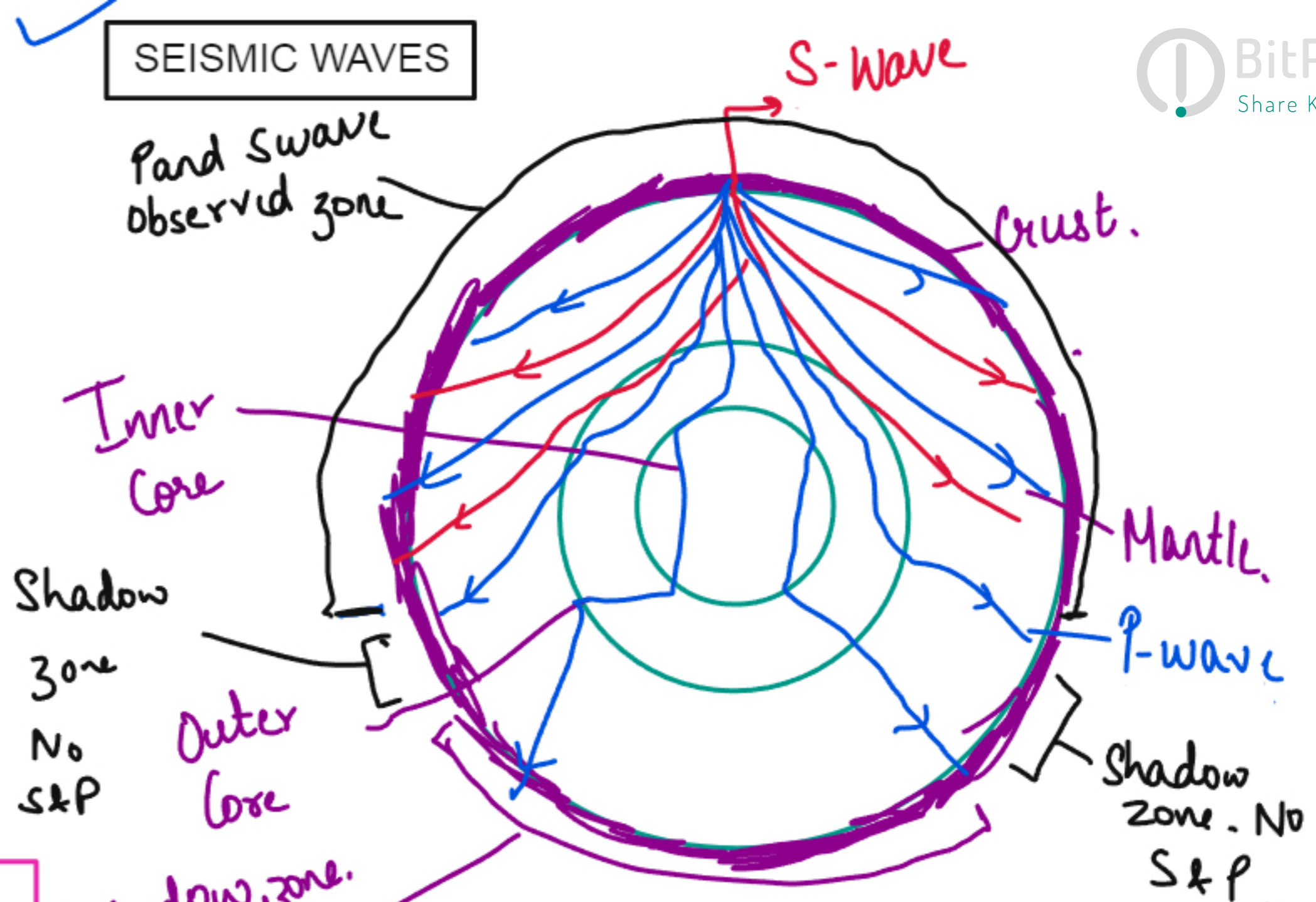
The nearest point on the surface of the focus is the epicenter.

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SEISMIC WAVES

P-Wave	S-Wave
They are longitudinal	They are transverse
They are faster than other waves.	They are slower than other waves
They can travel through solids and liquids.	They travel through solids only
They can pass through liquid outer core.	S-waves cannot pass through the liquid outer core.

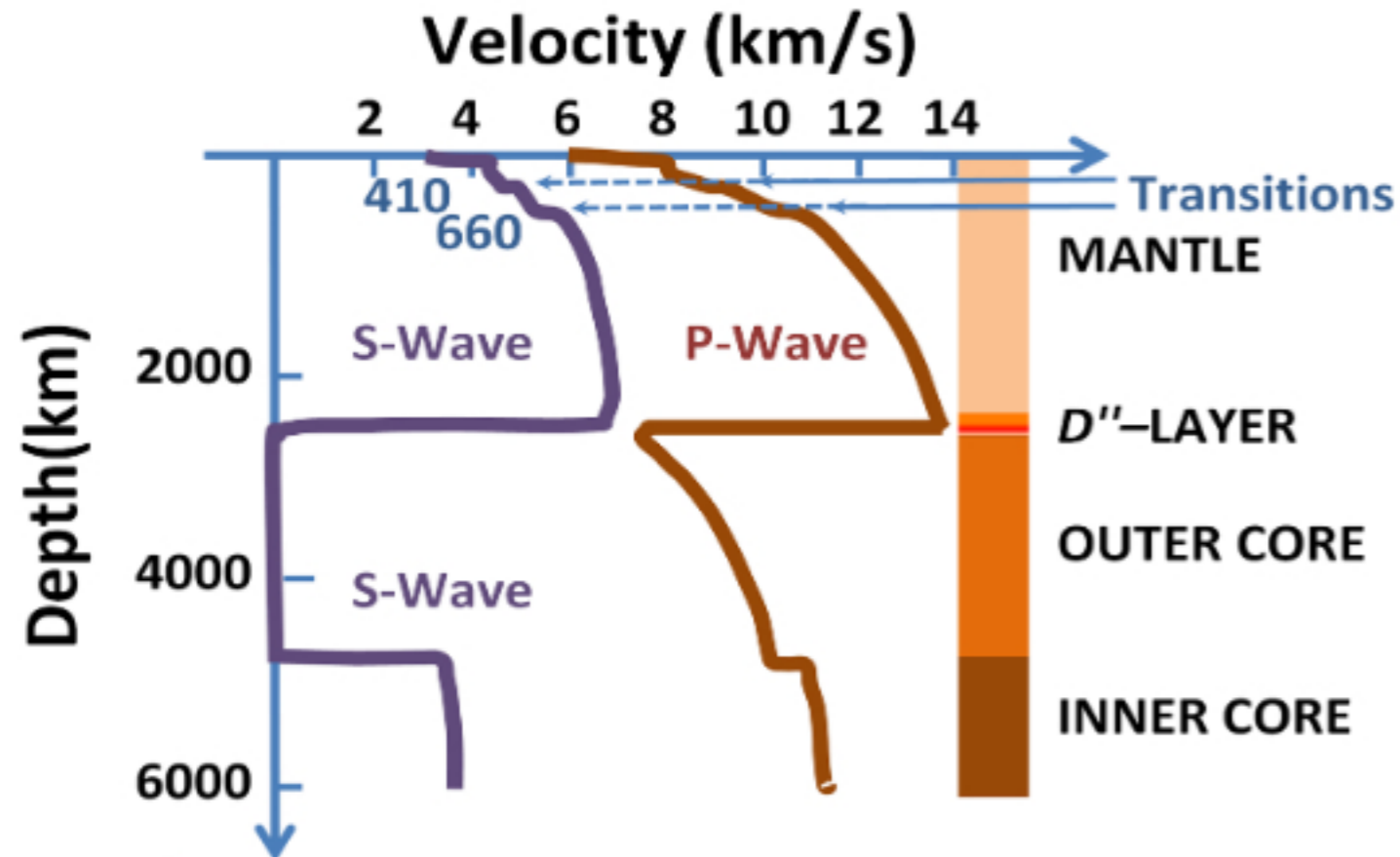


Shadow Zones are the place where no P and S waves are detected.

S shadow zones where no S wave and only P waves are detected.

only P wave seen in shadow zone.

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P and S Wave travel through the Mantle changing directions with depth.

P waves refract at the boundary between mantle and outer core.

S waves being transfer do not travel through liquid outer core.

1. Liquid Outer core under the Mentle
Shadow zones are detected as P waves refract twice. Once while entering the core from the mantle and leaving the core from the mantle. Since the refraction is further away forming shadow zones it suggests a liquid outer core under the mantle.

2. Solid Inner Core

Weak P waves in the shadow zones caused by the refraction of P waves while crossing the boundary between outer core and inner core.

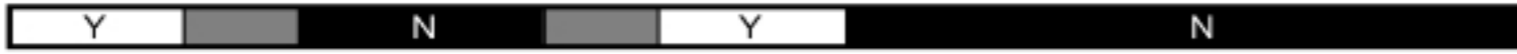
Long (L-waves) travel the slowest. They happen only in the Earth's crust and they cause more violent movements.



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ELECTROMAGNETIC SPECTRUM

Penetrates Earth's Atmosphere?



Radiation Type
Wavelength (m)

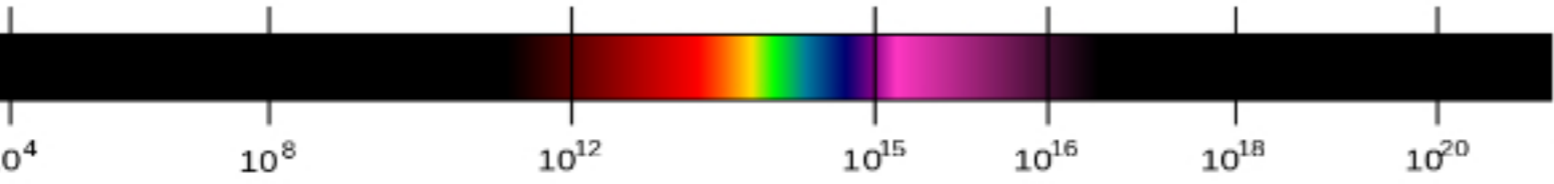


Approximate Scale of Wavelength

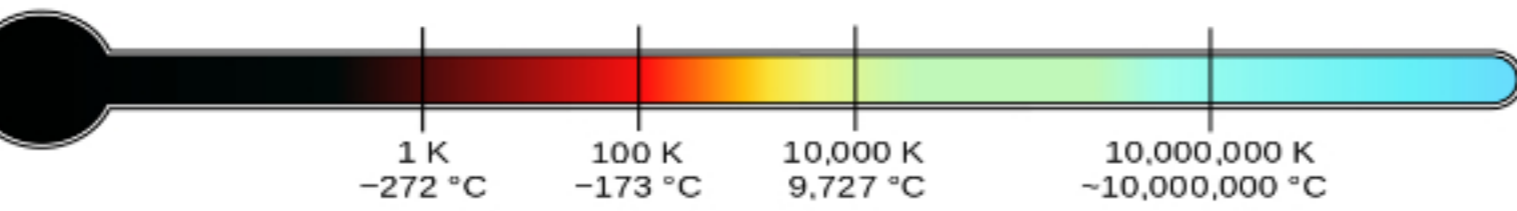


Buildings Humans Butterflies Needle Point Protozoans Molecules Atoms Atomic Nuclei

Frequency (Hz)



Temperature of objects at which this radiation is the most intense wavelength emitted



Increasing frequency

Decreasing Wavelength

It is the spectrum with all the electromagnetic waves arranged in the order of the increasing wavelength or frequency.

Electromagnetic waves are electric and magnetic disturbances that transfer energy (no matter) from one point to another

All the electromagnetic waves travel with the speed of light- $3 \times 10^8 \text{ m/s}$

The frequency and the wavelength can be given by the formulae :-
 $v = f\lambda$

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ELECTROMAGNETIC SPECTRUM
MNEMONIC

ELECTROMANGETIC SPECTRUM

MNEMONIC



<u>R</u>adioWaves	<u>R</u>ead	<u>R</u>ich	<u>R</u>abbits
<u>M</u>icrowaves	<u>M</u>y	<u>M</u>en	<u>M</u>ate
<u>I</u>nfrared	<u>I</u>nstructions	<u>I</u>n	<u>I</u>n
<u>V</u>isible Light	<u>V</u>isible	<u>V</u>egas	<u>V</u>ery
<u>U</u>ltraviolet	<u>U</u>nder	<u>U</u>se	<u>U</u>ltra
<u>X</u>-Rays	<u>X</u>-Ray	<u>X</u>pensive	<u>X</u>pensive
<u>G</u>amma Rays	<u>G</u>lasses	<u>G</u>irls	<u>G</u>ardens

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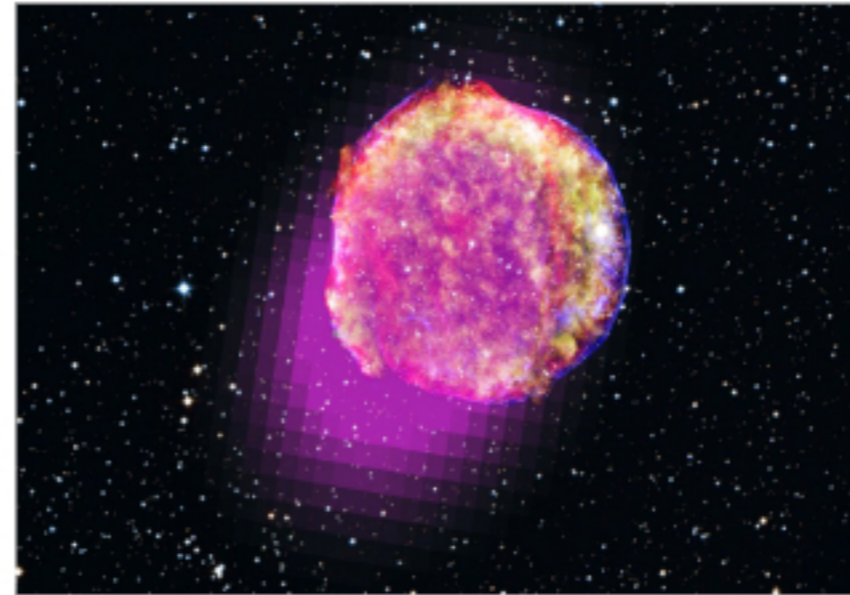
GAMMA RAYS

SOURCE

Gamma rays are produced when the radioactive substance emit nuclear radiations.

PROPERTIES

- They have the lowest wavelength.
- They have highest frequency.
- They travel with the speed of light.



USES

1. They are uses to disinfect food and surgical equipment.
2. It is used to kill cancer cells. In gamma treatment, the cobalt 60 is used to direct the gamma radiation to the cancer cells and kill it without affecting the surrounding tissue.

DISADVANTAGES

1. Gamma Rays are highly ionizing
2. Exposure to low dose of Gamma Rays can cause gene mutation, DNA damage and even cancer.
3. Exposure to high dose of Gamma radiation can caused killing of the cell.



X-RAYS

SOURCES

They are produced by stopping high speed electrons.

PROPERTIES

1. They are electromagnetic wave which travels with the speed of light.
2. They have wavelength greater than Gamma Rays but smaller than ultraviolet rays.
3. They have lower frequency than Gamma Rays but greater than ultraviolet rays.
4. Their wavelength is about the diameter of the atom.



USES

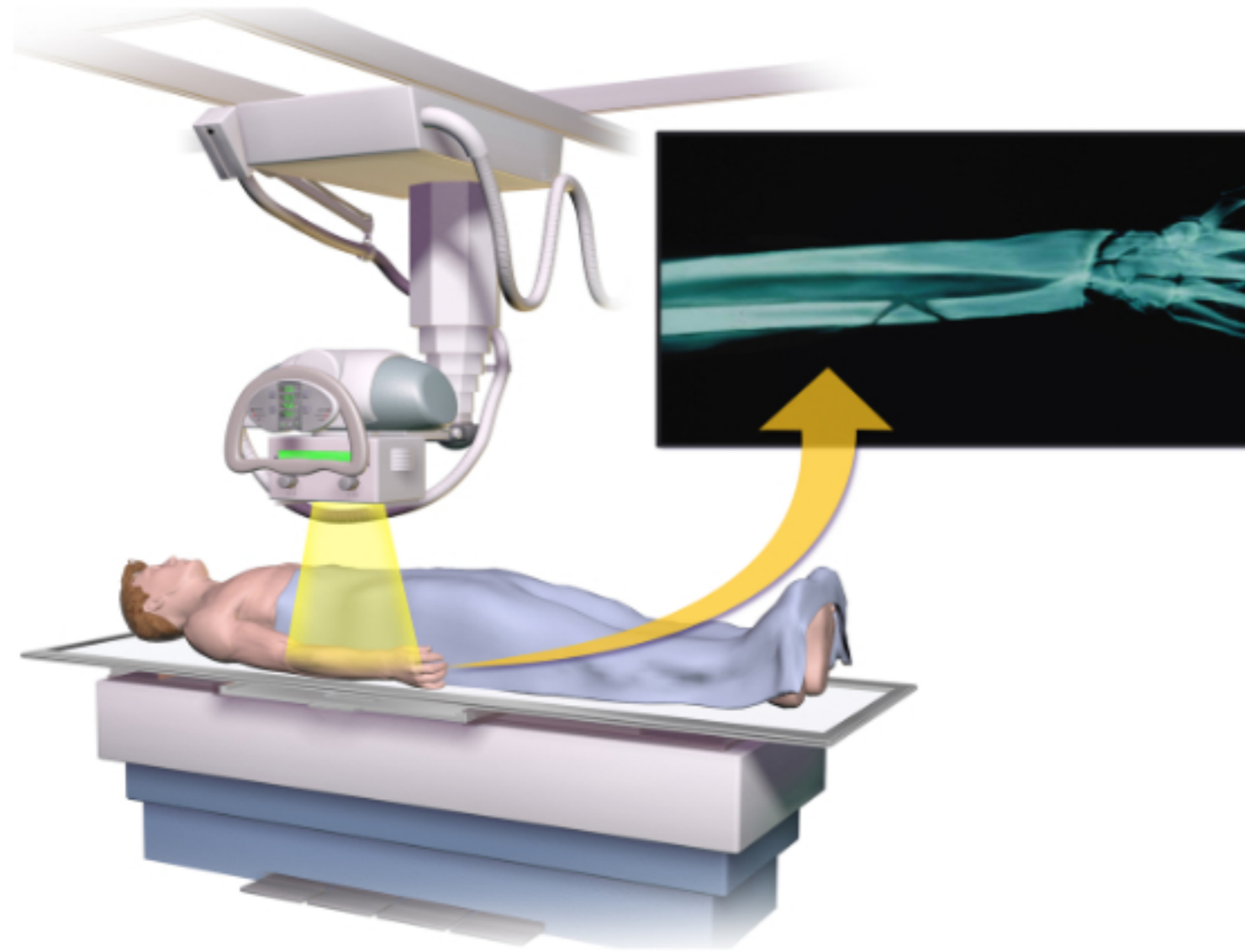
1. Shorter wavelength X-rays are used in X-ray therapy to kill cancer cells without destroying the healthy cells.
2. Longer wavelength X-rays are used to photograph the internal structure of the body.

DISADVANTAGES

1. X-Rays are highly ionizing
2. Exposure to a low dose of Gamma Rays can cause gene mutation, DNA damage and even cancer.
3. Exposure to a high dose of Gamma radiation can caused killing of the cell.

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HOW X-RAYS WORK ?



X-rays are passed through the body.

The X-rays pass through the soft tissues but are absorbed by the bones and harder tissues.

The X-rays that pass through the softer areas reach the detector and appear to be black whereas the rays that are absorbed do not reach the detector and appear light in the image.

If any organs containing softer tissues need to be photographed then the patient is given a contrasting medium like Barium which becomes a good absorber of X-rays and helps the photography of that organ.

The detector contains the charged coupled device CCD which converts X-rays to light which then creates an electronic signal which is used by the computer to make a digital image.

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ULTRA VIOLET RAYS

SOURCE

1. They are produced from the Sun. The Sun is the source of ultraviolet rays.

PROPERTIES

1. They are electromagnetic wave which travels with the speed of light.
2. They have wavelength greater than X-Rays but smaller than Violet light.
3. They have lower frequency than X- Rays but greater than violet light.



USES

They are uses as fluorescent markers or fluorescent lamps which contains the chemical which converts UV Light to Visible Light.

DISADVANTAGES

1. They can cause sunburn and suntan
2. They can also lead to skin cancer.
3. They can also lead to blindness.

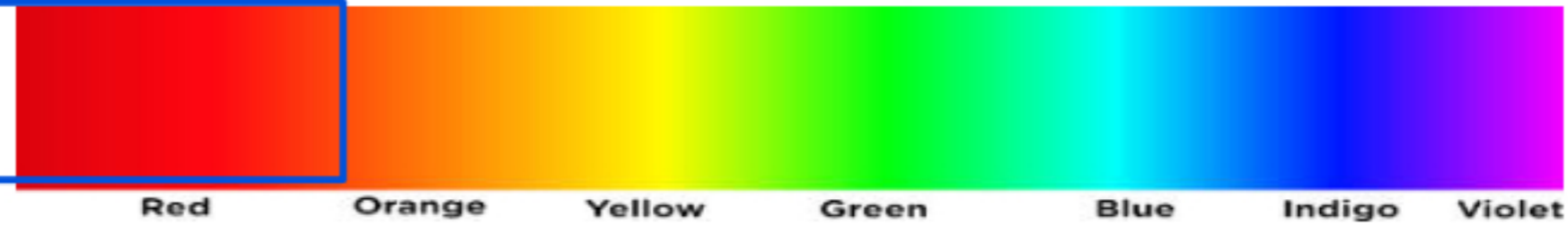
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1. Sun and lamps emits light
2. It is the only part of the spectrum which is visible

VISIBLE LIGHT

← Increasing Wavelength and Decreasing Frequency



PROPERTIES

1. It is made up of 7 colours
2. VIOLET
INDIGO
BLUE
GREEN
YELLOW
ORANGE
RED
3. When the white light is passed through the prism, it can give the spectrum of colours

USES

- Light is used in a camera to take the picture.
- Light is also used in Light Microscope
- Light helps to see the object.
- Light waves are also used in communication

DISADVANTAGES

- Too much exposure to visible light can lead to cancer, blindness and skin damage.

INFRA RED WAVES

All the hot objects like Kettle, Toaster, Radiator emits infrared radiation.

PROPERTIES

1. They are electromagnetic wave which travels with the speed of light.
2. They have wavelength greater than visible light but smaller than Microwaves.
3. They have a lower frequency than visible light but greater than microwaves.



USES

1. They are used in optical fibres for communication.
2. They are used in remote controls.
3. They are used as infrared scanners to detect heat produced by the body and unhealthy tissues
4. Infrared cameras helps to see objects in dark.

DISADVANTAGES

1. They can cause sunburn and suntan
2. They can also lead to skin cancer.
3. They can also lead to blindness

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They are emitted as Cosmic Microwave Background Radiation. Sun also emits some microwaves

PROPERTIES

1. They are electromagnetic wave which travels with the speed of light.
2. They have wavelength greater than infrared light but smaller than Radiowaves.
3. They have a lower frequency than infrared light but greater than radiowaves.
4. They are found between Radiowaves and Infrared Waves

MICROWAVES



The water in the food absorb microwaves and become heated and heats the food preventing the microwave from heating as it has no water.

USES

1. They are used in communication.
2. They are used in satellite TV.
3. They are used in cooking.
4. They are used to carry mobile phone signal.

DISADVANTAGES

1. Exposure to microwaves can heat the body tissues.
2. Exposure to high dose of microwaves can cause eye damage and even cataract.

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RADIOWAVES

SOURCE

Radio waves can be generated by natural sources such as lightning or astronomical phenomena; or by artificial sources such as broadcast radio towers, cell phones, satellites and radar.

PROPERTIES

1. They are electromagnetic wave which travels with the speed of light.
2. They have the highest wavelength.
3. They have the lowest frequency.



USES

They are used in communication to carry TV, radio and mobile signals.

They are used in wireless connection and bluetooth connection.

DISADVANTAGES

1. Exposure to radiowave can heat the body tissues.
2. Exposure to high dose of radiowaves can cause eye damage and even cataract.

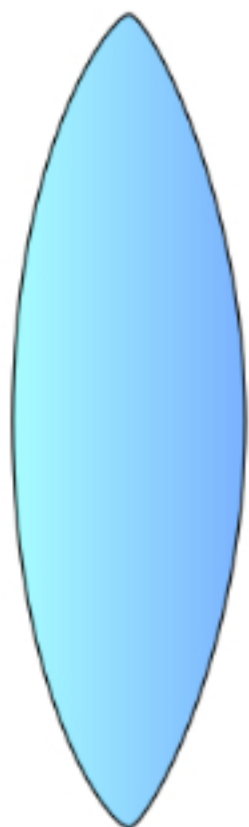
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LENSES

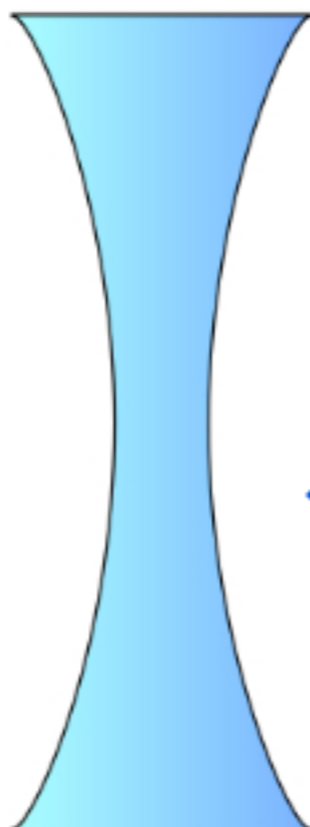
They are used to refract the light and forms the image of an objects. They are used in camera.

Converging Lens



Biconvex

Diverging Lens



Biconcave

CONVEX LENS	CONCAVE LENS
<ol style="list-style-type: none">1. It is a converging lens2. It is thicker at the center than at the edges3. It has a real focus4. It converges a parallel beam of light on refraction through it5. It is used in microscope, magnifying glass6. Used to correct short sight	<ol style="list-style-type: none">1. It is a diverging lens.2. It is thinner at the center than at the edges.3. It has a virtual focus4. It diverges a parallel beam of light on refraction through it.5. Used in some telescopes6. Used to correct long sight.

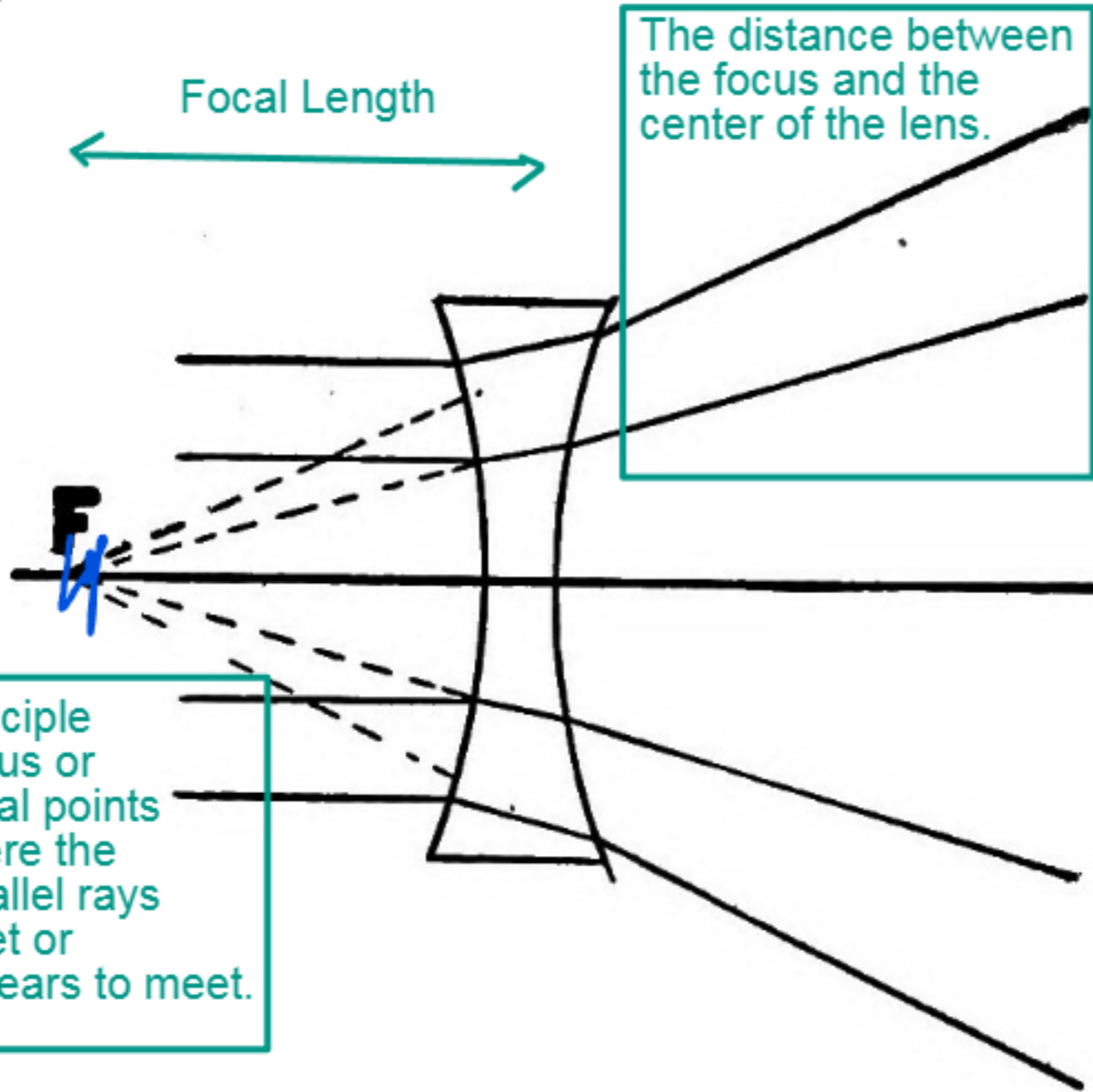


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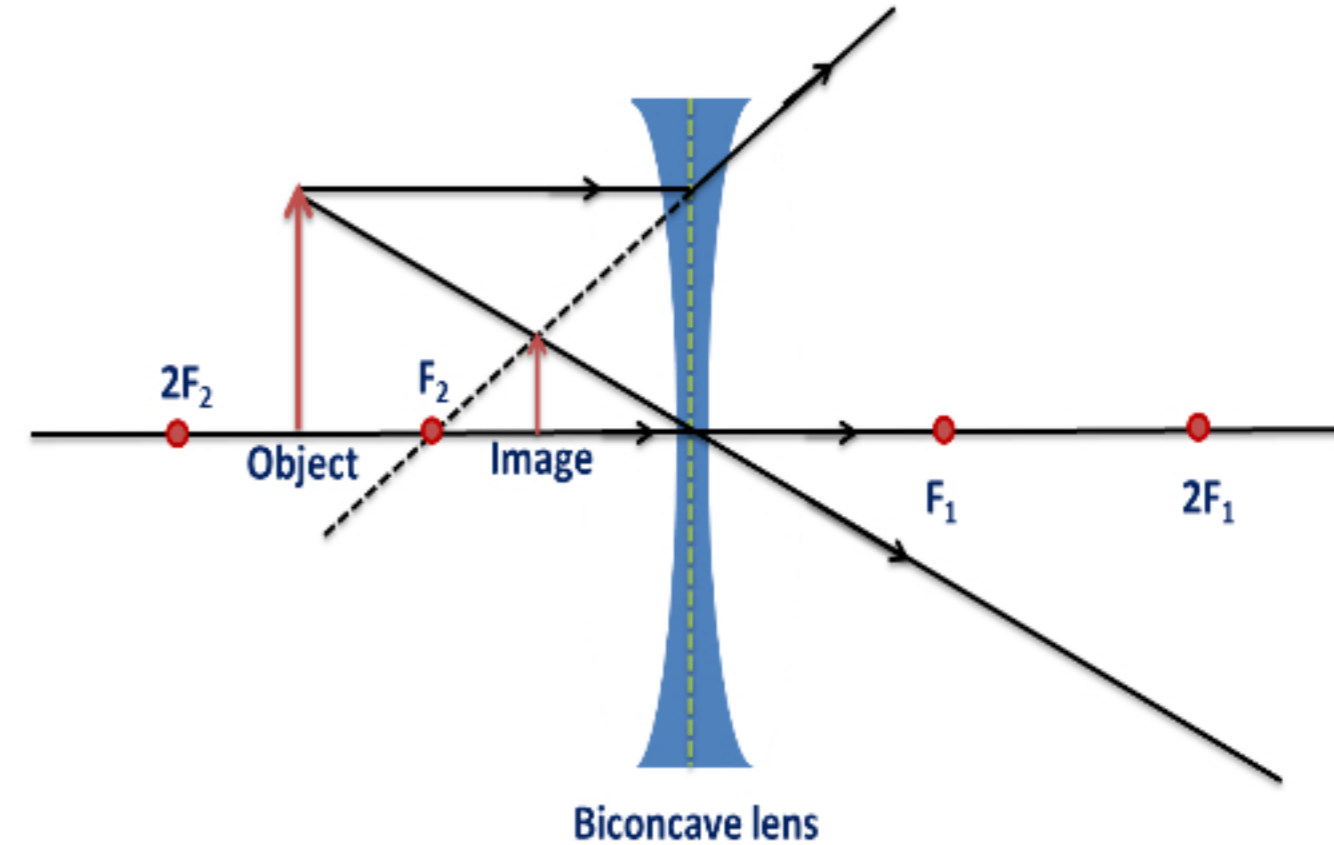
CONCAVE LENS

Focal Length

The distance between the focus and the center of the lens.

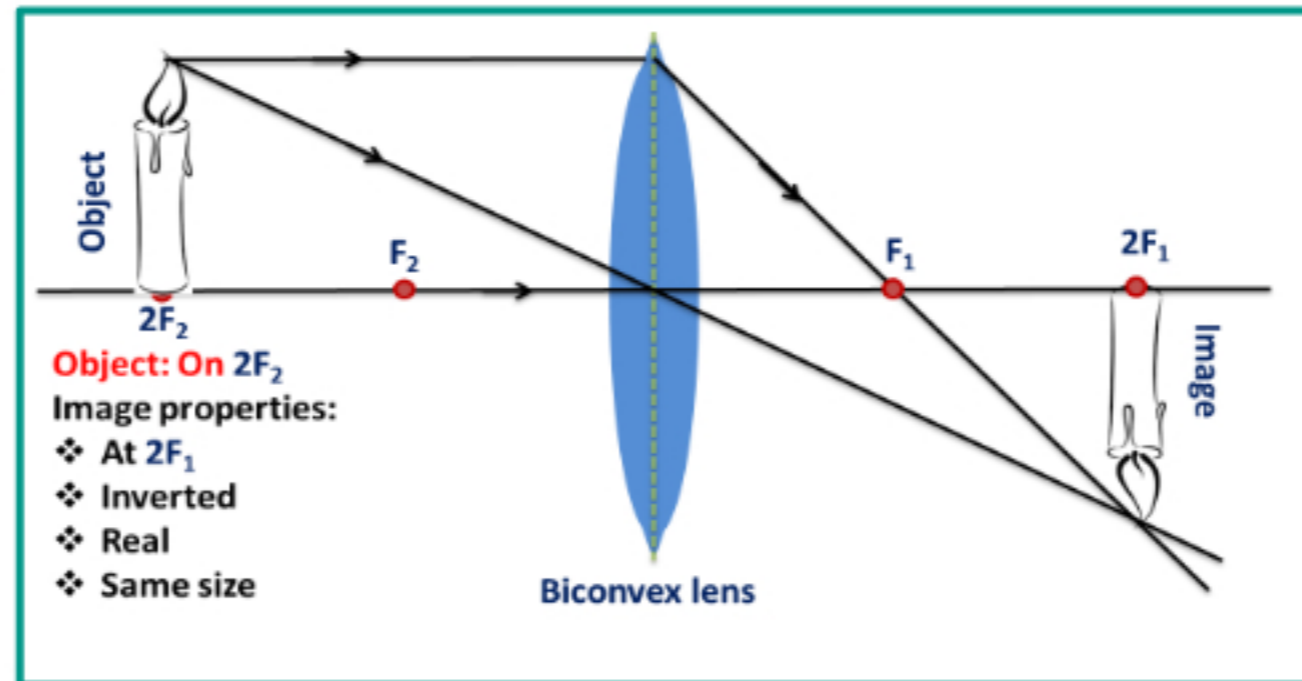
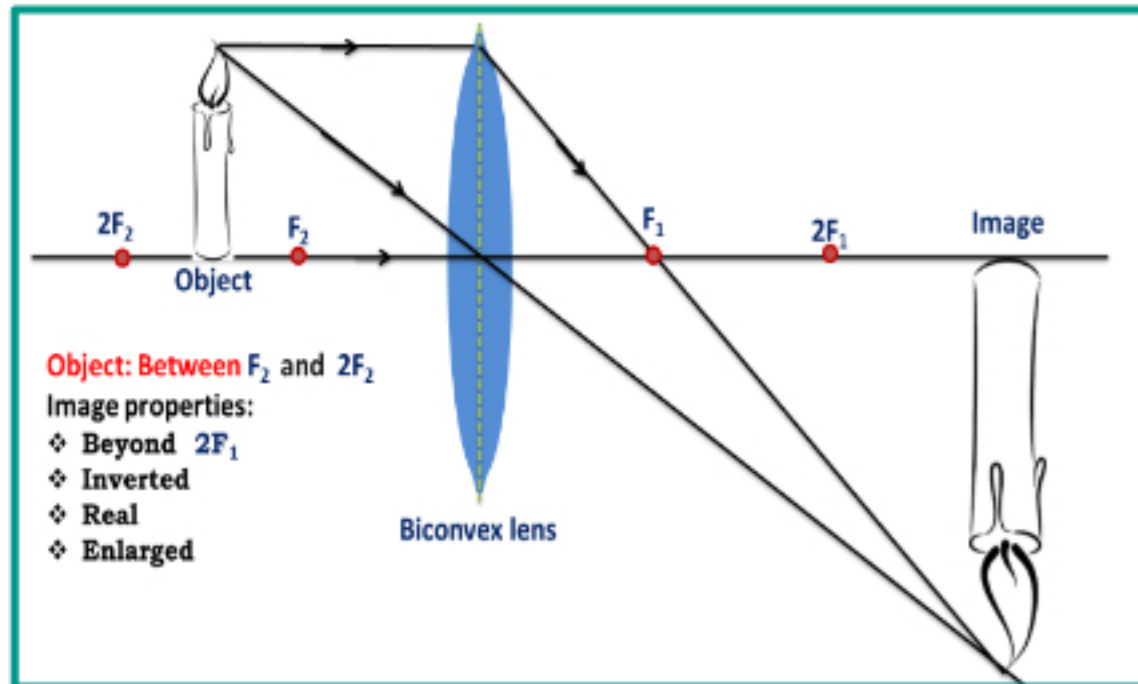
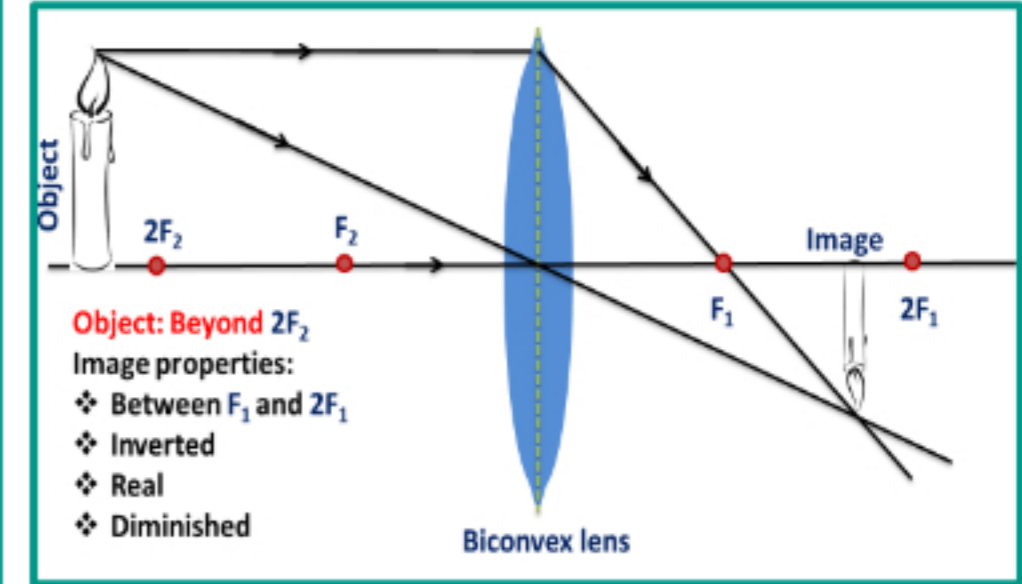
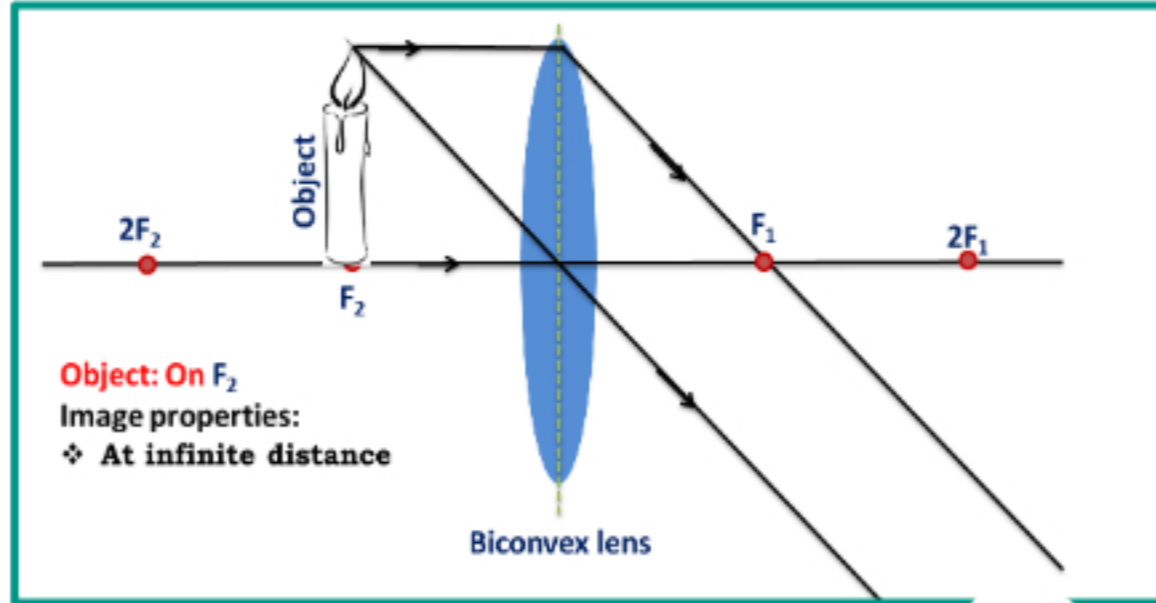
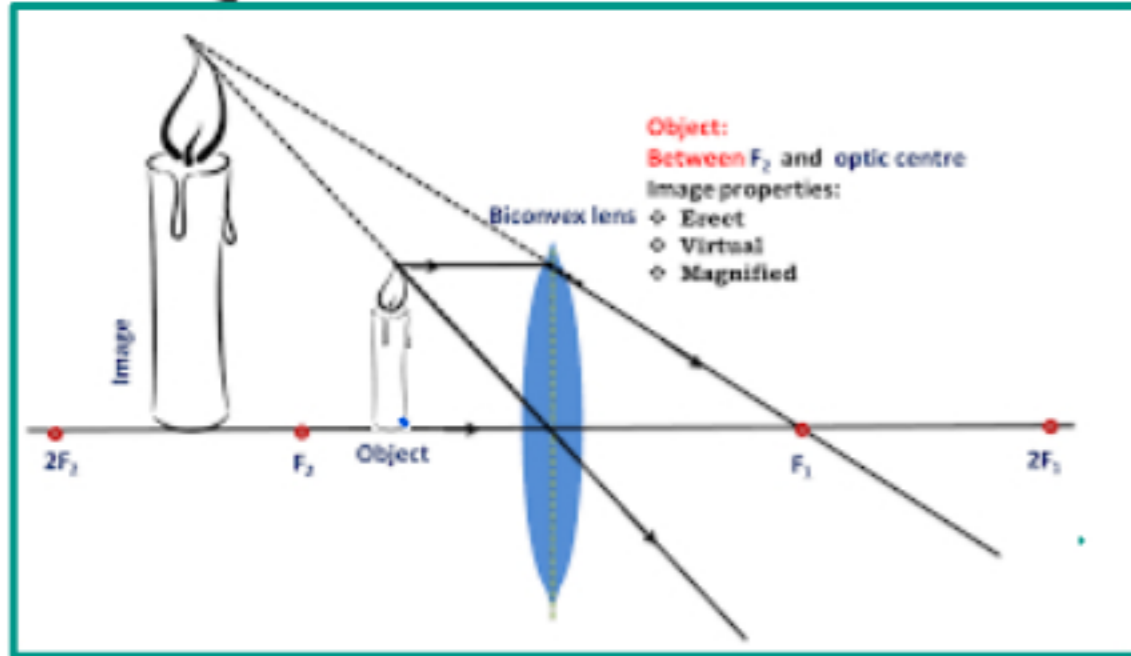


Principle Focus or Focal points where the parallel rays meet or appears to meet.



Images formed is virtual, upright and smaller than the object.

CONVEX LENS



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WAVES

LONGITUDINAL WAVES

WAVE SPEED

TIME PERIOD

TRANSVERSE WAVES

TROUGH

LENS

FOCAL LENGTH

KEY TERMS

CRESTS

FREQUENCY

AMPLITUDE

WAVELENGTH

REFLECTION

REFRACTION

OPAQUE

CONVEX LENS

TRANSLUCENT

ULTRASOUND

EARTHQUAKE

TRANSPARENT

SEISMOLOGY

SEISMIC WAVES

ELECTROMAGNETIC SPECTRUM

FOCUS

CONCAVE LENS



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WAVES

Waves are oscillations or disturbance that transfer energy from one point to another.

KEY TERMS

CRESTS

It is the height of the wave

AMPLITUDE

It is the maximum displacement of the wave from the mean Position.

TRANSVERSE WAVES

In transverse waves, the oscillations move perpendicular to the direction of the wave.

LONGITUDINAL WAVES

In longitudinal waves, the oscillations move parallel to the direction of the wave.

FREQUENCY

It is the number of waves passing each second.
It is measured in Hertz (Hz)

WAVE SPEED

It is the distance travelled by the wave each second.

TROUGH

Trough
It is the depth of the wave.

TIME PERIOD

The time it takes for one wave to travel.

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WAVELENGTH

The distance between two consecutive crests or trough.

REFLECTION

Reflection is the phenomenon of bouncing off the wave when it hits a medium.
eq: Reflection of light wave when it hits a plain Mirror.

REFRACTION

Bending of light as it travels from one medium to another.
Reflection on a smooth surface
Reflection on a rough surface.

OPAQUE

Opaque objects does not allow the light to be transmitted but absorb all the light.

KEY TERMS

TRANSLUCENT

These objects allow some part of the light to be transmitted.

TRANSPARENT

They allow the light to be transmitted through them without any absorption.

ULTRASOUND

It is the frequency of sound greater than 20,000 Hz.

EARTHQUAKE

Earthquake takes place when the rocks or the tectonic plates in the Earth's Crust or the upper Mantle Moves due to forces inside the Earth.

SEISMOLOGY

Seismology is the study of Seismic Waves.



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SEISMIC WAVES

Seismic Waves are the shock waves which originate when the forces inside the earth moves the rocks or the tectonic plates. These waves travel through the Earth and also across its surface.

ELECTROMAGNETIC SPECTRUM

It is the spectrum with all the electromagnetic waves arranged in the order of the increasing wavelength or frequency.

FOCUS

Principle Focus or Focal points where the parallel rays meet or appears to meet

KEY TERMS

LENS

They are used to refract the light and forms the image of an objects. They are used in camera.

CONVEX LENS

1. It is a converging lens

CONCAVE LENS

1. It is a diverging lens.

FOCAL LENGTH

The distance between the focus and the center of the lens.



NEXT STEP !!!

- Check the Specification
- Do Exam Style Questions

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GCSE BIOLOGY

INFECTION AND RESPONSE

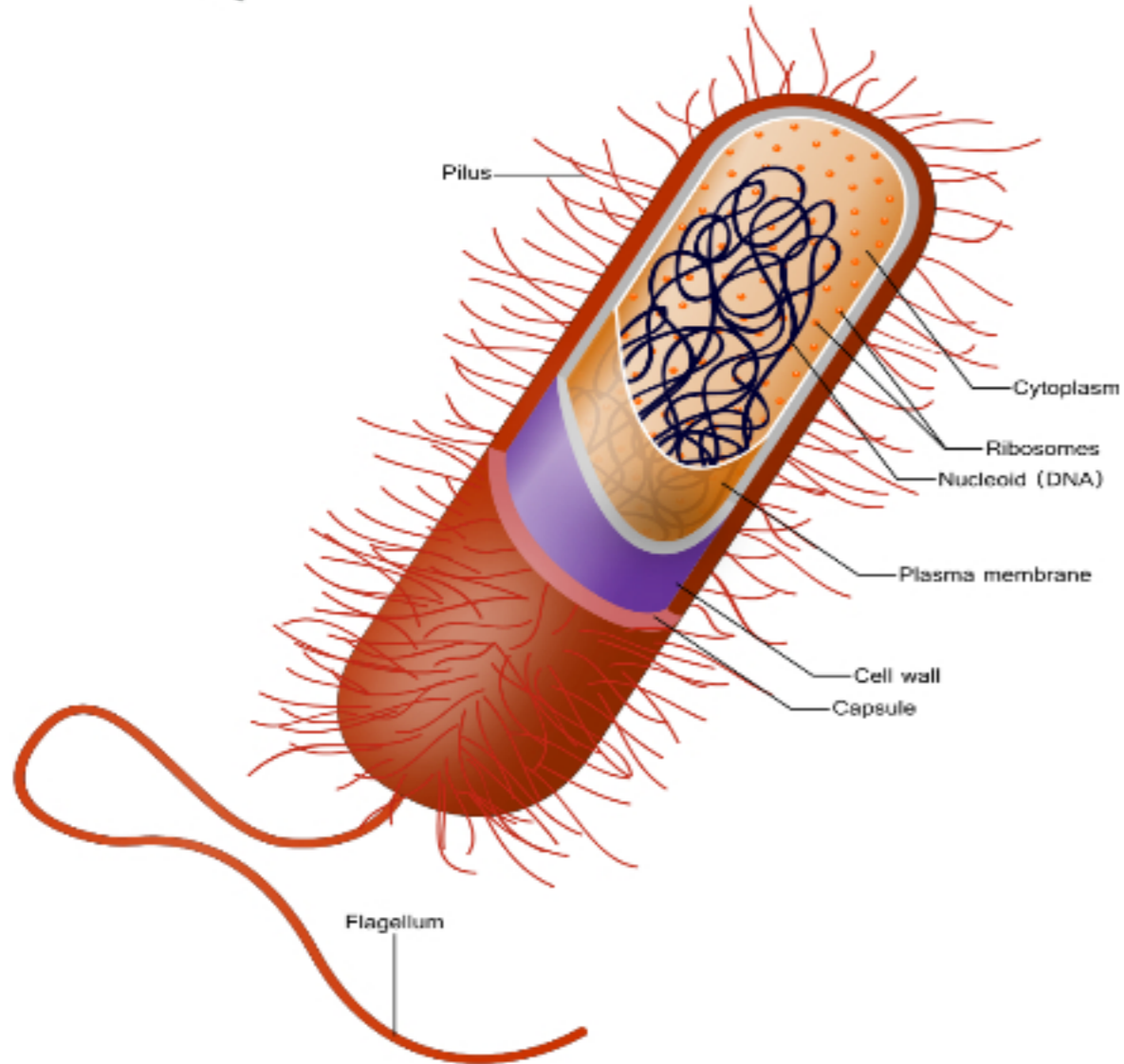


Communicable Disease
Viral Diseases
Bacterial Diseases
Fungal Diseases
Protist Diseases
Human Defense System
Vaccination
Antibiotics and Painkiller
Drug Discovery and Development
Monoclonal Antibodies
Plant Diseases
Plant Defense responses

Disease is a disorder or abnormality in a body that produces sign and symptoms

Health is a state of physical and mental well-being.

TYPES OF DISEASES



COMMUNICABLE DISEASES	NON-COMMUNICABLE DISEASES
It is an infectious disease.	It is non infectious disease
the disease can be transmitted from infected to healthy person	The disease cannot be transmitted from infected to healthy person
It is caused by pathogens.	They have varied cause mainly deficiency of a nutrition or abnormal functioning of cells
eg:- AIDS, Flu, cholera	eg Diabetes, Cancer

These diseases spread and develop quickly so are acute

They develop over a period of time, lasts longer so they are chronic.

HEALTHY DIET



Obesity, Cancer, Diabetes
Malnutrition, Deficiency
diseases like Scurvy are all
linked to diet.



Mental stress is a cause of many
diseases like cancer, diabetes,
heart problems

All these factors are interconnected
and can lead to diseases in interaction

LIVING CONDITIONS



Living conditions like access to
proper health care, clean
food and water, age, gender
and wealth affects health

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Pathogens are the microorganisms that cause a communicable disease.
eq: Bacteria, Virus, Protists, Fungi etc

Pathogens can be transferred from infected to healthy person, from one species to another or from contaminated air, water and food to a healthy person

BACTERIA

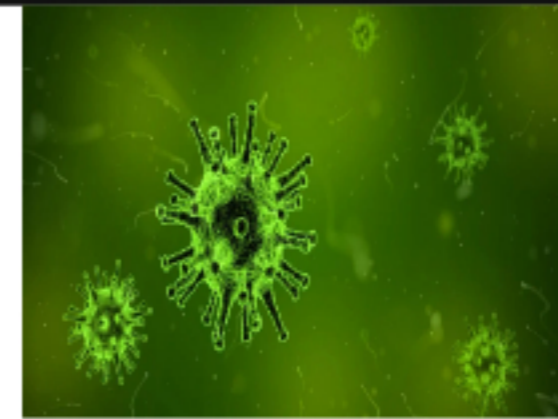


Food poisoning
Gonorrhoea

Microscopic
Unicellular
Prokaryotes
Found everywhere from air, water, sea,
human intestine
Good bacteria helps in digestion, making curd
and decomposition.
Bad bacterias multiply rapidly and release toxins
which causes diseases.

VIRUS

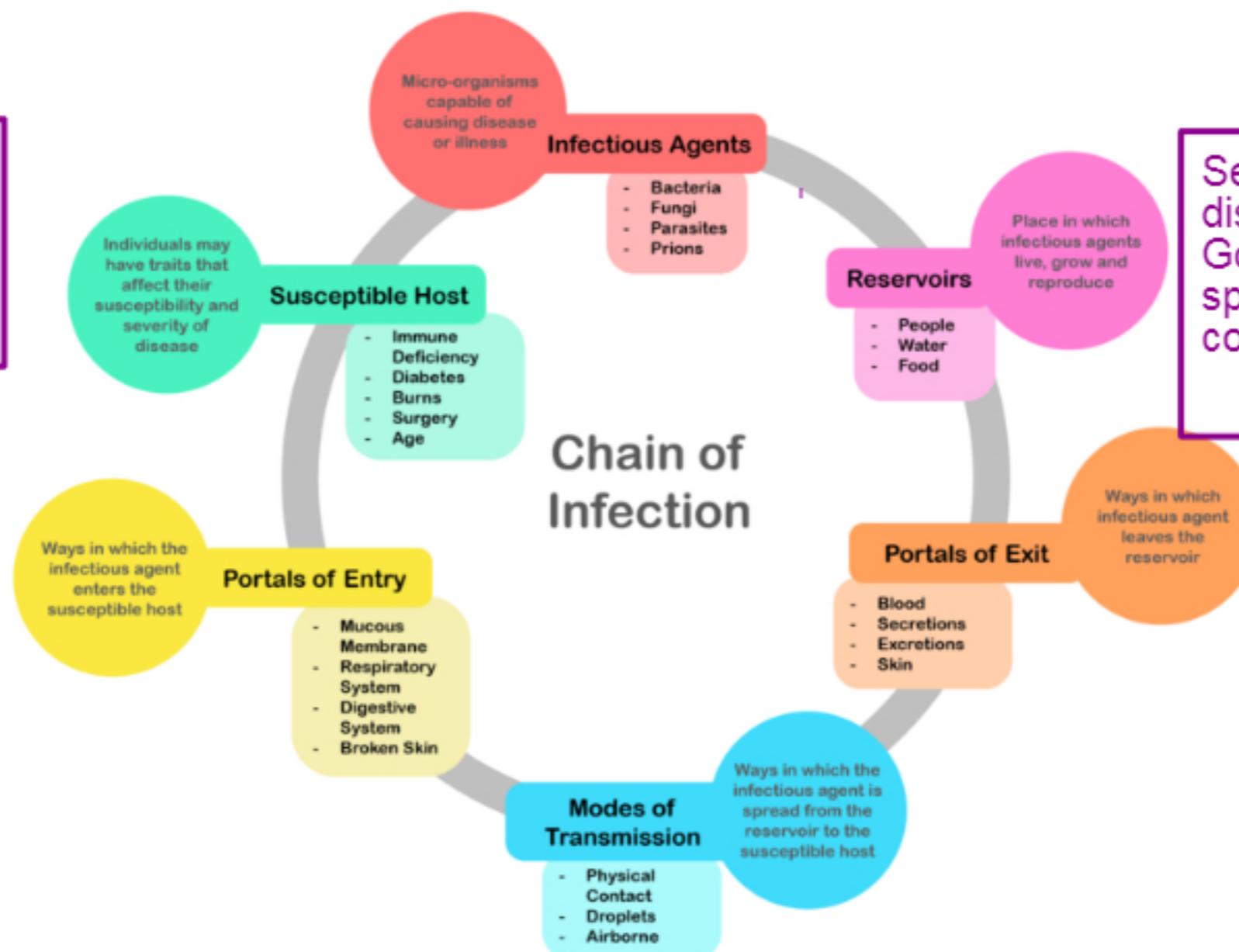
AIDS
Measles



Viruses are an exception as they are non living
outside the living organisms
Once they enter the living organism they become
living, takes over the host machinery and use the
cell resources to make copy of themselves and
damage and destroy the cells.



SPREAD OF PATHOGENS



Lifestyle and living conditions can also affect the spread of the disease

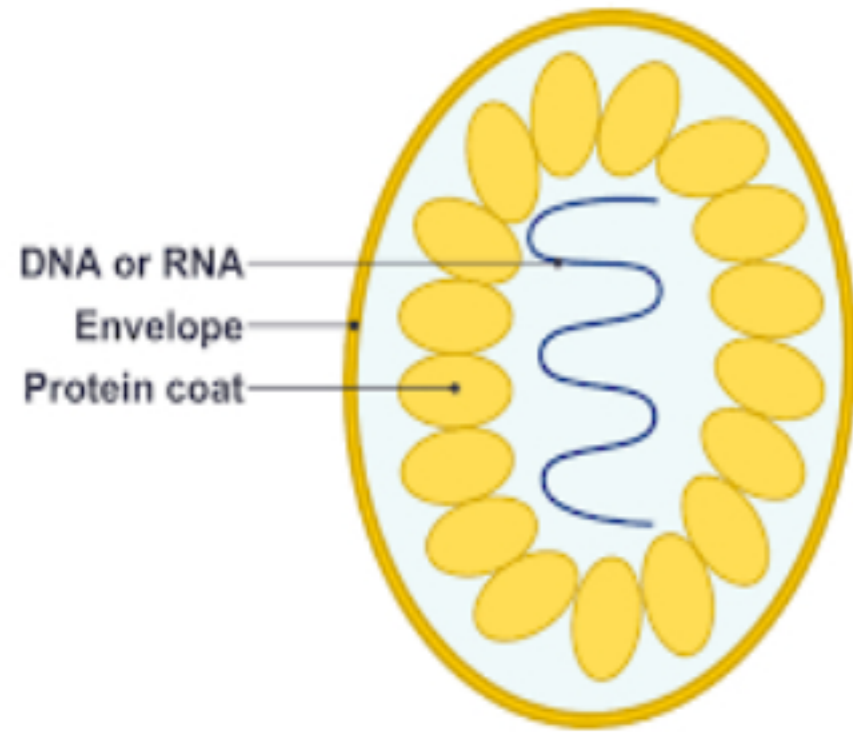
Sexually transmitted diseases like AIDS, Gonorrhoea are spread through direct contact.

Cholera, Diarrhoea, food poisoning are caused by contaminated food or water.

Corona Virus, Flu, Tuberculosis, Common Cold are spread through air droplets.

VIRAL DISEASES

VIRUS



Animal Viral Diseases:
Measles and AIDS

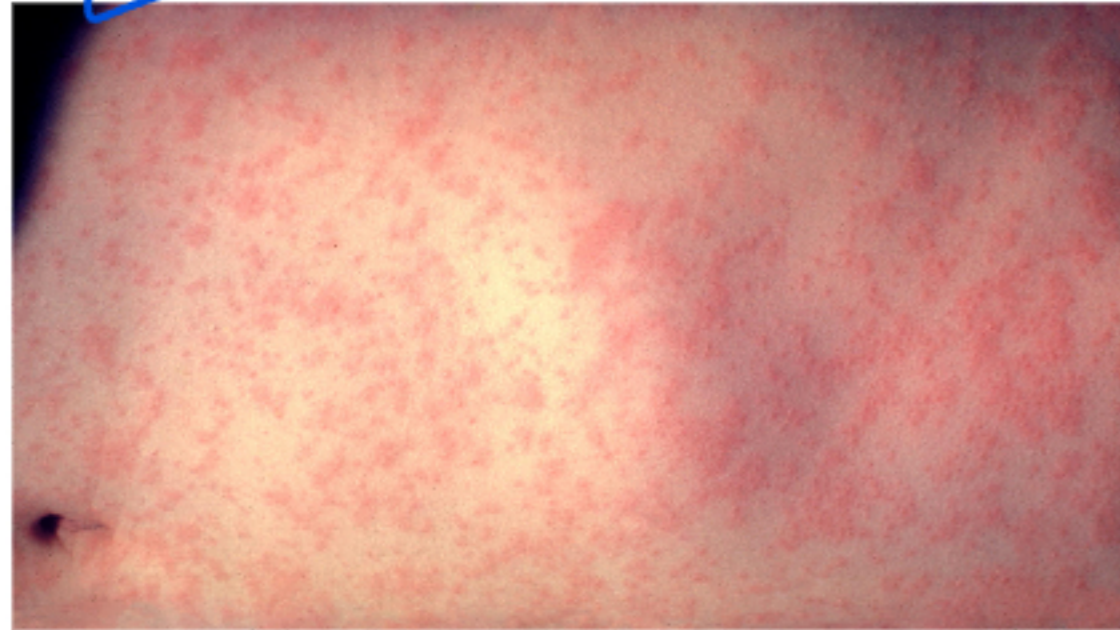
Plant Viral Diseases:
Tobacco Mosaic Virus

- Virus are the pathogens and cause infectious diseases.
- They are at borderline of living and non living.
- They do not have a regular cellular structure.
- They have a genetic material enclosed in a protein coat.
- They take-over the whole cell machinery and make more copies of themselves and damage the host cells.

No anti-biotics work on them and the only management for viral diseases is isolation, vaccination and some anti-viral and anti-retroviral drugs.

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MEASLES



- Infectious diseases
- Causes skin rash and high fever
- It is an air borne disease and caused by inhalation of droplets with the pathogens.
- No cure available. Diseased person is isolated.
- Vaccination provides immunity against the diseases

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HIV/AIDS



- Acquired Immuno Deficiency Syndrome caused by Human Immuno Virus.
- This disease target the immune system and destroy immune cells so person die with a simple flu like disease.
- The disease spread by sexual contact, blood transfusion or sharing needles.
The disease can be prevented by using condoms or fresh needles
- The disease is managed by taking antiretroviral drug.



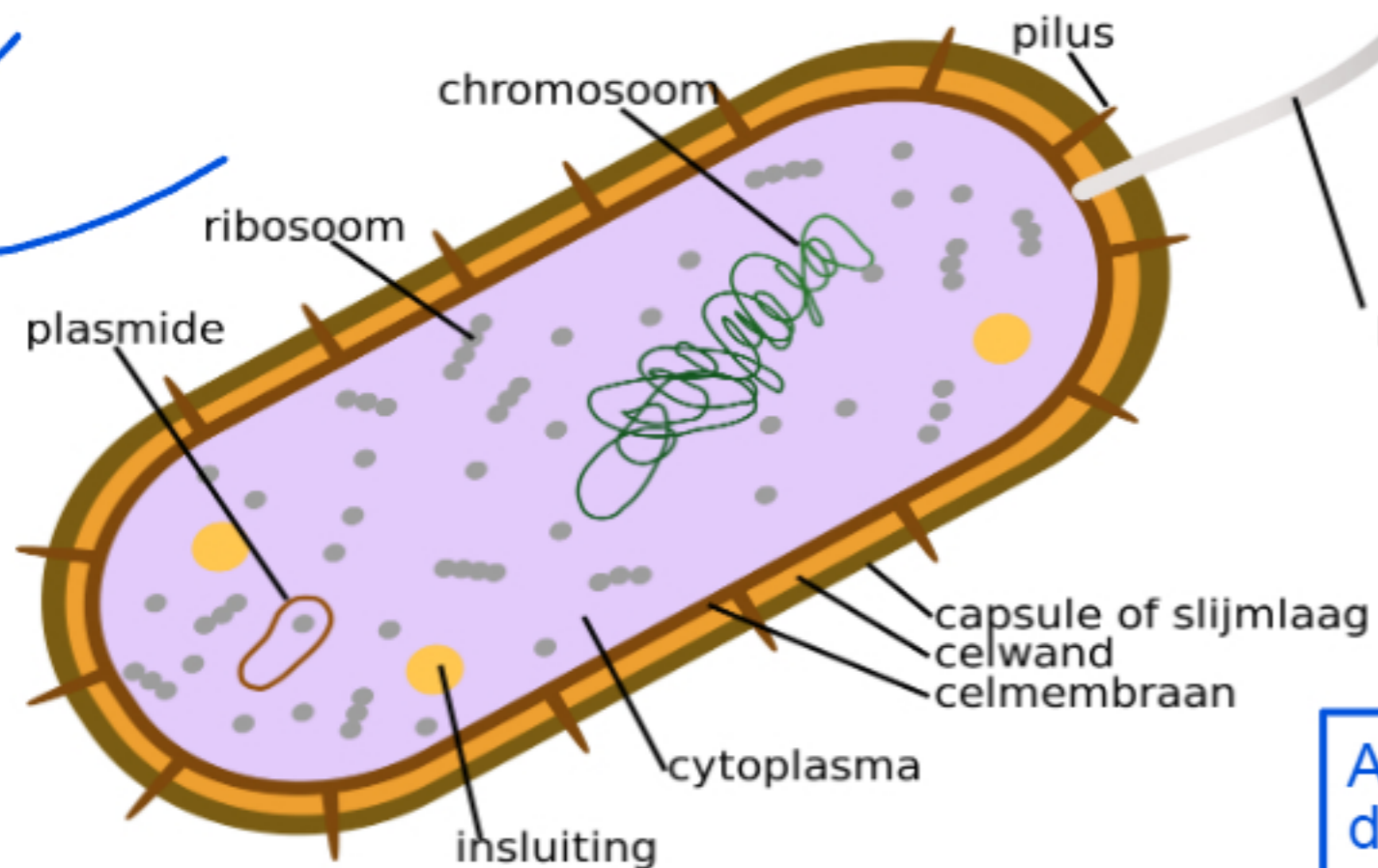
- Is spread by the contact between a diseased crop with healthy crop or transmitted by insects or vectors.
- The virus damages the cells, causes discolouration of the leaves, reduces the yield and growth of the crop.
- No cure and treatment available.
- Good pest control and good agriculture practice and growing resistant crops helps managing this diseases.

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BACTERIAL DISEASES



Microscopic
 Unicellular
 Prokaryotes
 Found everywhere from air, water, sea,
 human intestine
 Good bacteria helps in digestion, making curd
 and decomposition.
 Bad bacterias multiply rapidly and release
 toxins
 which causes diseases.

Antibiotics and Vaccinations helps to treat bacterial
 diseases but antibiotic resistance is a bigger
 challenge for treating bacterial diseases.

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FOOD POISONING



- Salmonella or Campylobacter is the cause of food poisoning which is present in the gut of other animals.
- It is transferred from uncooked meat or eggs and disturbs the natural bacterial population in human's intestine causing food poisoning.
- Symptoms include vomiting, stomach ache, abdominal cramps, diarrhoea and fever which are produced by toxins secreted by Salmonella
- Management of the disease include vaccinated the chicken for Salmonella, properly cooking chicken and meat and separate handling of the raw chicken.

BACTERIAL DISEASES IN ANIMALS

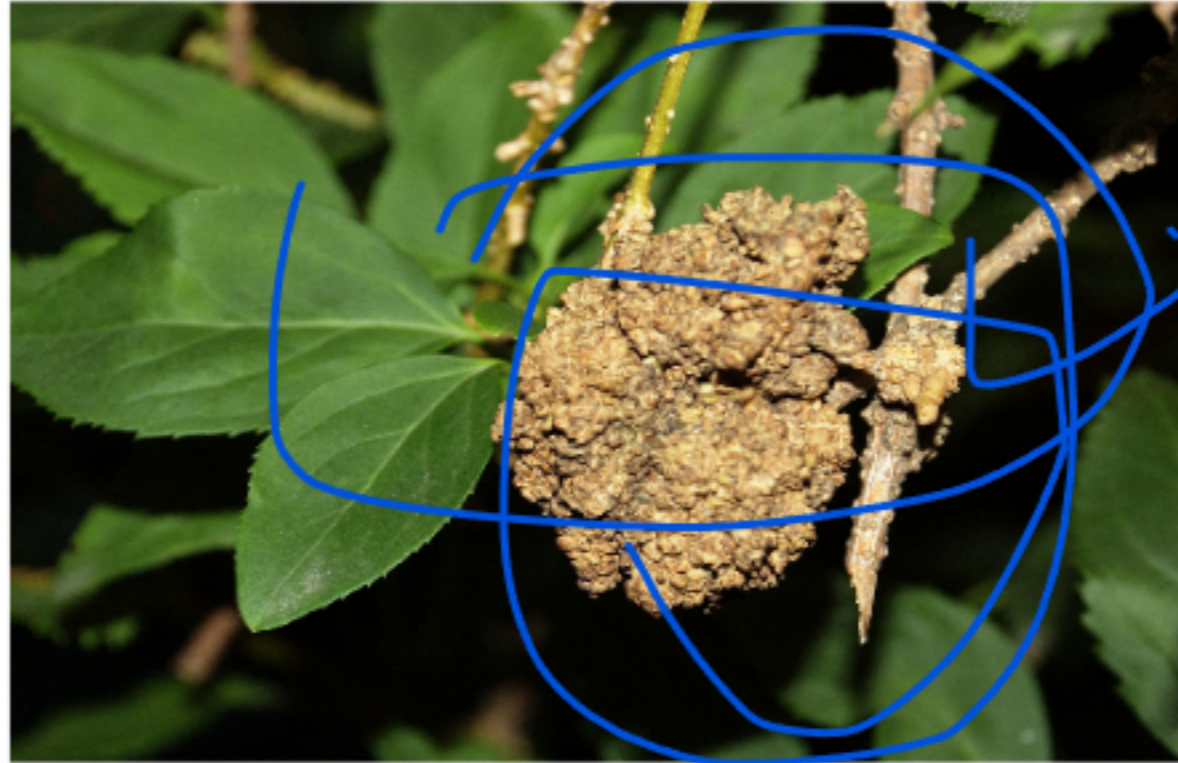
GONORRHOEA



- It is a sexually transmitted diseases
- It is caused by unprotected sex.
- Symptoms include discharge from vagina or penis, pelvic pain. Long term effect includes ectopic pregnancies and infertility.

It is treated with antibiotics.

Contraception and limiting the number of sexual partners prevent the spread of the disease.



- Crown Gall Disease Caused by Agrobacterium tumefaciens.
- The bacteria insert the plasmids into the plant cell and create genetically modified mass of undifferentiated cells known as gall which develops at the junction of root and shoot.
- This bacteria is used in genetic engineering to create genetically modified cells as scientist use them to insert the gene of their interest into the host.

FUNGAL DISEASES



In Animals: It causes Athlete's foot Disease

In Plants: Rose Black Spot

Damaged heart Valves can develop Fungal Diseases.

Some fungal diseases in humans can affect the brain and the lungs.

The diseases are treated by anti-fungal drugs. ✓

ROSE BLACK SPOT DISEASE

- The disease is spread by the wind carrying the spores of fungus. ✓
- Once the spores land on the plant they are spread to other parts and to other plants by wind and rain.
- The disease causes purple black spots on the rose leaves, discoloration of the leaves. The leaves are unable to photosynthesis and the plant do not grow and flower.
- The disease is treated by spraying fungicides. In winters the spores stay dormant on the stems so farmers can remove them to prevent the spread of the diseases.
Growing Fungus resistant crops can prevent the disease from developing.



PROTIST DISEASES

Protist are single-celled eukaryotic cells.

They require a vector to spread like mosquito for Malaria.

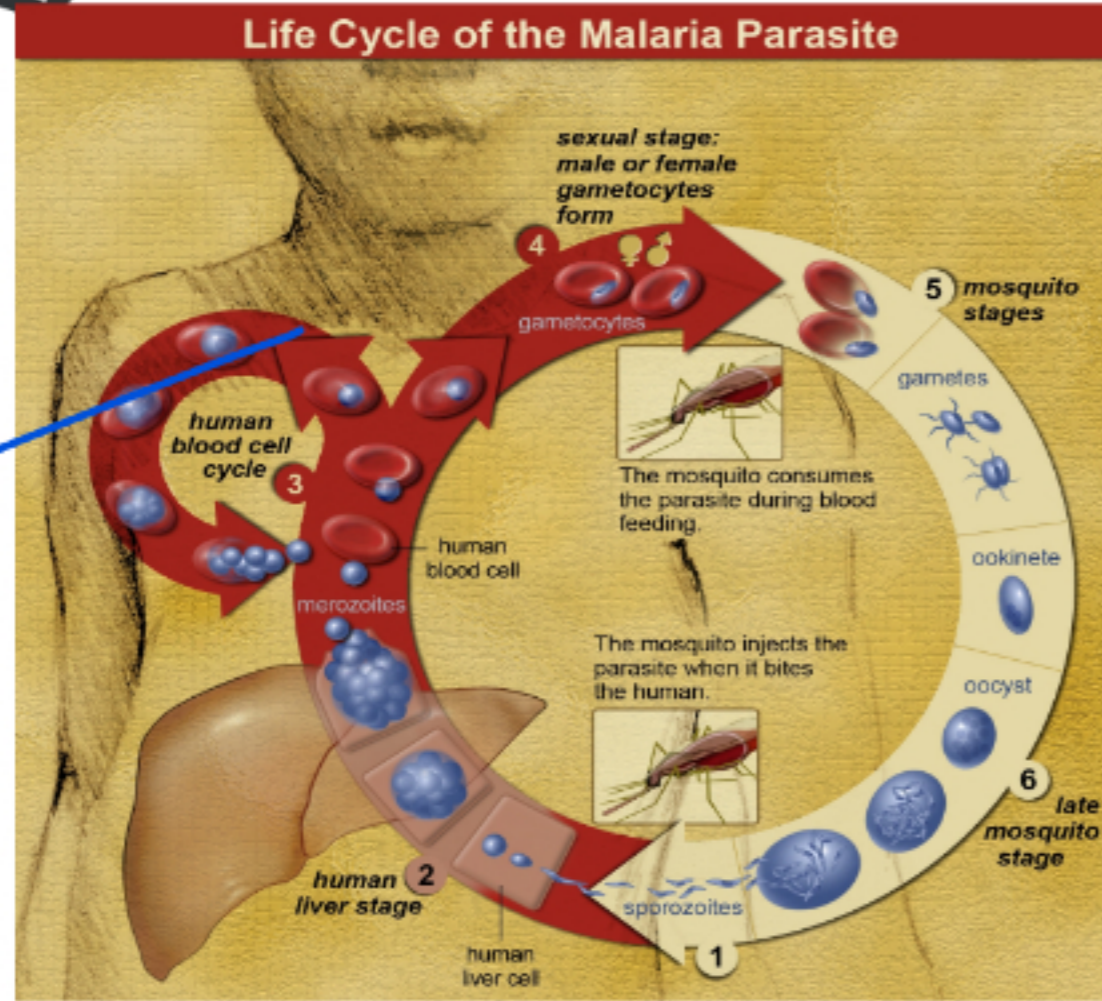
MALARIA

It is caused by the plasmodium but the vector is Female Anopheles Mosquito.

The protist reproduce sexually in mosquito and asexually in humans.

The mosquito first injects the protist into the healthy person which goes into the liver and produce many cells which then goes into the red blood cells and makes gametocytes.

The mosquito then consumes the blood with gametocytes and the gametocytes then causes sexual reproduction in the mosquito making more copies of protist sporozites and the cycle repeats.



Symptoms include fever and shaking specially when gametocytes are released from the blood cells.

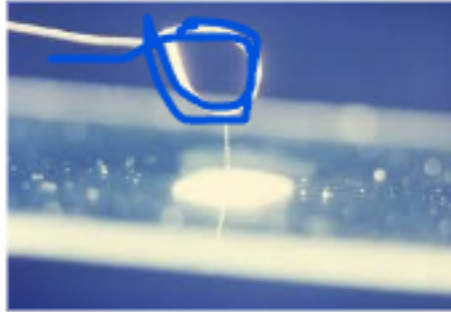
The disease is cured by anti-malarial drugs. Preventing the breeding and spread of mosquitos using insecticide and mosquito nets helps to control the disease.

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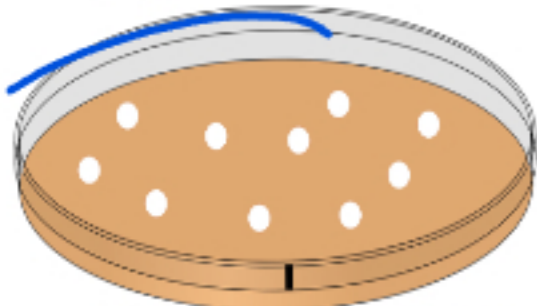
BACTERIAL CULTURE



Burner to sterilize the loop, petri dish

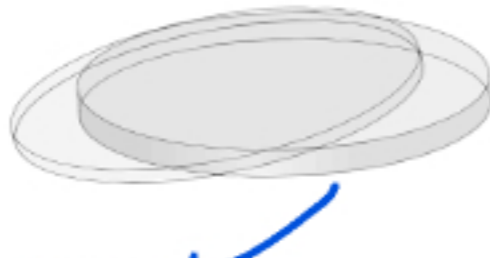


Inoculating loop to streak or dot the bacteria.



Petri Dish with Agar Medium

Agar medium is the culture medium that contains carbohydrates for energy, nitrogen for proteins and other minerals which help bacteria to grow.



Step 1: Sterilize

Step 2: Inoculate

Step 3: Incubation

Sterilization is done by heating the petri dish, agar medium and loop on the bunsen burner to kill any contamination.

The dishes are incubated upside down to prevent condensation. The dishes are incubated at 25 degrees to prevent overgrowth of bacteria and growth of pathogens.

After sterilization, the loop is dipped into the bacterial culture and the colony is streaked on the plate.

The petri dishes are then taped to prevent the contamination for incubation. They are not sealed as sealing will stop the oxygen.



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Calculating number of bacteria

a) Calculate (n) the number of time the bacteria will divide in a given time by dividing the time with doubling time.

b) Number of bacteria in that time will be calculated by

$$2^n$$

BACTERIAL CULTURE CALCULATIONS

Q1 If bacteria divide every 20 minutes, calculate the number of bacteria after 5 hours ?

Given time = 5 hours = $5 \times 60 = 300$ minutes

$$\text{Number of Divisions (n)} = \frac{300}{20} = 15 \text{ div}$$

$$\text{Number of bacteria} = 2^{15} = 32768 \text{ bacteria}$$



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PREVENTING BACTERIAL GROWTH

Antibiotic



Can be natural or synthetic drug
It is used to kill, inhibit or prevent the growth of bacteria in a living host. eg Penicillin

Antiseptic



It is a chemical which kills or inhibit the growth of microbes and is applied externally on living tissue like skin.
eg; Savlon

Disinfectant



It is used to kill, inhibit or prevent the growth of bacteria on non living surfaces.
eg Sanitizer

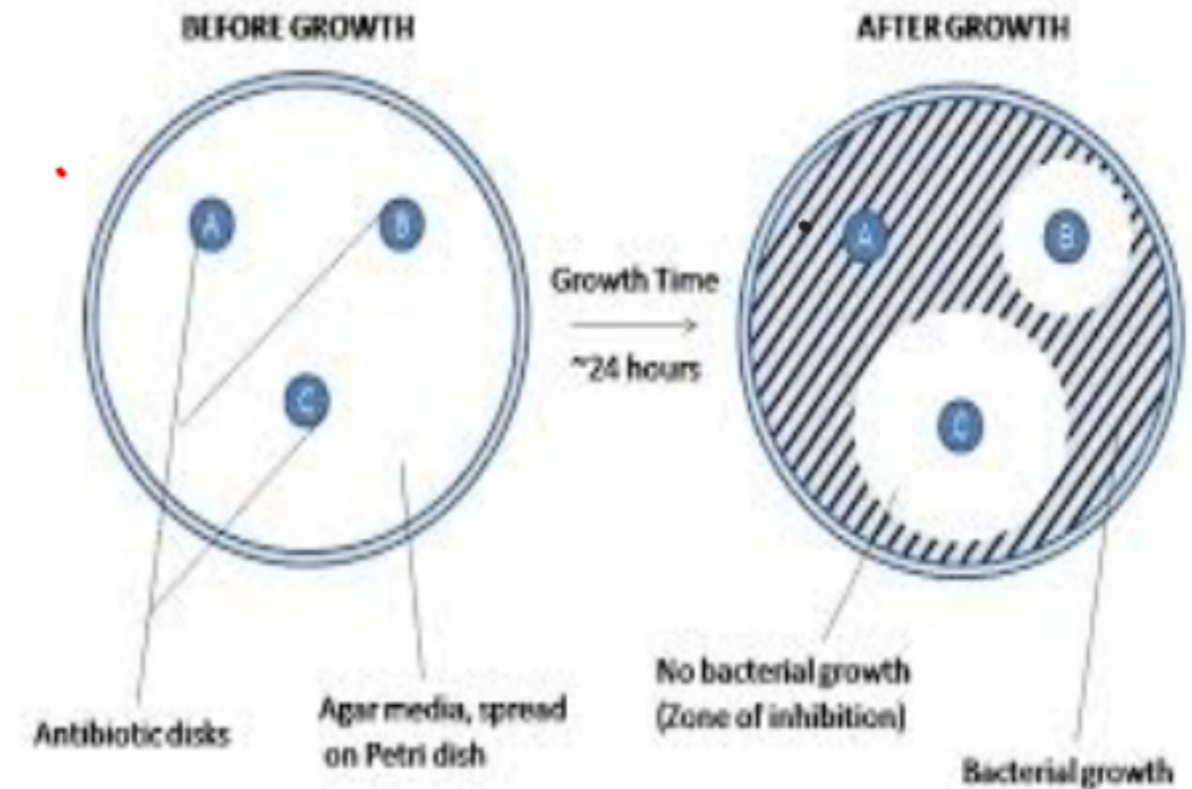
Antiseptics and Disinfectant can only be used externally.
To kill the infections internally antibiotic is used.

eg: Penicillin,

Antibiotics kills the bacteria without harming the host cells.

Most of the antibodies target the bacterial cell wall and kills the bacteria making the person feel better.

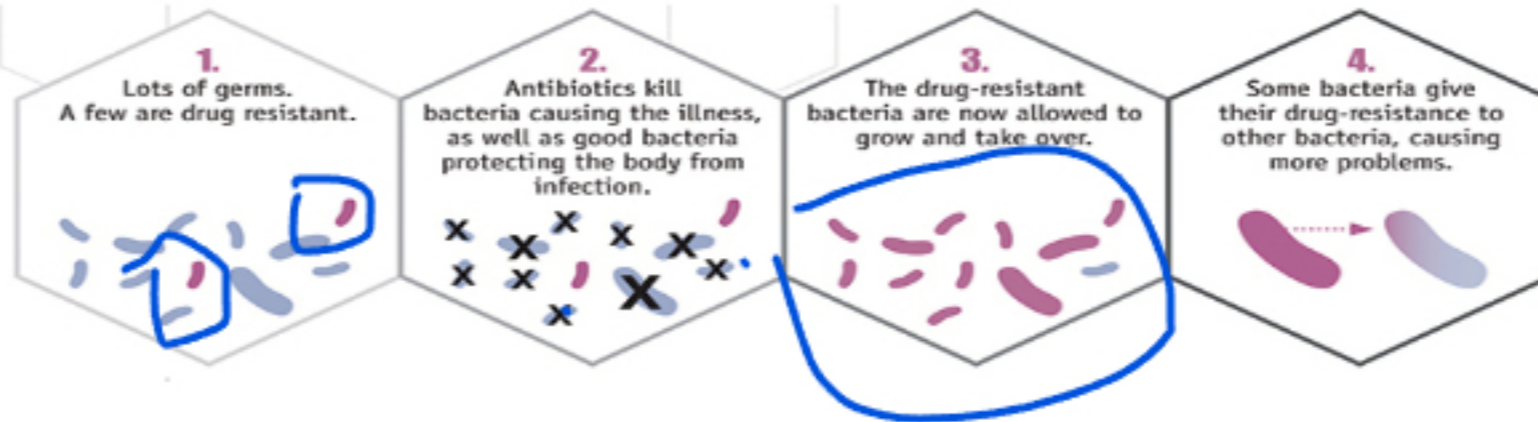
Painkillers and analgesics like paracetamol and aspirin cure the symptoms like pain and fever but does not kills the disease. To kill the disease we need an antibiotic.



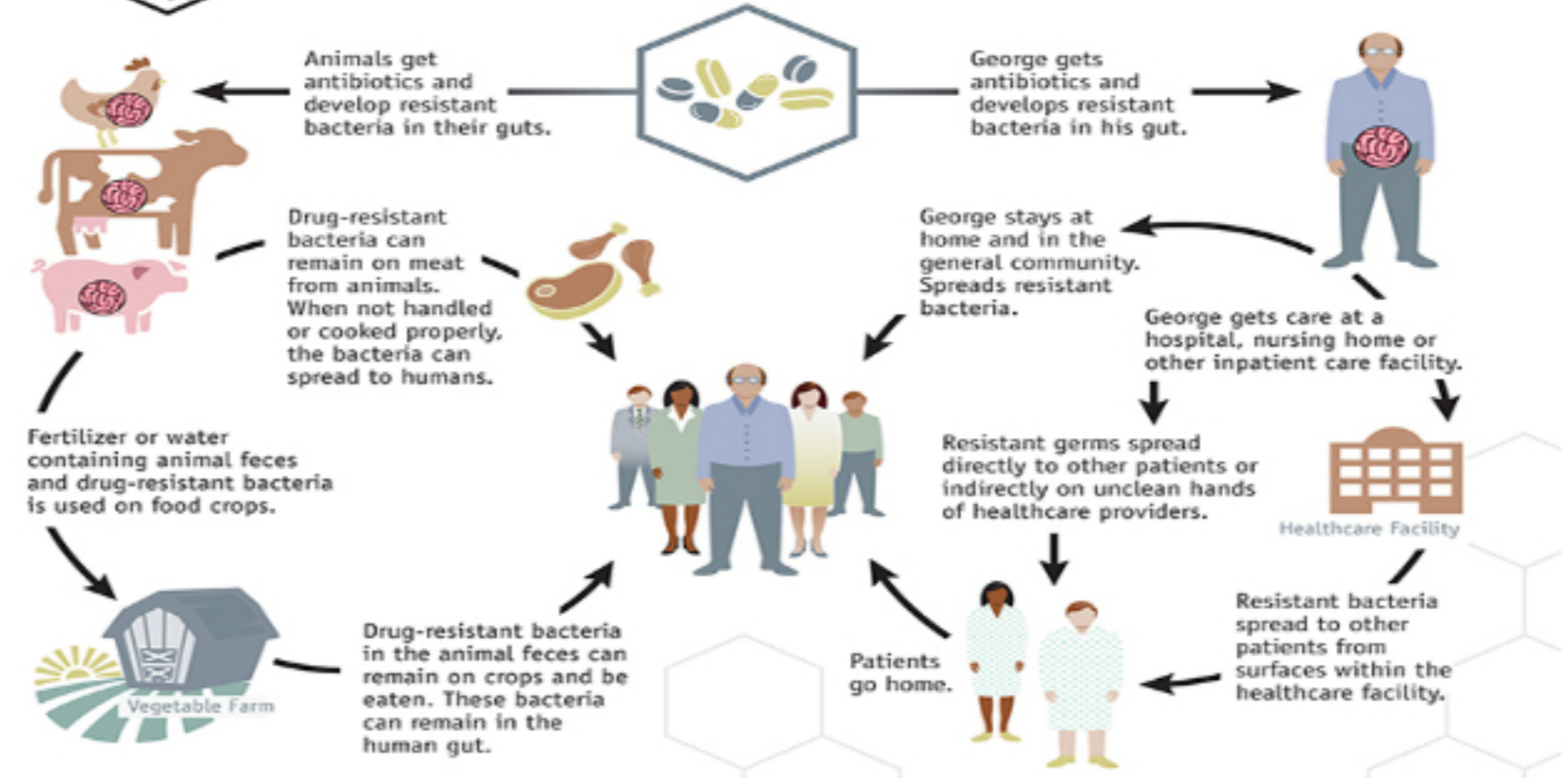
PROBLEMS WITH ANTIBIOTICS

- a) Antibiotic Resistance
- b) Antibiotics do not work against Viruses.

How Antibiotic Resistance Happens



Examples of How Antibiotic Resistance Spreads

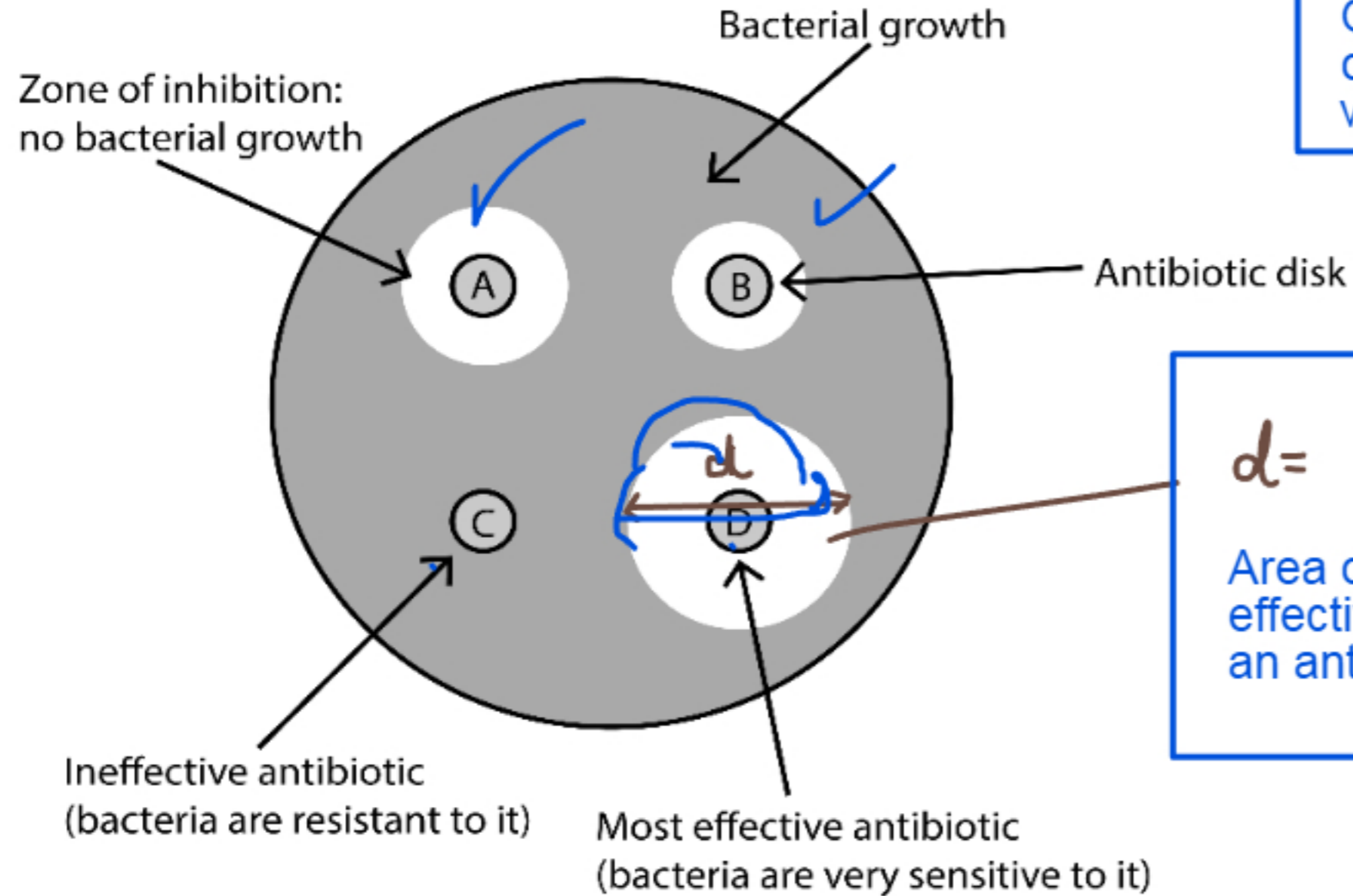


Simply using antibiotics creates resistance. These drugs should only be used to treat infections.



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EFFECT OF ANTIBIOTICS ON BACTERIA



Greater the area of inhibition of an antibiotic, more effective will be the antibiotic.

$d = \text{diameter of disc}$

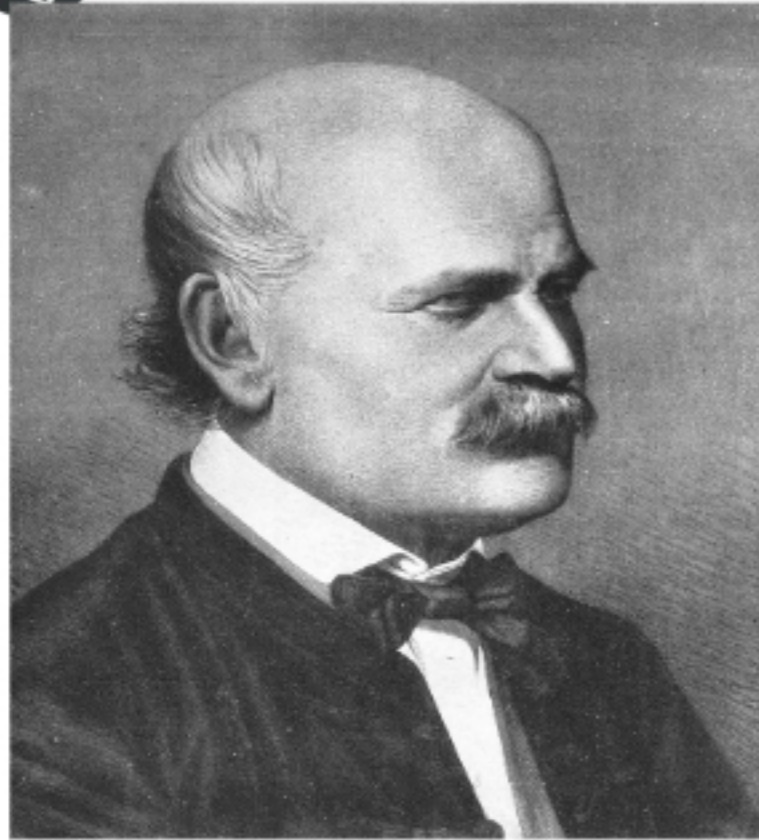
Area of effectiveness of an antibiotic = $\frac{\pi d^2}{4}$

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HISTORY OF MICROBIOLOGY



IGNAZ SEMMELWEIS - mid 1850

He was a doctor and he found that diseases are caused by some kind of infectious agent.

He found that women died during that time with a fever after giving birth.

He found that medical students were not washing hands before assisting in delivery and when they started washing hand the death rate of women decreased.

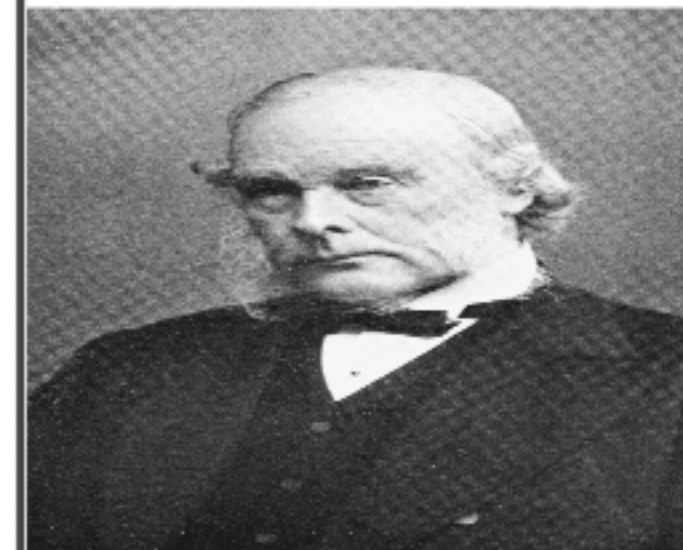
Louis Pasteur- Mid 19th Century



He showed that infectious agents are microorganisms.

He developed vaccines for anthrax.

Joseph Lister



Started using antiseptics in the operation theatre to kill the micro-organisms

a) Quarantine or Isolation

b) Prevent the growth and spread of vectors like Mosquitos

c) Vaccination

d) Sanitization and disinfection

e) Cooking the meat thoroughly and keeping raw and cooked meat separately

f) Propert Hygeine and Sanitation.

COVID 19
CORONAVIRUS DISEASE

STOP THE SPREAD OF GERMS

Help prevent the spread of respiratory diseases like COVID-19.

Avoid close contact with people who are sick.



Cover your cough or sneeze with a tissue, then throw the tissue in the trash.



Clean and disinfect frequently touched objects and surfaces.



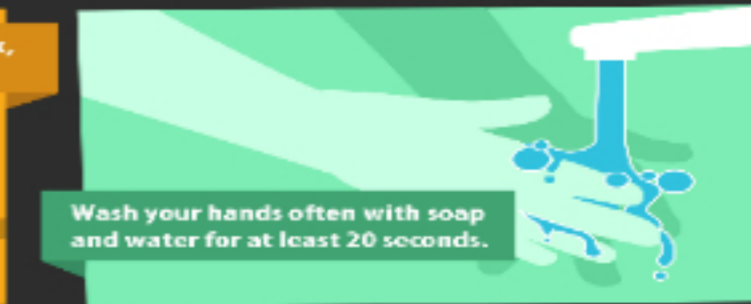
Avoid touching your eyes, nose, and mouth.



Stay home when you are sick, except to get medical care.



Wash your hands often with soap and water for at least 20 seconds.



For more information: www.cdc.gov/COVID19

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HUMAN DEFENSE SYSTEM

NON SPECIFIC IMMUNE RESPONSE
INNATE IMMUNITY

SPECIFIC IMMUNE RESPONSE
ADAPTIVE IMMUNITY

FIRST LINE OF DEFENSE

SECOND LINE OF DEFENSE

THIRD LINE OF DEFENSE

- ✓ Skin
- ✓ Secretions of the Skin
- ✓ Mucous in the Respiratory tract
- ✓ Hair and Mucous in the Nose
- ✓ Stomach Acids

✓ Phagocytosis

Anitobodies

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FIRST LINE OF DEFENSE

SKIN

- a) Skin is a physical barrier, water proof prevent the entry of microbes
- b) Skin produce sweat and other anti bacterial secretions
- c) Any cut or wound lead the platelets to clot the blood quickly to prevent the entry of microorganisms.

Hair and mucus in the nose

Hair and the mucus trap any infections coming with breathing preventing the entry of microbes in the body.

Cilia

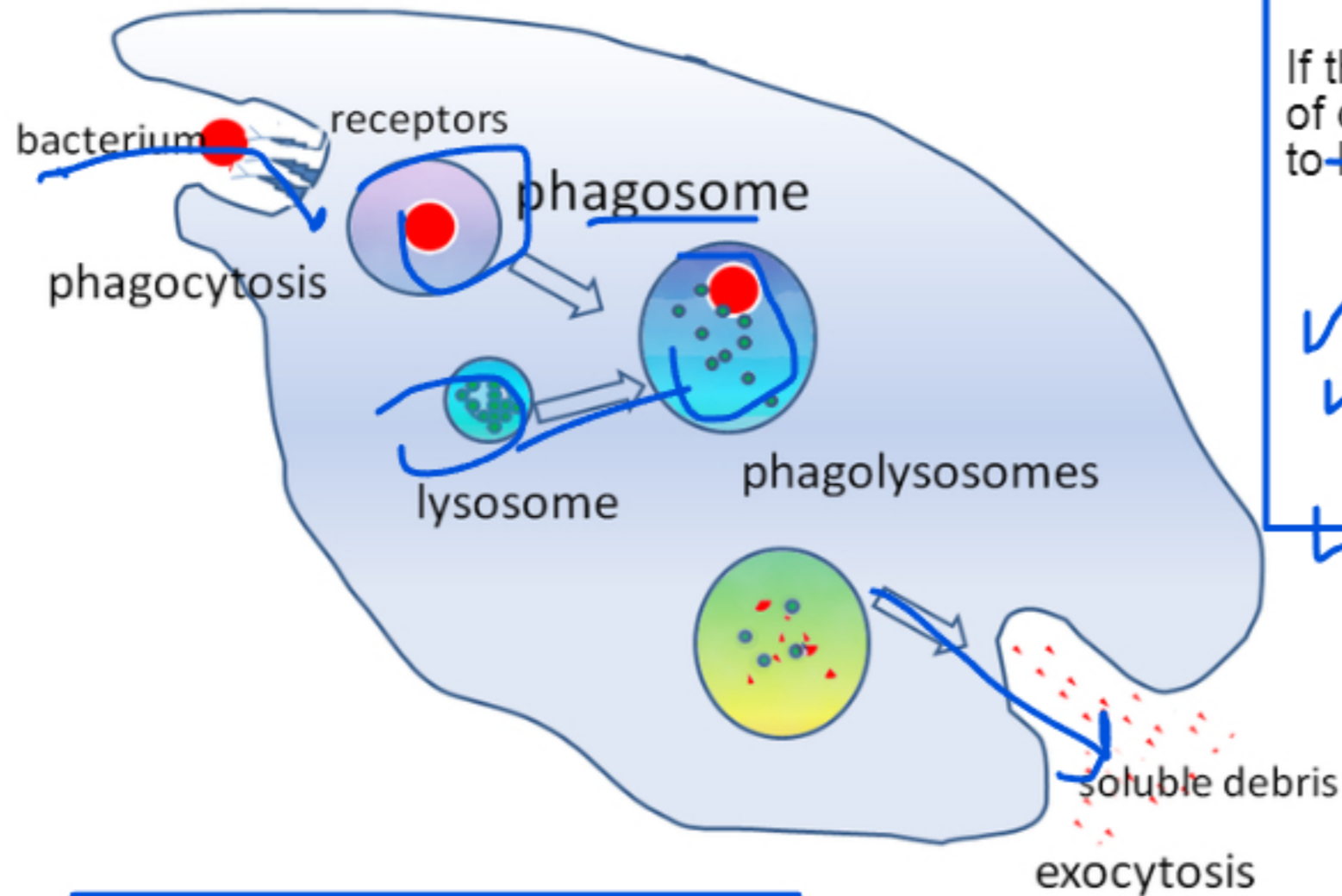
Cilia lines the trachea and the bronchus which are tiny hair like structures which beat the mucus to the throat where it is swallowed and reaches the stomach and is digested by the stomach acids.

Stomach Acids

Any infection entering with the food is killed with the hydrochloric acid produced by the stomach.



PHAGOCYTOSIS



White blood cells are the second line of defense.

If the infection still exist and is not killed by the first line of defense then the white blood cells do the following to ~~kill it~~ :-

- ✓ a) Phagocytosis
- ✓ b) Produce Antibodies
- ✓ c) Product Antitoxins

Antigens are the specific proteins on the surface of micro-organisms against which the white blood cells create specific antibodies.

White blood cells are the soldiers of the body

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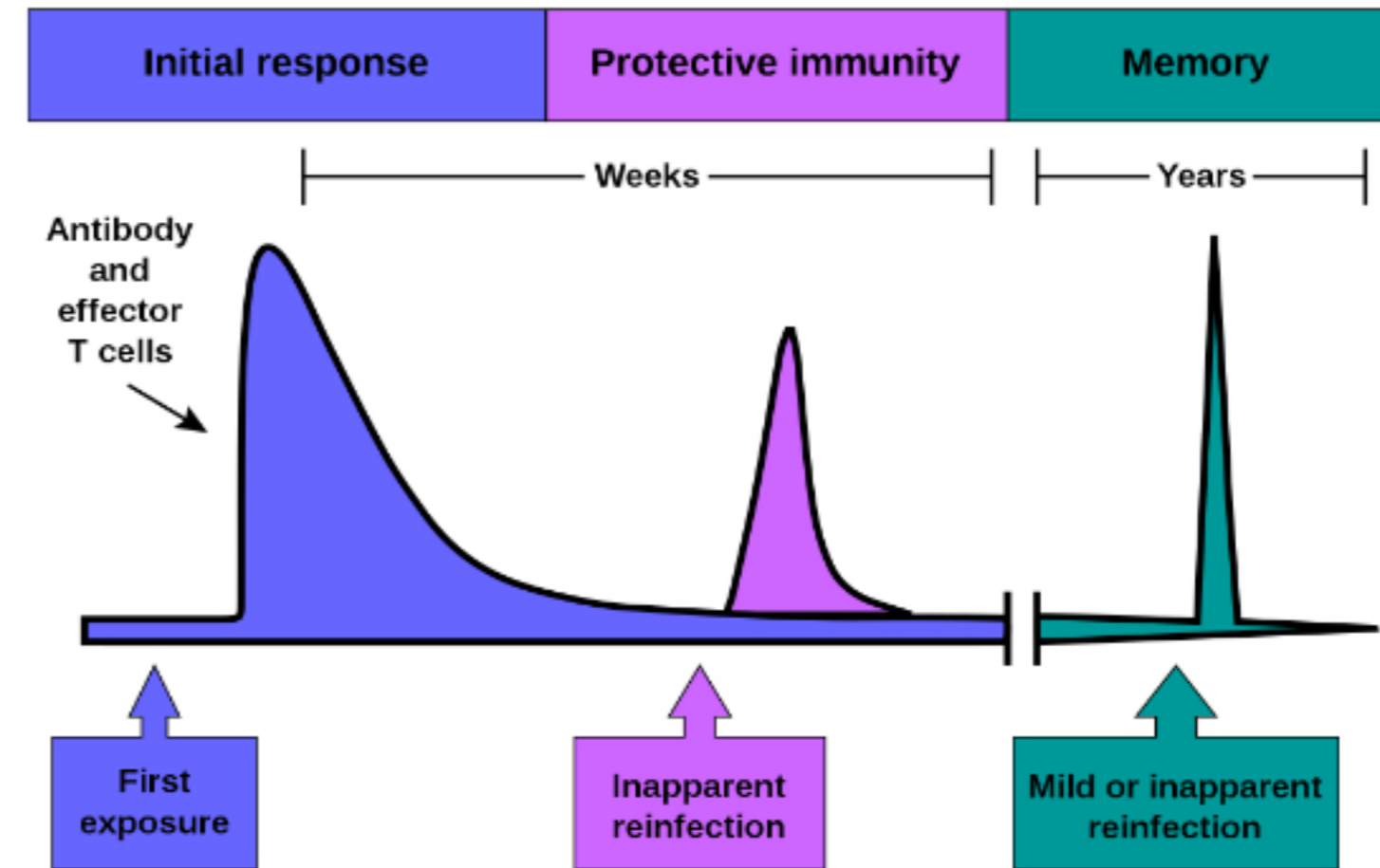
Vaccine is a dead or a weakened form of a disease which stimulate the body to make the antibodies against them without making you seriously ill.



The memory cells of the white blood cells remember the antibodies produced and when the actual disease is encountered the immune system responds rapidly killing the infection without even developing symptoms in some cases.

Vaccines are available for

Bacterial Diseases: Tetanus and Diphtheria
Viral Diseases: Measles and Mumps
Small pox is completely wiped with the use of vaccines

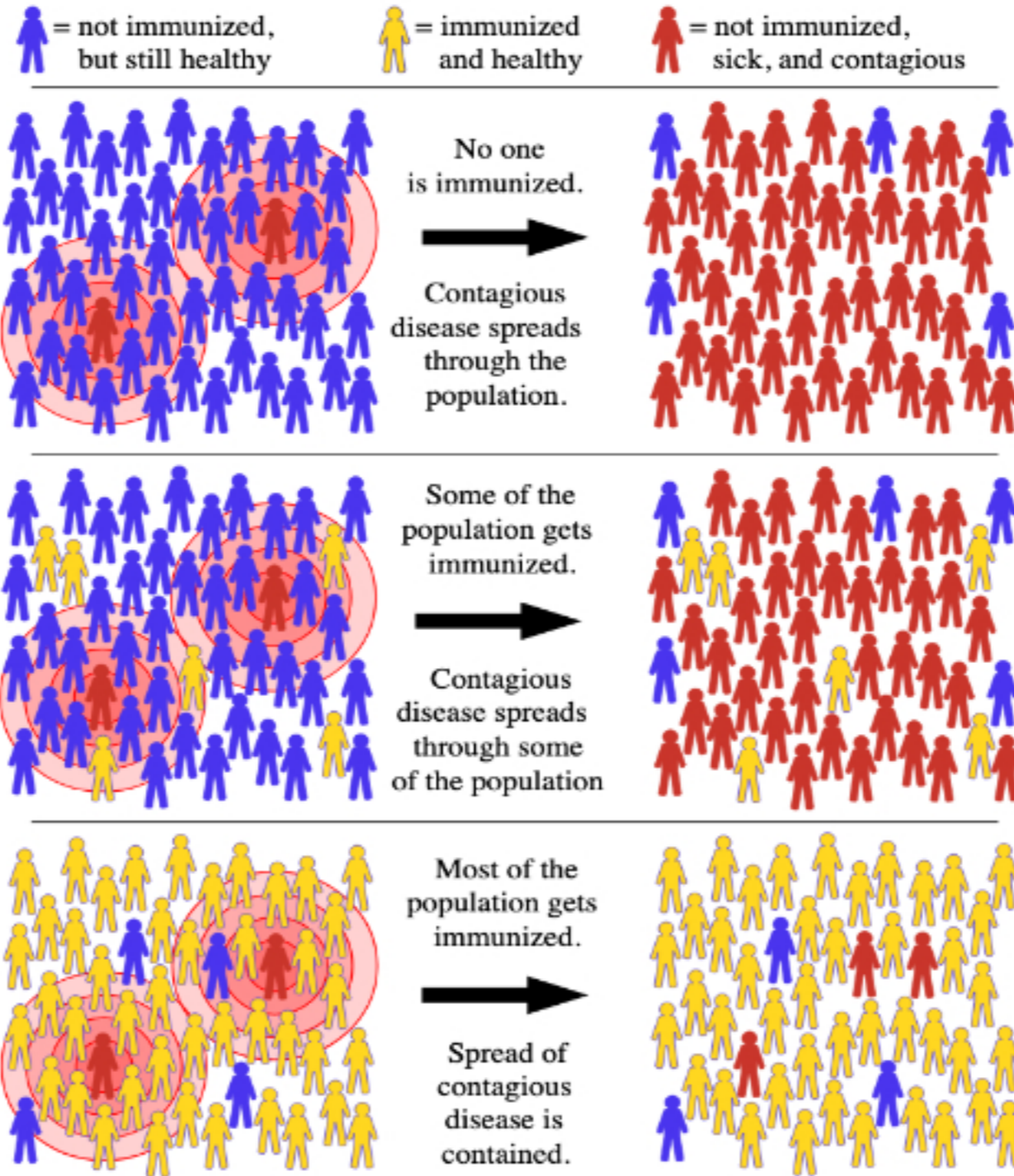


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HERD IMMUNITY

Large Population need to be immunized to prevent the spread of the disease.

If only few people are immunized the disease can still spread.





For all the synthetic and modern drug the starting point is the microorganism or a plant



MICRO-ORGANISMS and PLANTS ARE THE MAJOR SOURCE OF DRUGS

Pencillin is the drug obtained from microorganism Penicillium.

Flemming observed that in his bacterial culture plates which were left open, Penicillium molds grow and it around the molds no bacterial colony was seen.

He extracted pencillin from the mold and used it to cure bacterial disease during wold war !!

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DRUG TESTING



Test on Cell and Tissues
↓
Test on Animals (Pre-Clinical Test)
↓
Test on Humans (Clinical Testing)

PLACEBO
Giving an inactive version of the drug where the patient think that they are getting the drug.

DOUBLE-BLIND TRIALS
Where the doctor and patient does not know whether they are receiving a drug or the placebo. The scientist allocate the people into group and has the information on what each group is getting.

MONITORING AND PUBLISHING OF THE RESULT IS VERY IMPORTANT

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DRUGS FROM PLANTS



FOXGLOVE

Digitalis and Digoxin is the drug extracted from Foxglove.
It is used to cure heart problems.



Bark of Willow Tree is the source of aspirin which has anti-inflammatory and pain relieving properties.

BARK OF WILLOW TREE



They suck the phloem sap and take all the food of the plant damaging the plants.

They are also vectors of many infectious diseases as they can transfer bacteria, virus from infected to healthy plant.

They are controlled by pesticides or biological pesticides like ladybird.

OTHER PLANT DISEASES

NEMATODE



They live in the soil, eat the plant roots and damage the roots of the plant.

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OTHER PLANT DISEASES

NITROGEN DEFICIENCY

Plants take nitrogen as nitrates. They need nitrogen for protein synthesis so a deficiency of nitrogen will lead to stunted growth and low crop yield.

MAGNESIUM DEFICIENCY

Magnesium is required for chlorophyll synthesis. So deficiency of magnesium leads to chlorosis in which leaves turn yellow and plants yield decreases due to lack of photosynthesis.



The mineral deficiency is treated using the fertilizers.

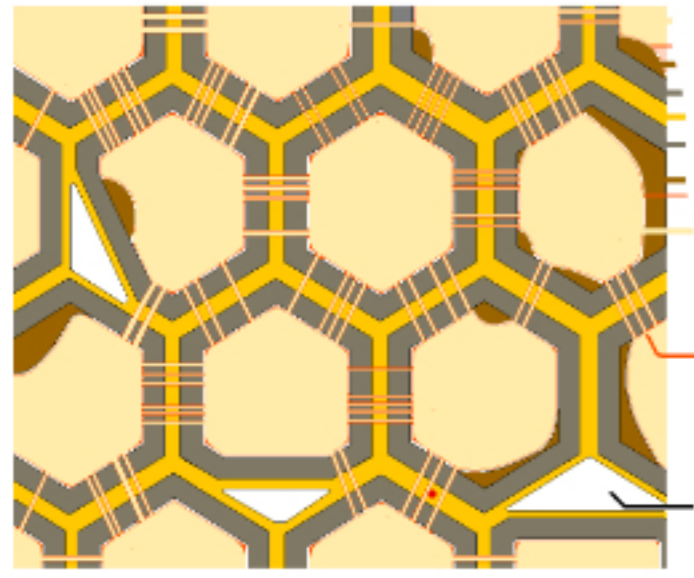
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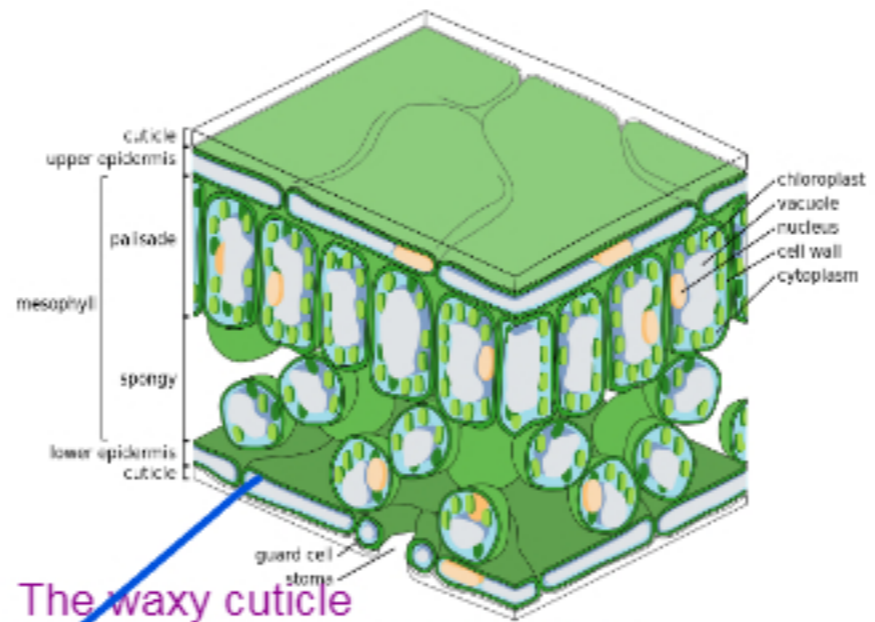
PLANT DEFENCE RESPONSES

PLANT CELL WALL



The cell wall protects the plant and restricts the entry of pathogens.

WAXY CUTICLE



The waxy cuticle restricts the entry of pathogens.

LEAF BARK



The dead cells of the bark restricts the entry of the pathogens

LEAF FALL



The deciduous trees shed the leaves and that takes off any pathogens in the plant.

CHEMICAL SECRETIONS

Certain plants like Mint and Witch Hazel release the chemicals like antimicrobials that prevent the entree of pathogens.



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PLANT DEFENCE RESPONSES
AGAINST HERBIVORES



Foxglove plant, releases poison to prevent herbivore attack.



Plants like Cactus has thorns to prevent the herbivore attack.



Plants like Lamb Ear's have hairy stem and leaves that prevent herbivore attack. Some plants also release poison with the hairs that prevent them for other animals.



EXPERT GUIDANCE
MIMICRY

PLANT DEFENCE RESPONSES

DROOPING OR CURLING



Plants mimic to be unhealthy or have spots on them that mimic butterfly egg to prevent other insect attack



Some plants like Touch Me Not, droop or curl with a touch frightening other animals.

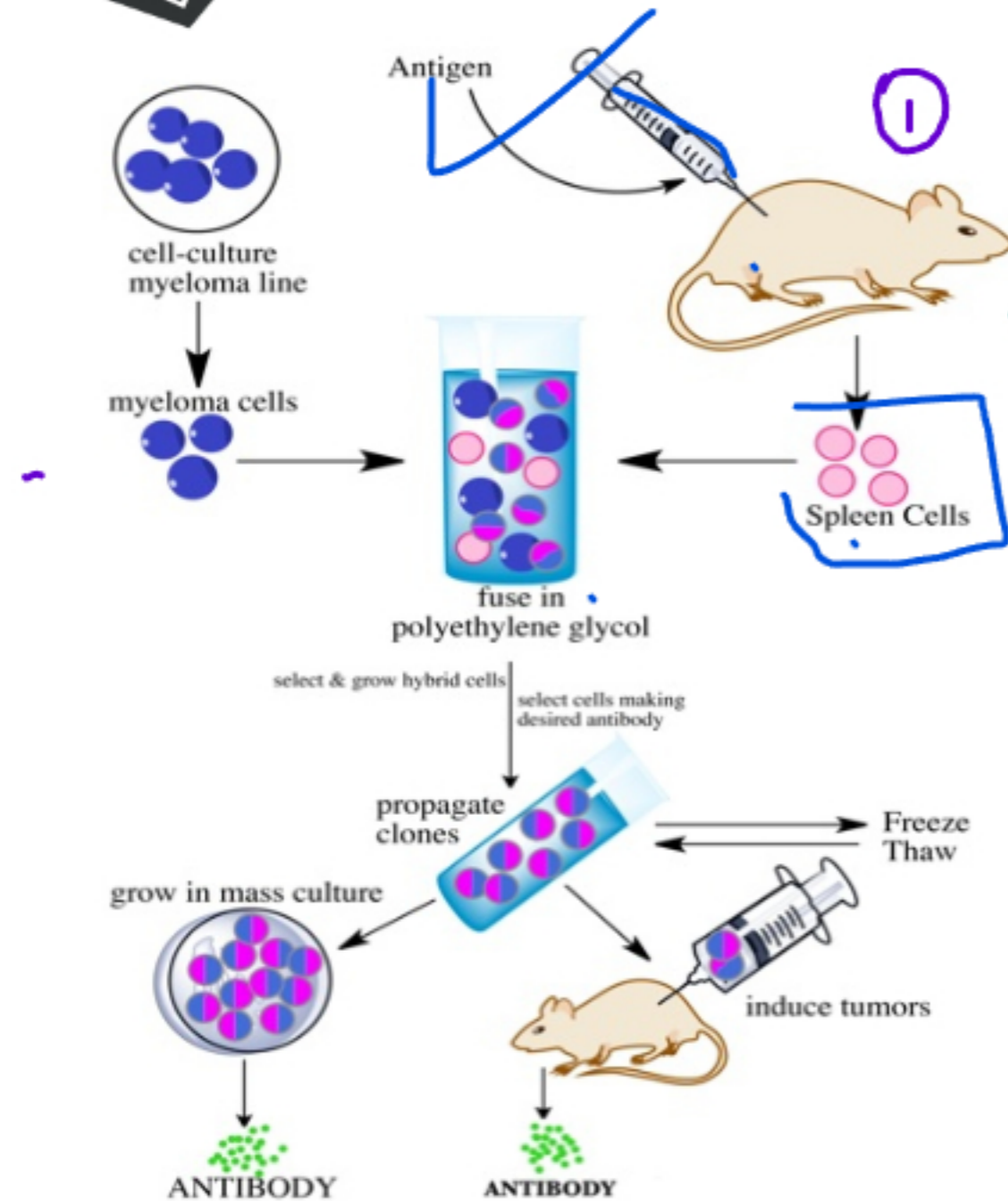


EXPERT GUIDANCE

MONOCLONAL ANTIBODIES

They are the antibodies produced from a single clone of cell.

Antibodies are the protein's made by the special white blood cells called the lymphocytes in response to the antigens.



B cells from mouse

Tumor Cells

Hybridoma

cloned

clone

antibodies purified and cloned

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Pregnancy Testing

The urine of pregnant woman contains the hormone HCG-Human chorionic gonadotropin.

The pregnancy kits contain monoclonal antibodies that bind to the HCG hormone.

If the urine has HCG hormone, it will bind to the monoclonal antibody present in the kit and will show a colour change.

Monoclonal antibodies are specific and only target the diseased or cancerous cells without affecting the healthy cells.

They are specific so can treat many diseases

USES OF MONOCLONAL ANTIBODIES

Diagnosis

The monoclonal antibodies binds to the antigens of the pathogens.

If the patient blood is added to the antibodies of the diseases and it results in binding and can detect the disease before producing the symptoms.

But they are expensive, need expertise and they hve side effects as they are produced in mouse so have side-effects in humans.

They can also be used to monitor the concentration of a drug or a hormone.

They can also use to locate a chemical in a cell.



EXPERT GUIDANCE

MONOCLONAL ANTIBODIES IN TREATING CANCER

EXPOSING THE CELLS

Monoclonal antibodies can bind to the antigens on the cancer cells and make them more exposed and trigger the immune response where white blood cells kills them.

BLOCKING THE RECEPTORS

They can bind to the cancer cells and block the receptors of growth hormone. So the growth hormone can no longer bind and stops the division of cancer cells

DELIVER THE DRUG

They can bind to the cancer cells and release the drugs to kill the cells.

Since monoclonal antibodies are specific to an antigen they will only bind to a cancer cell without harming the healthy cell.

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EXPERT GUIDANCE

✓ Disease

✓ Communicable Disease

✓ Non Communicable Disease

✓ Pathogen

✓ Culture Medium

✓ Agar Gel

✓ Mutation

✓ Antiseptic

✓ Disinfectant

KEY TERMS

✓ Vaccines

✓ Chlorosis

✓ Antibiotics

✓ Clinical Trials

✓ Placebo

✓ Double Blind Trial

✓ Monoclonal Antibodies

✓ Hybridoma

KEY TERMS

Disease is a disorder or abnormality in a body that produces sign and symptoms
Health is a state of physical and mental well-being.

COMMUNICABLE DISEASES

It is an infectious disease.
the disease can be transmitted from infected to healthy person.
It is caused by pathogens.
eg:- AIDS, Flu, cholera
These diseases spread and develop quickly so are acute.

NON-COMMUNICABLE DISEASES

It is non infectious disease.
The disease cannot be transmitted from infected to healthy person .
They have varied cause mainly deficiency of a nutrition or abnormal functioning of cells.
eg Diabetes, Cancer
They develop over a period of time, lasts longer so they are chronic.

Antiseptic

It is a chemical which kills or inhibit the growth of microbes and is applied externally on living tissue like skin. eg; Savlon

Disinfectant

It is used to kill, inhibit or prevent the growth of bacteria on non living surfaces. eg Sanitizer

Antibiotic

Can be natural or synthetic drug It is used to kill, inhibit or prevent the growth of bacteria in a living host. eg Penicillin

PATHOGENS

Pathogens are the microorganisms that cause a communicable disease. eg: Bacteria, Virus, Protists, Fungi etc .

Culture medium is the growth medium which can be solid, liquid or semi-solid and it is used to support the growth of microorganisms.

Agar Gel is the jelly like carbohydrate which is used as a growth medium for growing microorganisms in the laboratory.

Mutation is the change in the genes or the DNA.

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Vaccine is a dead or a weakened form of a disease which stimulate the body to make the antibodies against them without making you seriously ill.

Hybridoma is the hybrid cell produced by fusing the B cells with the tumour cells.

Chlorosis is the loss of green colour in the leaves which is caused by lack of chlorophyll due to mineral deficiency.

Clinical trial is the testing of drug on the group of people to validate its effectiveness.

Placebo are the substances which mimic the actual drug but they are not the drug.

Double blind trials are the clinical trial in which neither the patient nor the doctor knows who is getting the placebo and who is getting the drug.

Monoclonal antibodies are the antibodies made from the clone of a single B cell.

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NEXT STEP !!!

- Check the Specification
- Do Exam Style Questions

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