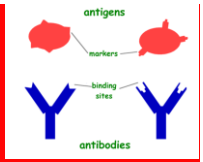
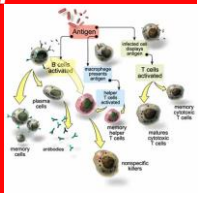


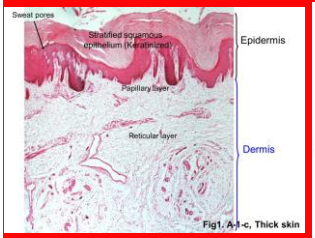
Human Physiology

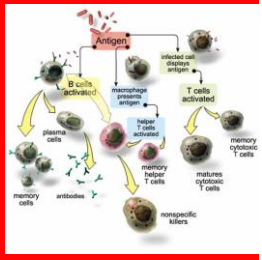
6.3- Defense Against Infectious Disease



Essential idea:

- The human body has structures and processes that resist the continuous threat of invasion by pathogens.



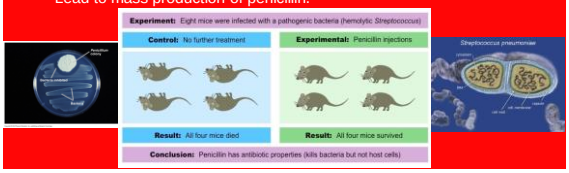


Nature of science:

- Risks associated with scientific research
  - Florey and Chain's tests on the safety of penicillin would not be compliant with current protocol on testing. (4.8)

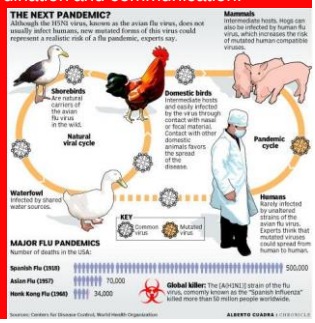
Applications and Skills

- Application: Florey and Chain's experiments to test penicillin on bacterial infections in mice.
  - Oxford, late 1930s
  - Infected mice with *Streptococcus pneumoniae*
  - Human trials
    - 1st was a 43 year old policeman.
    - Improved but died of relapse when supply of penicillin ran out.
    - Increased production lead to tests on 5 more patients.
  - Lead to mass production of penicillin.



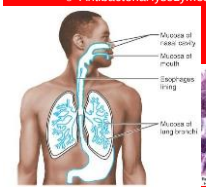
International-mindedness:

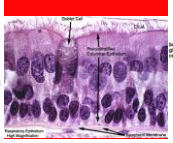
- The spread and containment of diseases such as bird flu require international coordination and communication.



Understandings

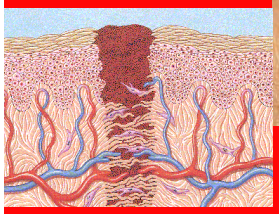
- The skin and mucous membranes form a primary defense against pathogens that cause infectious disease.
  - Sebaceous glands secret sebum
    - Moistens skin
    - Lowers skin pH (inhibits bacteria and fungi)
  - Mucus Membranes
    - Secretes glycoprotein
    - Physical barrier
    - Antibacterial lysozymes





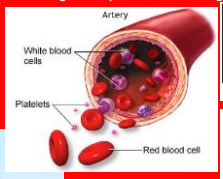
Understandings

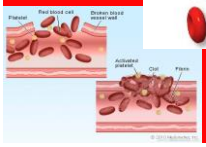
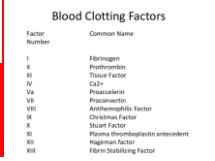
- Cuts in the skin are sealed by blood clotting.
  - Stops blood flow.
  - Prevents entrance of pathogens.




Understandings

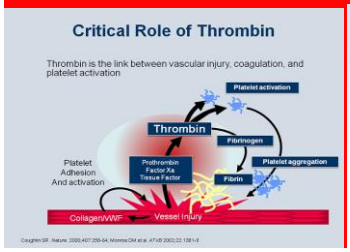
- Clotting factors are released from platelets.
  - Cascade system under strict controls.
  - Platelets aggregate and form a temporary plug.
  - Platelets (cellular fragments) release clotting factor.

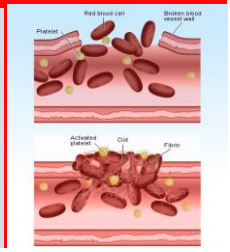


Understandings

- The cascade results in the rapid conversion of fibrinogen to fibrin by thrombin.
  - Clotting factor initiates the production of thrombin (enzyme).
  - Thrombin turns soluble fibrinogen (protein from liver) into insoluble fibrin.
  - Fibrin catches more platelets and blood cells creating the clot.

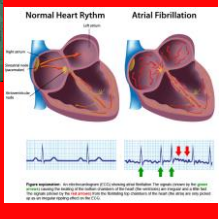


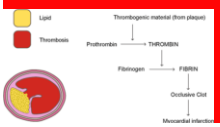


Applications and Skills

- Application: Causes and consequences of blood clot formation in coronary arteries.
  - Coronary arteries get blocked with a clot (thrombus).
  - Coronary thrombosis deprives muscle of oxygen and nutrients.
  - Contractions are irregular and wall quivers (fibrillation).

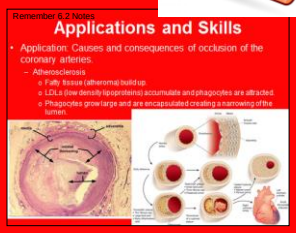


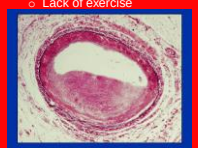




Applications and Skills

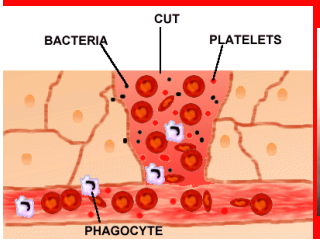
- Application: Causes and consequences of blood clot formation in coronary arteries.
  - Atherosclerosis also causes occlusions.
  - Hardening of the arteries with calcium salts.
  - Contibuting factors:
    - Smoking
    - High cholesterol
    - High blood pressure
    - Diabetes
    - Obesity
    - Lack of exercise





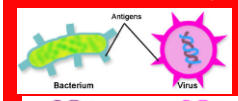
Understandings

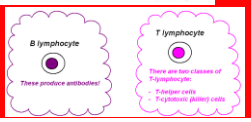
- Ingestion of pathogens by phagocytic white blood cells gives **non-specific immunity** to diseases.
  - Squeeze through pores of capillaries.
  - Engulf (endocytosis) pathogens and destroy with lysosomes.
  - Pus is large numbers of white blood cells.

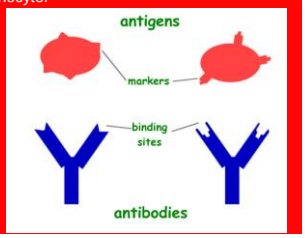


Understandings

- Production of antibodies by lymphocytes in response to particular pathogens gives **specific immunity**.
  - Chemicals that stimulate an immune response are **antigens**.
  - Antigens stimulate the specific lymphocytes to divide (plasma cells).
  - **Antibodies** are produced by lymphocytes in response to antigens.
  - One type of antibody per lymphocyte.
  - Antibodies bind to antigens.

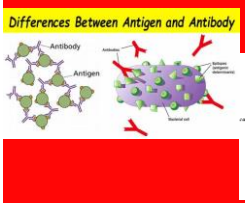






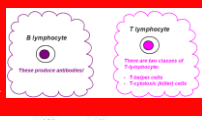
Understandings

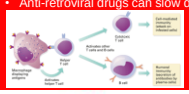
- Production of antibodies by lymphocytes in response to particular pathogens gives **specific immunity**.
  - Antibodies make a pathogen recognizable to phagocytes.
  - Antibodies bind to receptors on viruses.
  - Some lymphocytes become memory cells.
  - Memory cells allow for rapid antibody production during a second exposure.

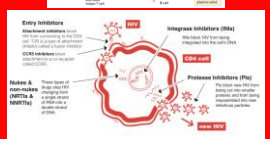


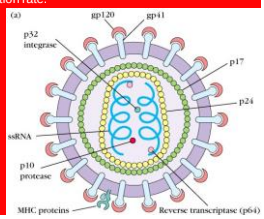
Applications and Skills

- Application: Effects of HIV on the immune system and methods of transmission.
  - Helper T-cells (lymphocytes) are destroyed.
  - Inability to make antibodies.
  - HIV is an RNA virus (retrovirus)
    - Uses reverse transcriptase to make its DNA in host.
    - Anti-retroviral drugs can slow down infection rate.



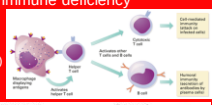


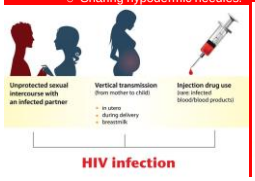


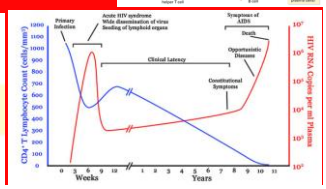


Applications and Skills

- Application: Effects of HIV on the immune system and methods of transmission.
  - Low helper T-cells (low antibodies) allows other infections to occur.
  - A syndrome of infections is AIDS (acquired immune deficiency syndrome)
  - AIDS spreads by:
    - Unprotected sexual intercourse (due to abrasions)
    - Transfusion of infected blood or Factor VIII.
    - Sharing hypodermic needles.

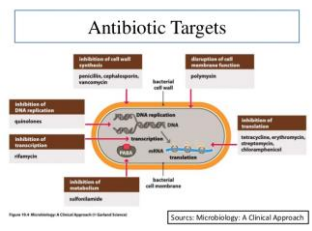






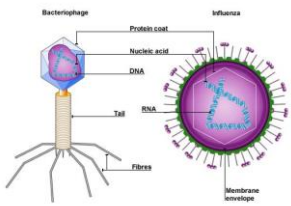
Understandings

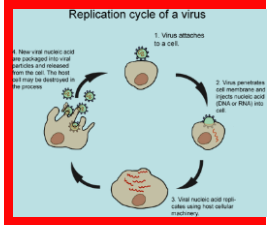
- Antibiotics block processes that occur in prokaryotic cells but not in eukaryotic cells.
  - Discovered in saprotrophic bacteria (*Penicillium*).
  - Inhibits the growth of competitors.
  - Target DNA replication, transcription, translation, ribosome function, and cell wall formation in bacteria.



Understandings

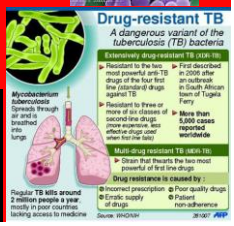
- Viruses lack metabolism and cannot therefore be treated with antibiotics.
  - Viruses are not living organisms.
  - They have no metabolic mechanisms.
  - Destroying host cell mechanisms will destroy the host.
  - Antibiotics are ineffective and escalate bacterial resistance.





Understandings

- Some strains of bacteria have evolved with genes that confer resistance to antibiotics and some strains of bacteria have multiple resistance.
  - Methicillin-resistant *Staphylococcus aureus (MRSA)* is a problem in hospitals.
  - Multidrug-resistant tuberculosis (MDR-TB) has more than 300,000 cases per year.
  - *Streptococcus pyogenes* (strep throat) resistant to erythromycin. (DBQ 310)



Understandings

- Some strains of bacteria have evolved with genes that confer resistance to antibiotics and some strains of bacteria have multiple resistance.
  - Prevention Measures:
    - Prescribe antibiotics only when necessary.
    - Complete the course of antibiotic treatment.
    - Maintain high standards of hygiene in hospitals.
    - Don't use antibiotics in food chain to increase growth.
    - Develop new antibiotics (none since the 1980's).

End