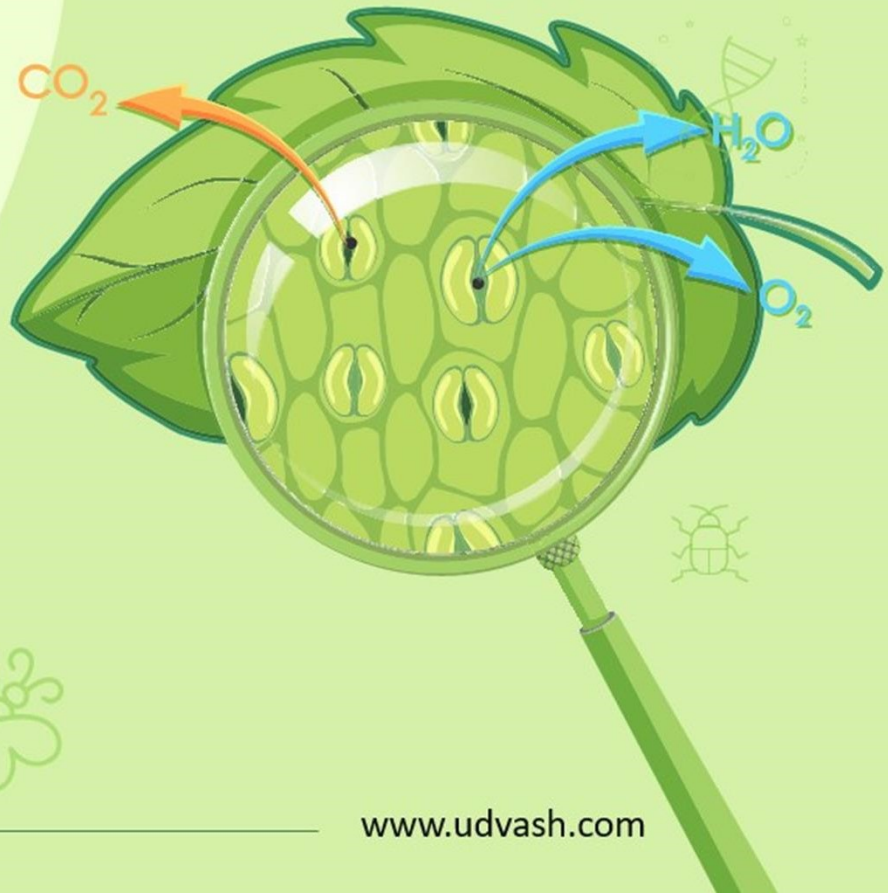
Class 12 Academic Program-2020

BIOLOGY 2ND PAPER

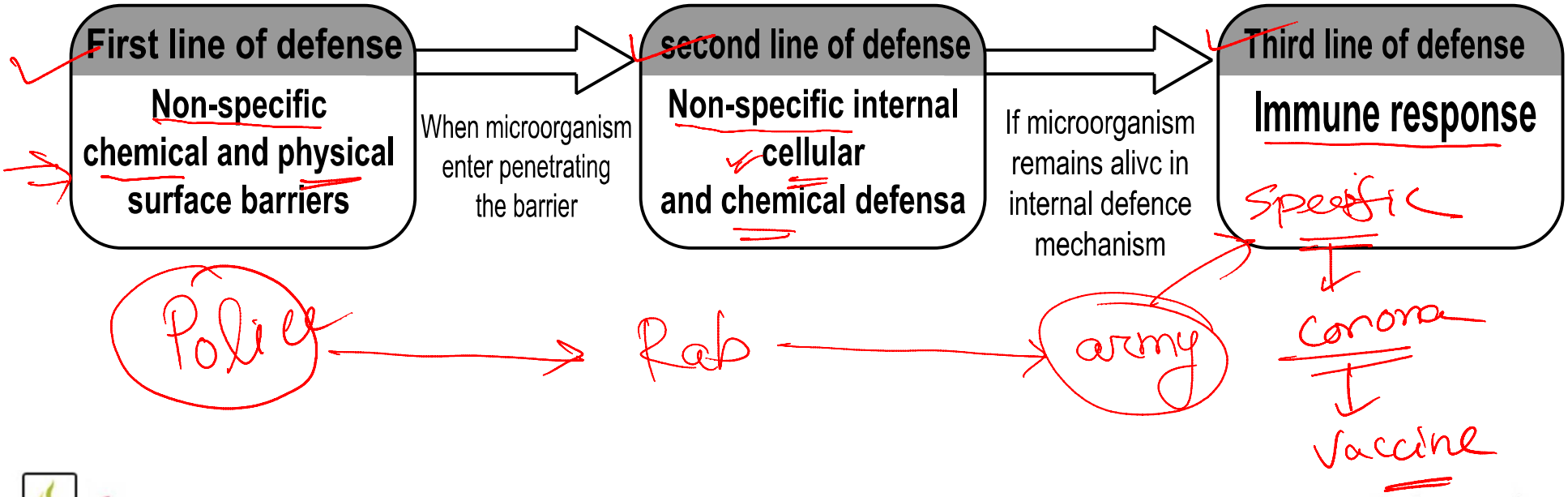
Lecture : Z-20

Chapter 10 : Defence System of Human body



The defence system of human body

➢ Three prevention strategies are applied to human body for getting protection from diseases. Each strategy is called line of defence. Each system is the ever-alert as a physical and chemical deterrent and defence line. 3 defence line of human body (the first, second and third) are mentioned below.



First line of Defense

➢ For the defence of human body, the line that prevents external microorganism or particles from entering the inside of the body as chemical and physical surface barrier is called the defence line. This defence line builds-up effective measure combining physical - chemical barriers on entering the body by considering all external objects harmful rather targeting some specific objects as harmful. That is why this line is known as non-specific line.

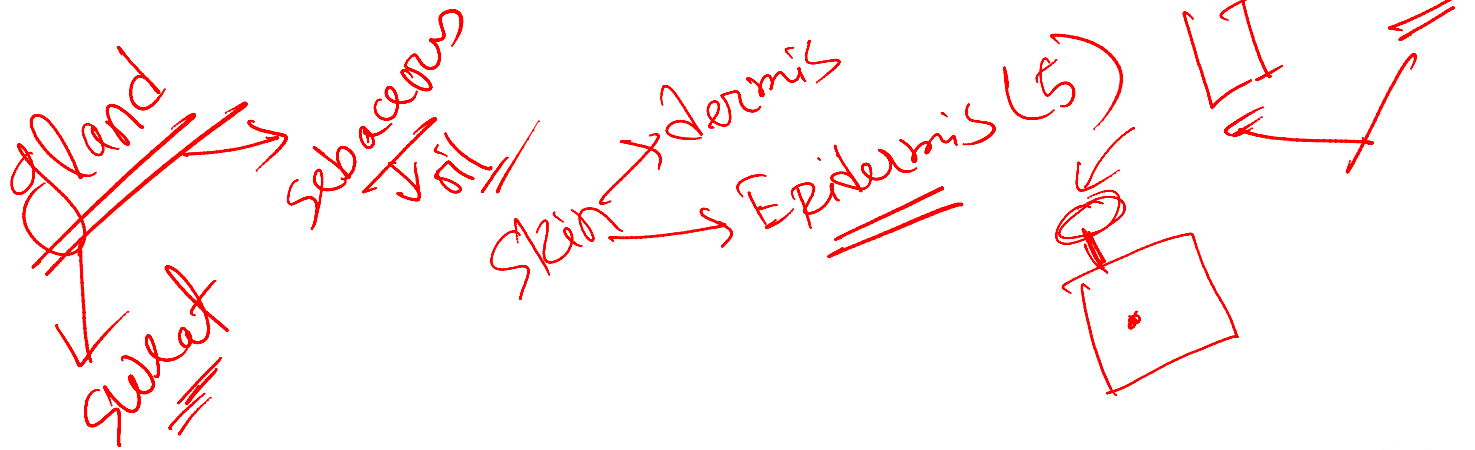
First line of Defense

(a) Skin (Skin / Integument; integer = to cover): skin works as an effective deterrent in four ways:

- (i) structurally keratinised, airtight, waterproof and impervious to most chemicals;
- (ii) are always replaced;
- (iii) Acidic pH; and
- (iv) the presence of antibiotics derived from sweat-glands.

(b) Hairs:

(c) Cilia:



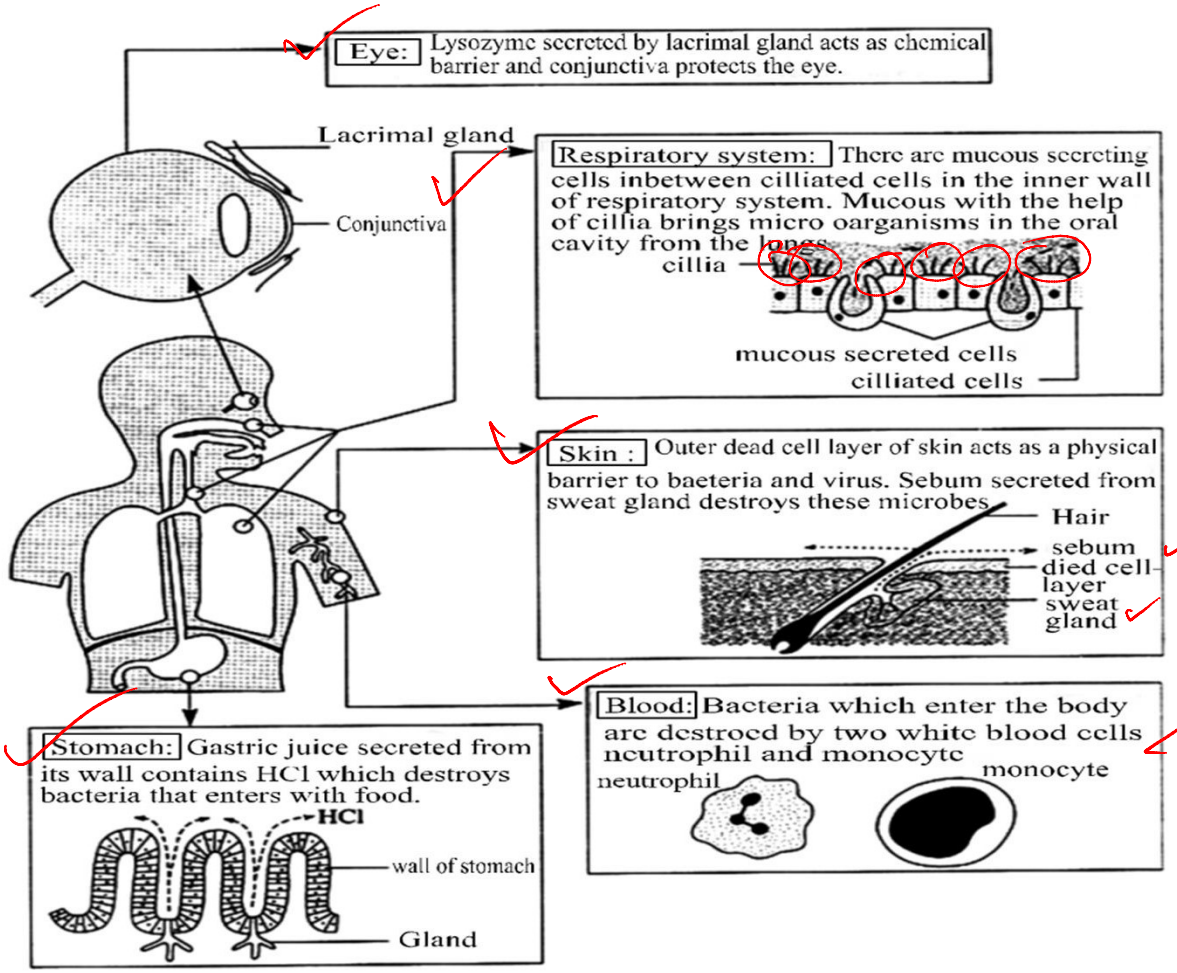
First line of Defense

(d) Tears and Saliva:

(e) Cerumen or Ear wax: The yellow-brown colored waxy substance oozed from the walls of the parts of the auditory canal is called Cerumen.

(f) Acid of Alimentary canal: Many types of harmful microorganisms are accrued in the stomach with food and water and destroyed by the activity of strong hydrochloric acid and proteolytic enzymes of stomach.

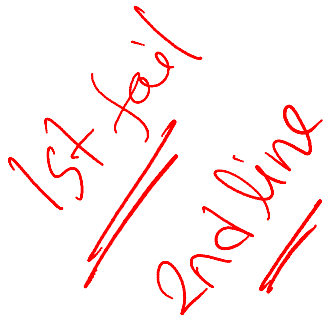
(g) Acid of Excretory and Reproductive System: Bacteria in the vagina secretes lactic acid and reduces the reproduction chance of other microorganisms.


Eye: Lysozyme secreted by lacrimal gland acts as chemical barrier and conjunctiva protects the eye.
Lacrimal gland
Conjunctiva
Respiratory system: There are mucous secreting cells inbetween cilliated cells in the inner wall of respiratory system. Mucous with the help of cillia brings micro oarganisms in the oral cavity from the lungs.
cillia
mucous secreted cells
cilliated cells
Skin : Outer dead cell layer of skin acts as a physical barrier to baeteria and virus. Sebum secreted from sweat gland destroys these microbes.
Hair
sebum
died cell layer
sweat gland
Blood: Bacteria which enter the body are destroed by two white blood cells neutrophil and monocyte
neutrophil
monocyte
Stomach: Gastric juice secreted from its wall contains HCl which destroys bacteria that enters with food.
HCl
wall of stomach
Gland

WBC

Second line of Defense

➢ The line consists of internal cellular and chemical defences, form an active resistance line against any microbial or particle entering inside the body through penetrating the outer defence line is called the second line of defence. It is also a non-specific defence line. Such second layer of defence is formed with at least 6 non-specific defence systems



Second line of Defense

a. Phagocytes: A large white-blood cell which play role in the defence system of the body by eating microorganisms, other cells and outer particles is called phagocyte. Neutrophil and macrophage are the two main phagocytes.

b. Natural killer cells, briefly NK cells: A kind of special lymphocytic white blood cell that detects some particular changes in the plasma membrane of tumour cell and virus affected cell, and destroys these cells. These are called Natural killer cells. They are also non-specific killer cells.

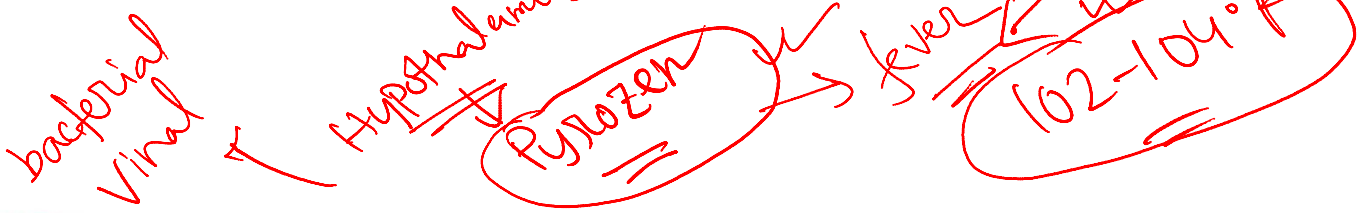
c. Inflammation: If any kind of damage occurs in the tissue (such as infection, burning, painful chemical or physical trauma wounds, etc.), in the beginning
(i) the wound becomes red,
(ii) becomes hot later, (iii) swells up and
(iv) Finally, reflects the pain
which are collectively called inflammatory response or inflammation.

Second line of Defense

d. Complement system or complement: The complement system is a group consists of at least 20 kinds of plasma proteins which helps the other defence systems by circulating in the blood.

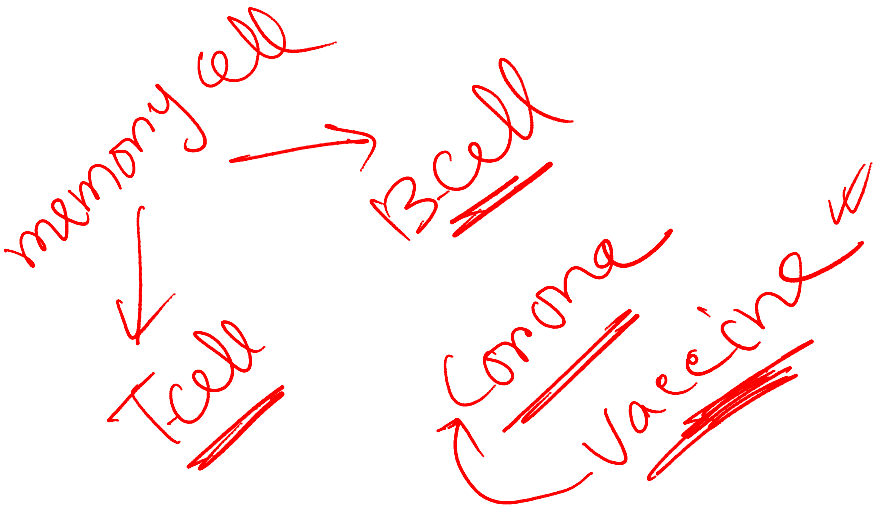
e. Interferon: As a response to the attacking virus and disruption to the virus propagation, a particular type of small glycoprotein is produced and secreted from the infected cells which is called interferon.

f. Fever: the last weapon of the second line of defence is fever. If the body temperature gets higher than the normal ($97 - 99^0F\ i.e. 36° - 37.2°C$) then it is called fever.



Third line of Defense

➢The line of defence that destroys particular intruders of external microorganisms or particles or cancer cells and for the first time after being attacked, remembers it for long as a harmful target and responses quickly and effectively to any attack in next is called the third level of defence. The overall activity of this line is known as immune response.



The role of skin in the defence of the body (the first level of defence)

- Human skin has always harmless bacteria, but harmful bacteria cannot live there. The oil or sweat secreted from sebaceous gland and sweat gland of skin, makes the skin acidic (pH 3.0-5.0). Bacteria or germs cannot survive or reproduce in such environment.
- the bacteria that lives in the vagina, reduces the pH levels by secreting lactic acid.
- Blood clotting in the injured place not only stops the Blood-letting but also prevents the germs from entering inside.
- Some parts even carries a lot of antibiotics, such as lysozyme in saliva, tears nosy membrane; spermin in semen; lactoperoxidase in milk and so on.
- Ceruminous gland secreted cerumen or wax of ear prevents the access of sand, bacteria and small insects inside the ear. Ceruminous gland is skinny gland in the ear.

Role of acid and enzymes of digestive canal for killing of bacteria of food (1st line of defence)

- Saliva gland contains a type of enzyme called lysosome. It destroys mouth and throat infectious Staphylococcus, Streptococcus, Bacillus etc. bacteria and many types of germs.
- Lysosome, with a small amount of hydrogen carbonate ions in saliva (it soothes or disables the presence of acids in teeth) in together protect the teeth from decay.
- Stomach wall's parietal or oxyntic cell secreted juice contains a huge amount of HCl which creates powerful acidic medium (pH 1.0-2.0) inside the stomach. Acidic medium destroys bacteria of foods.
- A kind of symbiotic microbes living in the gut secrets an antibiotic that destroys harmful bacteria and supersedes food viruses to grow.
- Secreted bile from the liver (alkaline juice pH 8.0) prevent the growth of Bacteria through creating antibiotic in the chime of duodenum.

The role of macrophages and neutrophil in the destruction of bacteria (the second level of defence)

For the destruction of entered bacteria of the body, two types of cells play significant role:

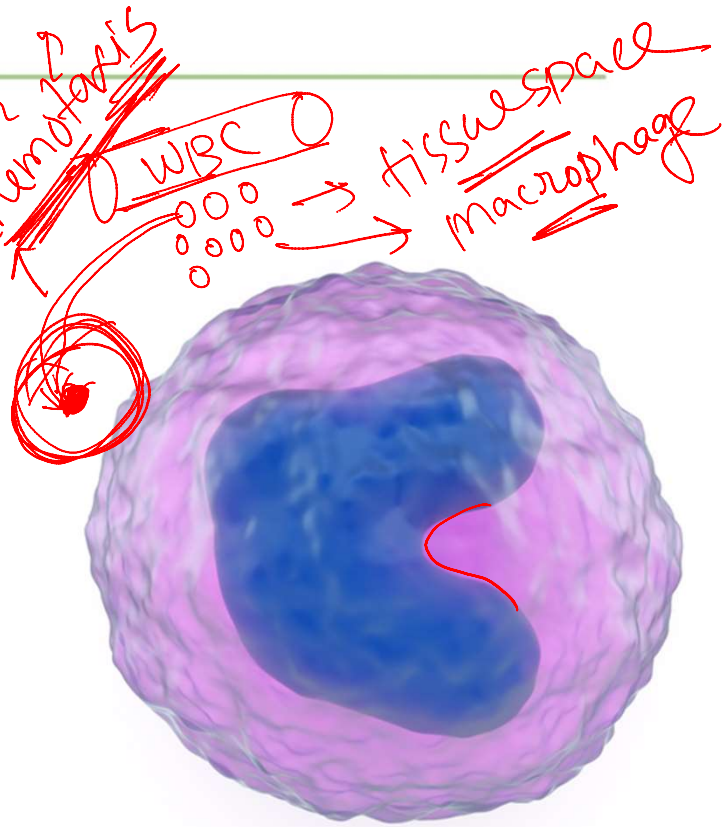
Macrophages and neutrophils.

Macrophage

1. Monocyte is kidney-shaped and agranular white-blood cell.

   Monocyte is 5 percent of the total white blood cell in the body

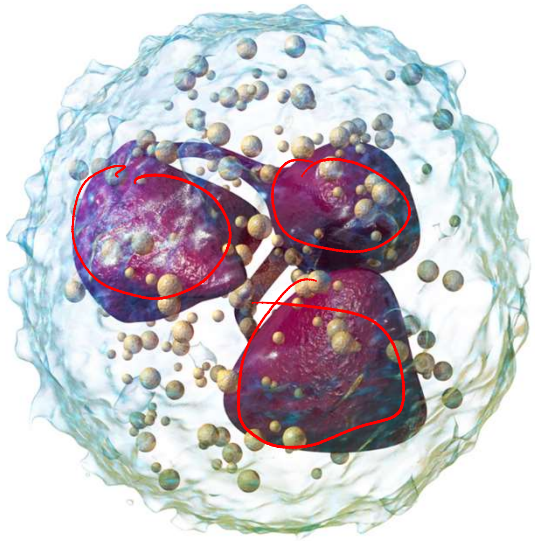
2. macrophage is transferred by 40 micrometers/min pseudopodia movement and remains alive for several months.
3. By the immune system being activated, macrophages work as phagocyte more powerful than neutrophils
4. Then per macrophage can consume more about 100 bacteria, often consume the red-blood cells, fungi or substances like malaria



Neutrophils

1. Neutrophil is a fine white-blood cell that is 12 - 15 micrometre diameter, granular, with 2-5 segmented nucleus

2. Neutrophils are 60-70% of total white-blood cell in the body. These particles show the behaviour of pseudopodia movement (40 micrometres / min) .
3. In a normal adult human, about 100 billion (10 billion), neutrophils are produced daily.
4. A neutrophil can consume 3 - 20 bacteria. After that it becomes inactive and died.

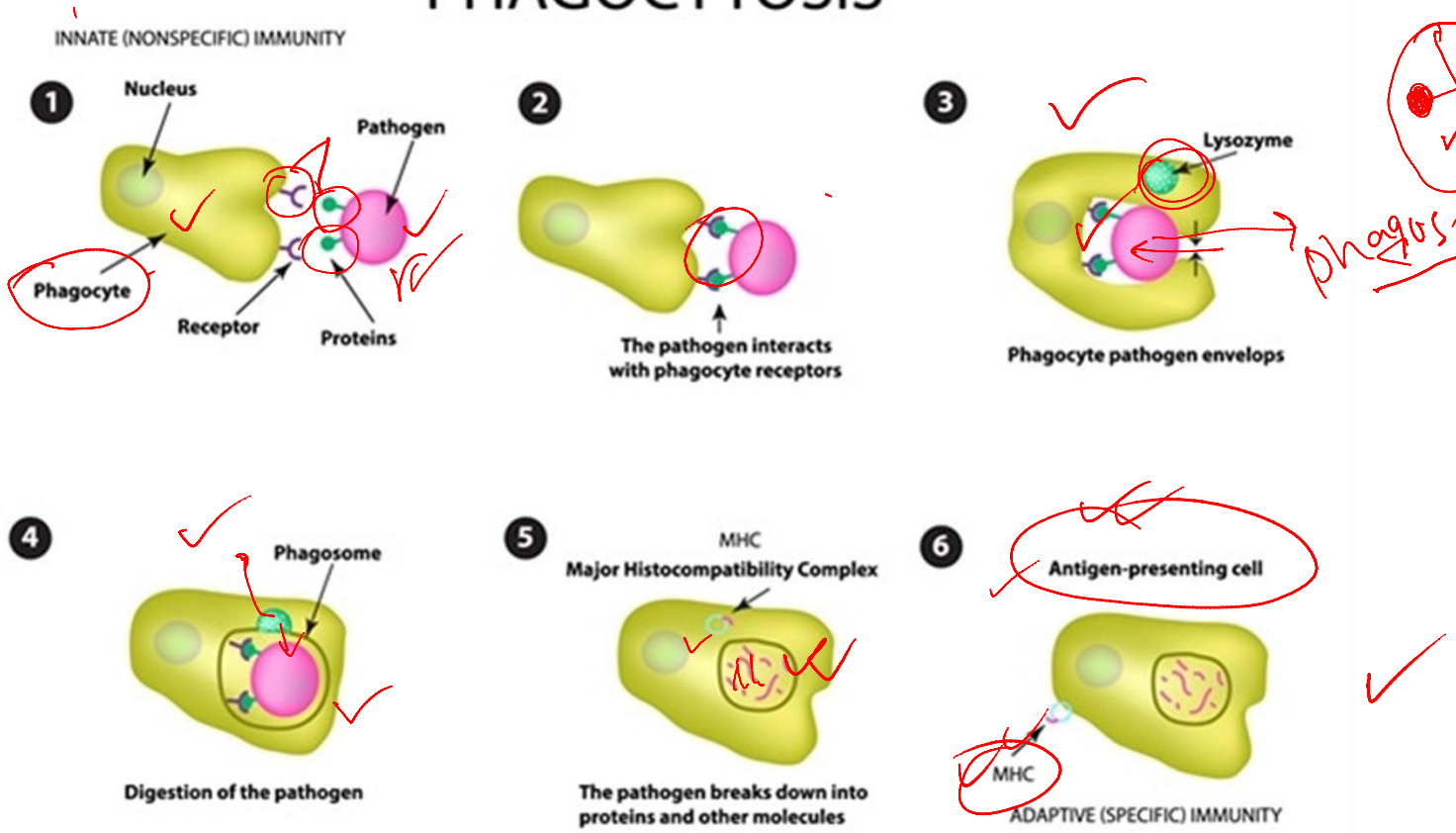


Phagocytosis

1. Activation of macrocytes:
2. Ingestion:
3. Formation of phagosome:
4. Formation of phagolysosomes:
5. Intracellular killing and digestion of bacteria:
6. Residual body containing indigestible materials):
7. Discharge of waste materials:

চিত্র: ফ্যাগোসাইটোসিসের ধাপসমূহ

PHAGOCYTOSIS



Innate and Acquired immunity (Third immunity layer)

Innate Immunity: The immunity of human life which is present from birth till lifetime through the placenta and which effects immediately in the immunity of the body is called innate immunity. This is a non-specific immunity

Acquired Immunity: The immune system which is not prevalent in the human body from the time of birth, rather which is created after birth from the response against a specific germ or application of a vaccine is known as acquired immunity. Acquired immune system is a specific immunity. Acquired immunity system is of two types: (a) Active Immunity and (b) Natural Active Immunity

Innate Immunity

1. Barriers: The barrier tissues are skin, digestive canal, different parts of the respiratory system and in it serves as a protective membrane for the female reproductive canal.
2. Inflammation: If any tissues are damaged, different types of granules especially neutrophil and macrophages
3. Complement: An interrelated group composed with a minimum of 20 types of plasma protein flows through the blood inertly and helps in the immunity system of the human body
4. Interferon: As a response to be infected by the virus and to prevent the multiplication of the virus in the cell,
5. Natural Killer Cells: These are lymphocytes, a special type of white blood corpuscles which destroys the tumour cells and virus infected cells.
6. Symbiotic Bacteria: Countless bacteria live permanently in the digestive system, skin, and reproductive system of women.

Acquired Immunity: Active Immunity

This type of acquired immunity actively takes part in the production of antibodies from the cell. It's of two types- Active and Artificial.

(i) Natural Active Immunity: In this immunity system infections are developed from exposure of germs incidentally and active immunity against microbial infections are developed. For example: an infection in the hospital or clinic. This type of immunity prevails for a longer time, sometimes throughout the whole life.

(ii) Artificial Active Immunity: There develops an active immunity after vaccination in this immunity system. For example: it develops the immunity against DPT vaccine diphtheria, tetanus and whooping cough.

Acquired Immunity: Passive Immunity

It is an acquired immunity in which antibodies from the body of a human can be transferred to other as well as from animals to the humans. It is of two types which is described below:

(i) Natural Passive Immunity: In this immunity, the antibodies are transferred from the placenta and colostrum of the mother to the baby. These transferred antibodies survive for a few weeks. By this time an immune system is grown in the child to produce antibodies.

(ii) Artificial Passive Immunity: In this immunity, the antibodies are introduced in the body through an injection. For example: the treatment by injecting serum from an infected patient after recovery into the body of another person.

Poll Question-01

Which one is the example of first line of defense?

(a) Phagocytes

(b) Interferon

(c) Skin

(d) Complement

Poll Question-02

How many defense layer of Immunity?

(a) 3

(b) 4

(c) 5

(d) 6

Poll Question-03

Which one is not an example of 2nd line of defense?

(a) Cerumen
(b) Phagocytes
(c) Interferon
(d) Complement

Poll Question-04

Which one is correct for interferon?

(a) Specific

(b) Chemically Lipoprotein

(c) Kills virus

(d) Inhibit bacterial production

লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।