6.3 DEFENSE AGAINST INFECTIOUS DISEASES

Surface barriers:

The first line of defense against the infectious disease are the surface barriers

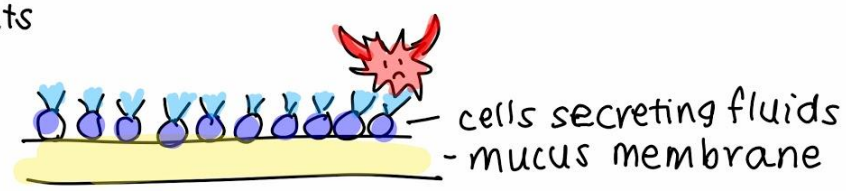
- they prevent the entry of pathogens into the body

Skin:

- protects the external structures
- consists of dry, thick & tough region composed predominantly of dead surface cells.
- biochemical defense agents
- secretes lactic acid and fatty acid to lower the pH.

Mucous Membranes

- protect the internal structures
- consists of a thin region of living surface cells → these release fluids to wash away pathogens
- Contains biochemical defence agents



BLOOD CLOTS

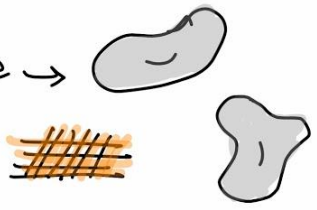
Clotting is the mechanism by which broken blood vessels are repaired when damaged.

- prevents blood loss
- limits the pathogenic acess to the bloodstream

Key components:

platelets - undergo a structural change →

fibrin - forms an insoluble mesh →



CLOTTING OF BLOOD

- Coagulation cascade

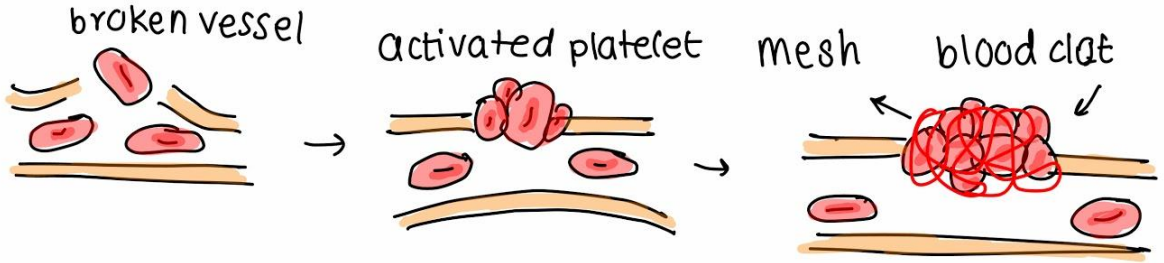
→the process by which blood clots are formed involves a complex set of reactions collectively called the coagulation cascade.

Prothrombin → activation results in production of thrombin.
↓

platelets change the shape and seal the site to reduce the blood flow.

Thrombin → catalyses the conversion of soluble plasma protein fibrinogen into an insoluble fibrous called fibrin.

Fibrin strands → form a mesh around the platelet plug
↳ traps blood cells to form a temporary clot.

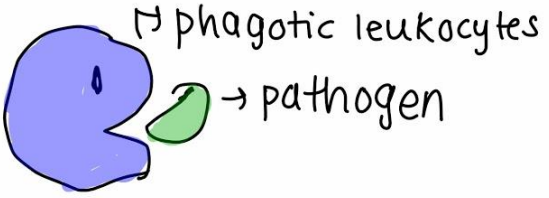


PHAGOCYTES

↳ second line of defense → innate immune system
↳ non-specific response.

- phagocytic leukocytes → engulf and digest foreign bodies

Other components:
- inflammation
- fever
- antimicrobial chemicals



Phagocytosis: process by which solid materials are ingested by a cell.

Phagocytic leukocytes circulate in the blood and move into the body tissue.

Damaged tissues release chemicals which draw the leukocytes to the site of infection.

The cellular extensions surround the pathogen and engulf it.

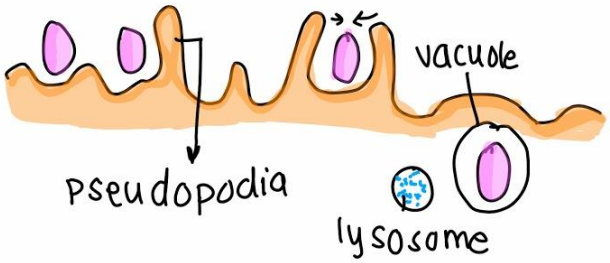
They fuse to form a vesicle which is then fused to a lysosome - forms phagolysosome

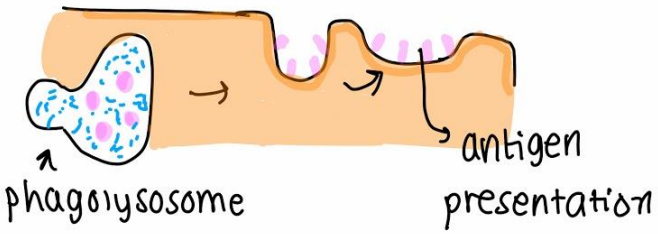
↓

pathogen gets digested.

↓

fragments get presented on the phagocyte.

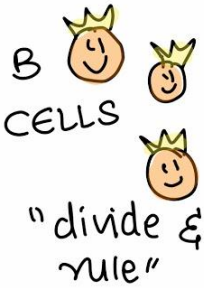




LYMPHOCYTES

↳ third line of defense

↳ adaptive immune system



B lymphocytes → antibody producing cells that recognise and target a particular antigen

Helper T lymphocytes: release chemicals cytokines to activate the specific B lymphocytes.

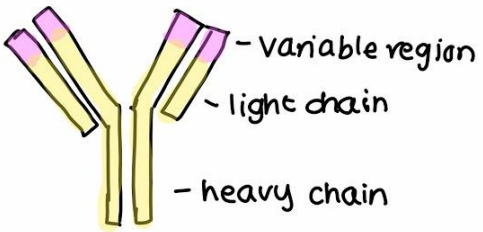
1. After the antigens are presented on the phagocyte, they migrate to the lymph nodes.
2. they activate helper T-cells which release cytokines
3. these cytokines activate the B cell capable of producing antibodies that are specific to the antigen
4. the B cells divide and differentiate to form short-lived plasma cells.
5. these plasma cells produce high amounts of specific antibodies.
6. antibodies → target the antigen → enhances the capacity of the immune system to recognise & destroy the pathogen.

7. Some of the B cells and the helper T cells develop into memory cells → provide long lasting immunity.

ANTIBODIES

a protein produced by B-lymphocytes that is specific to a given antigen.

Antigen: substance that the body recognises as a foreign substance and will elicit an immune response.



~ Y shaped molecule

~ made up of 4 polypeptide chains.

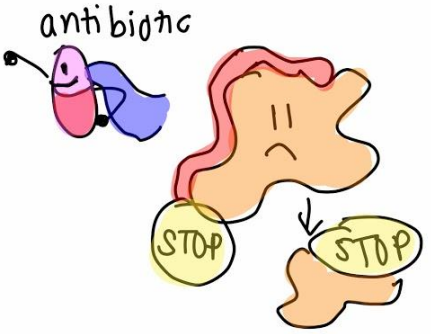
-variable region - where the antigen binds

~ rest of the molecule - serves as a recognition site for the immune system.

ANTIBIOTICS

compounds that kill/inhibit the growth of bacteria by:

- targeting the metabolic processes
- inhibiting the cell wall synthesis
- supress its ability to reproduce



viruses do not have their own metabolism & take over the host's cell machinery.

∴ cannot be treated with antibiotics.

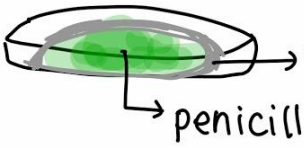
PENICILLIN

~ the first compound to have antibiotic properties

~ identified by Alexander Fleming in 1928.

discovery ~ an accident

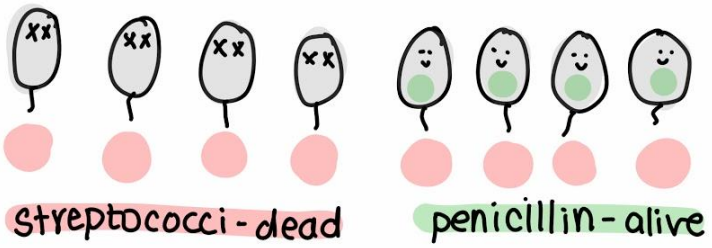
- unintended contamination of a dish containing S. aureus
- penicillium mould began to grow on the plate and a halo of inhibited bacterial growth was observed around it.



- concluded that the substance released was pencilin that was killing the nearby bacteria

MEDICAL APPLICATION

- demonstrated by Sir Howard Florey
- tested penicillin on infected mice.
- 8 mice – injected with hemolytic streptococci
- 4 mice – injected with penicillin



- untreated mice died whereas the ones injected with penicillin survived.

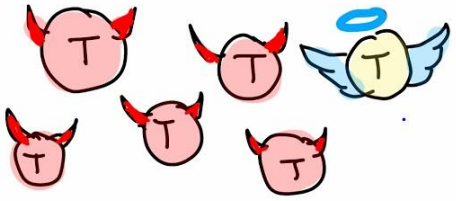
HIV INFECTION Human Immunodeficiency Virus

- retrovirus
- infects helper-T cells → disable the body's adaptive immune system.

Effects of HIV:

- targets helper-T lymphocytes
- the virus undergoes a period of inactivity

during this period, the infected helper T cells reproduce.



- they begin to spread and destroy the T lymphocytes in the process (lysogenic cycle)

- the reduction in the number of helper-T cells results in a lowered immunity as the antibody production gets affected
- the person's immunity is compromised and is prone to more infections which can be fatal.

TRANSMISSION

- exchange of body fluids
  - sexual contact
  - breastfeeding
  - blood transfusion
  - injection drug use