



- ability to fight with
diseases
- Resistance

IMMUNITY

HUMAN IMMUNE SYSTEM

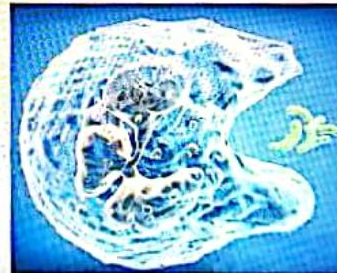
IMMUNITY

It is the ability of the immune system to fight the disease causing organisms.



Types of immunity

Innate
(inborn)
immunity ✓



Acquired
(adaptive)
immunity ✓

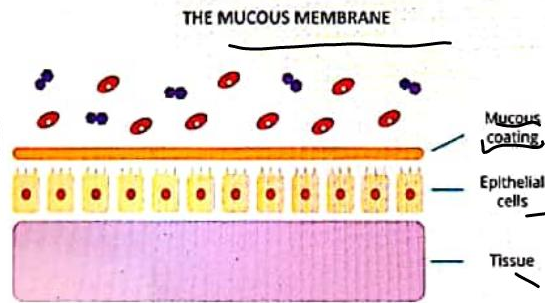
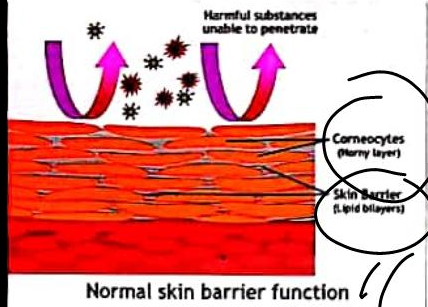


1. INNATE IMMUNITY

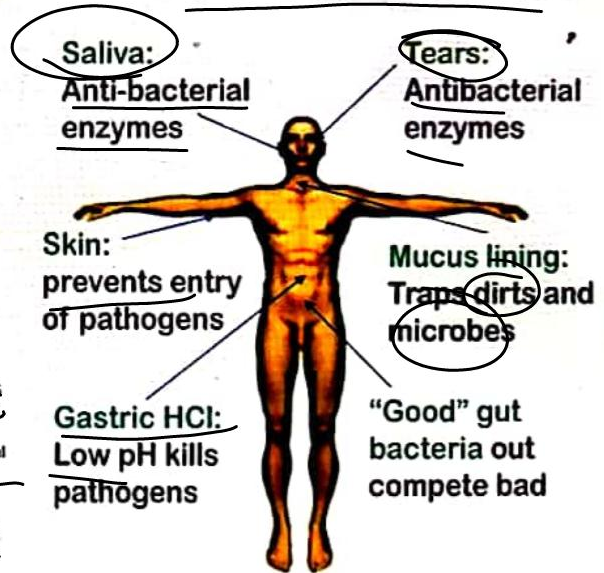
Barriers

1. Physical Barriers

- **Skin:** Prevent entry of foreign bodies.
- **Mucous coating** of the lining the respiratory, gastro-intestinal and urino-genital tracts to trap microbes.



First line of defence



HUMAN IMMUNE SYSTEM

IMMUNITY

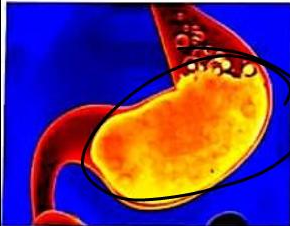
1. INNATE IMMUNITY

Barriers

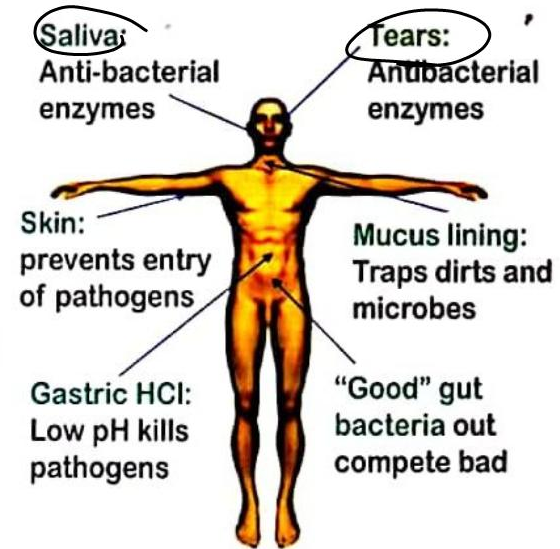
2. Physiological Barriers

↳ Metabolism

- They prevent microbial growth.
- It includes
 - » Gastric HCl ✓
 - » Saliva ✓
 - » Tear etc. ✓



First line of defence



1. INNATE IMMUNITY

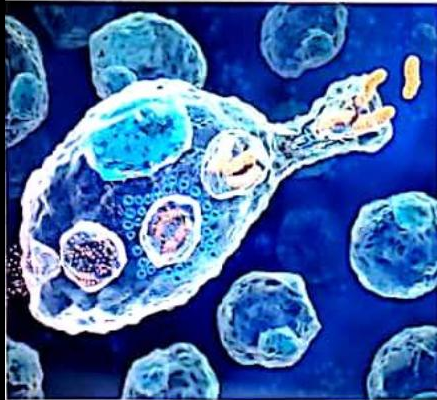
Barriers

3. Cellular Barriers

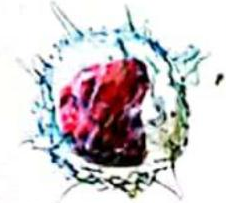
- **Phagocytes** like WBC [e.g. neutrophils or Polymorphonuclear leukocytes (PMNL), monocytes and natural killer lymphocytes], macrophages etc.

Made up of cells.

tissue phagocytes



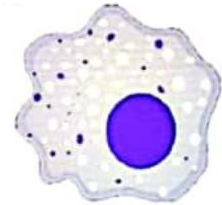
Neutrophil



Monocyte



Natural killer cells



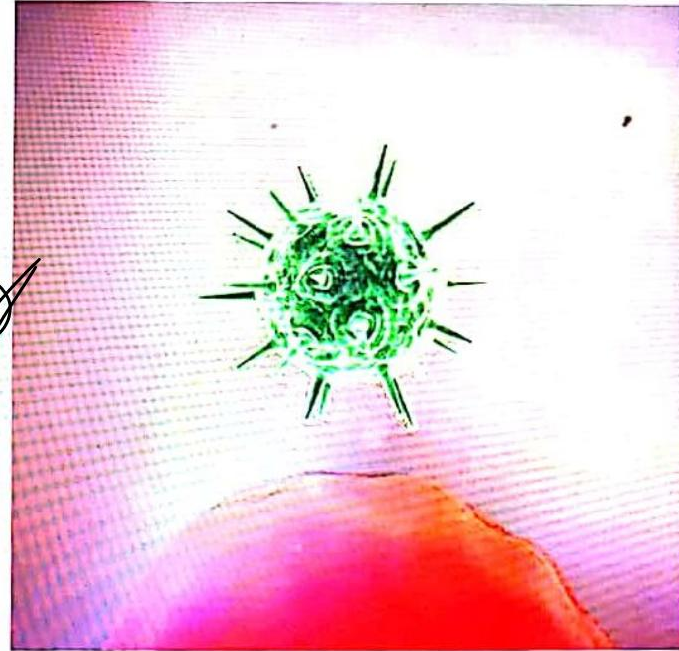
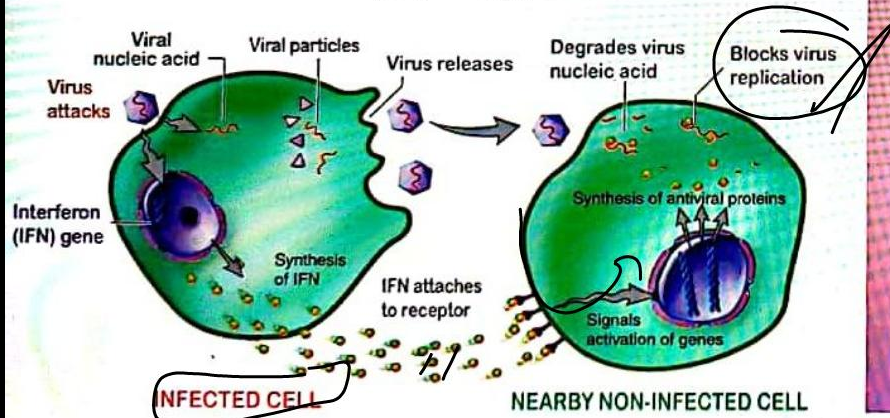
Macrophage

1. INNATE IMMUNITY

Barriers

4. Cytokine Barriers

Virus infected cells secrete a cytokine protein called interferon. It protects non-infected cells from further viral infection.

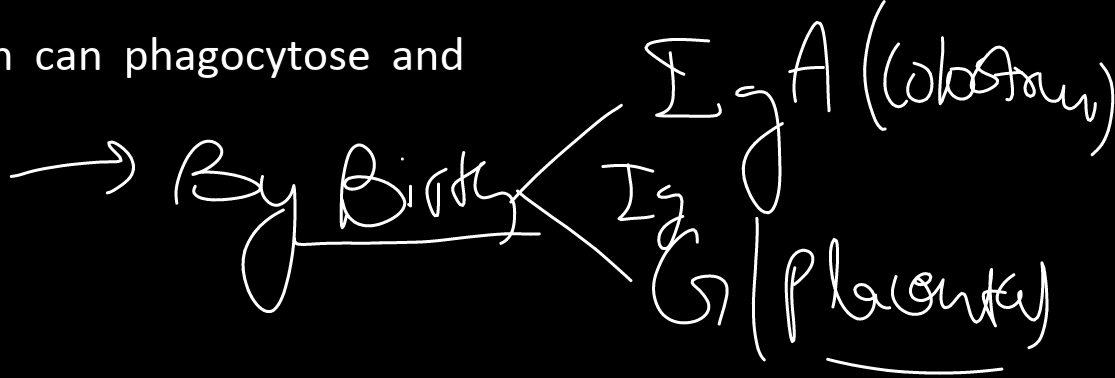


Human have acquired immune system that produces antibodies to neutralize pathogens. Still innate immune system is present at the time of birth because it

[NEET 2019]



- (A) Is very specific and uses different macrophages,
- (B) Produces memory cell for mounting fast secondary response.
- (C) Has natural killer cells which can phagocytose and destroy microbes.
- ~~(D) Provides passive immunity.~~



Which of the following immune responses is responsible for rejection of kidney graft? [NEET 2019]

- ~~(A)~~ Cell mediated immune response → T-cells
- (B) Auto-immune response ~~α~~
- (C) Humoral immune response ~~α~~ (B-cells)
- (D) Inflammatory immune response

Which of the following protects our body
against disease-causing pathogens?

- (A) Respiratory system
- ~~(B)~~ Immune system
- (C) Digestive system
- (D) Respiratory system

10.1 MICROBES IN HOUSEHOLD PRODUCTS

You would be surprised to know that we use microbes or products derived from them everyday. A common example is the production of curd from milk. Micro-organisms such as *Lactobacillus* and others commonly called **lactic acid bacteria (LAB)** grow in milk and convert it to curd. During growth, the LAB produce acids that coagulate and partially digest the milk proteins. A small amount of curd added to the fresh milk as inoculum or starter contain millions of LAB, which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing vitamin B₁₂. In our stomach too, the LAB play very beneficial role in checking disease-causing microbes.

The dough, which is used for making foods such as *dosa* and *idli* is also fermented by bacteria. The puffed-up appearance of dough is due to the production of CO₂ gas. *Can you tell which metabolic pathway is taking place resulting in the formation of CO₂? Where do you think the bacteria for these fermentations came from?* Similarly the dough, which is used for making bread, is fermented using baker's yeast (*Saccharomyces cerevisiae*). A number of traditional drinks and foods are also made by fermentation by the microbes. 'Toddy', a traditional drink of some parts of southern India is made by fermenting sap from



10.2.3 Chemicals, Enzymes and other Bioactive Molecules

Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes. Examples of acid producers are *Aspergillus niger* (a fungus) of citric acid, *Acetobacter aceti* (a bacterium) of acetic acid; *Clostridium butylicum* (a bacterium) of butyric acid and *Lactobacillus* (a bacterium) of lactic acid.

Yeast (*Saccharomyces cerevisiae*) is used for commercial production of ethanol. Microbes are also used for production of enzymes. Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry. You must have noticed that bottled fruit juices bought from the market are clearer as compared to those made at home. This is because the bottled juices are clarified by the use of pectinases and proteases. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*. Statins produced by the yeast *Monascus purpureus* have been commercialised as blood-cholesterol

→ Biological potent/active & used for production of useful molecules



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↳ HMG-CoA-Reductase

immunosupp. agent



Suppress the immune response

10.3 MICROBES IN SEWAGE TREATMENT

We know that large quantities of waste water are generated everyday in cities and towns. A major component of this waste water is human excreta. This municipal waste-water is also called sewage. It contains large amounts of organic matter and microbes. Many of which are pathogenic. Have you ever wondered where this huge quantity of sewage or urban waste water is disposed off daily? This cannot be discharged into natural water bodies like rivers and streams directly – you can understand why. Before disposal, hence, sewage is treated in sewage treatment plants (STPs) to make it less polluting. Treatment of waste water is done by the





Figure 10.6 Secondary treatment

heterotrophic microbes naturally present in the sewage. This treatment is carried out in two stages:

Primary treatment : These treatment steps basically involve physical removal of particles – large and small – from the sewage through filtration and sedimentation. These are removed in stages; initially, floating debris is removed by sequential filtration. Then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle form the **primary sludge**, and the supernatant forms the effluent. The effluent from the primary settling tank is taken for secondary treatment.

waste material

Secondary treatment or Biological treatment : The primary effluent is passed into large aeration tanks (Figure 10.6) where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into **flocs** (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the



① Aerobes

Biochemical
O₂
Demand.

A = 20
B = 26 // (fpp)

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Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge**. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called **anaerobic sludge digesters**. Here, other kinds of bacteria which grow anaerobically digest the bacteria and the fungi

