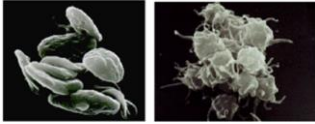
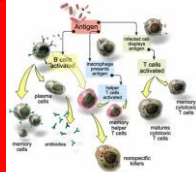


Human Physiology

6.3- Defense Against Infectious Disease

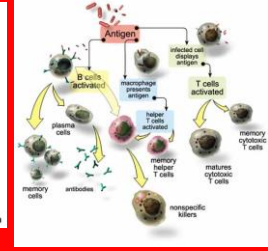
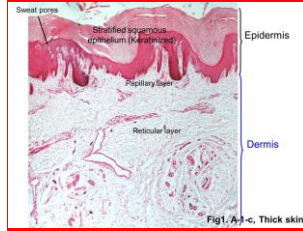


Resting platelets Activated platelets



Essential idea:

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



Nature of science:

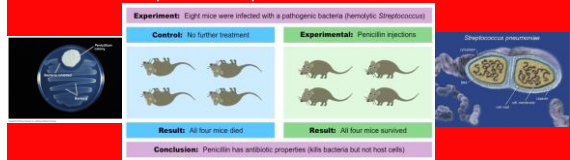
- Risks associated with scientific research
 - Florey and Chain's tests on the safety of penicillin would not be compliant with current protocol on testing. (4.8)



Sir Alexander Fleming (1881-1955) Ernst Boris Chain (1906-1979) Sir Howard Walter Florey (1896-1968)

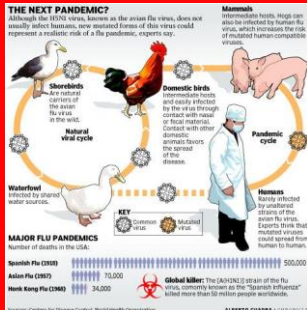
Applications and Skills

- 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.



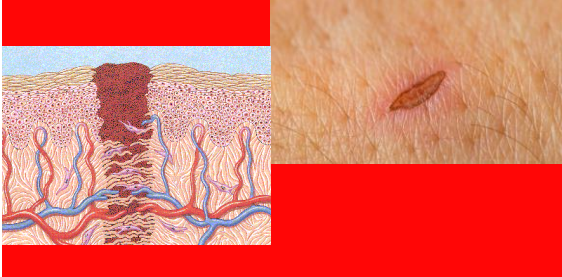
Understandings

- The skin and mucous membranes form a primary defense against pathogens that cause infectious disease.

- Sebaceous glands secrete sebum
 - Moistens skin
 - Lowers skin pH (inhibits bacteria and fungi)
- Mucus Membranes
 - Secrete glycoproteins
 - 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.

Blood Clotting Factors	
Factor Number	Common Name
I	Fibrinogen
II	Prothrombin
III	Tissue Factor
IV	Ca ²⁺
Va	Proaccelerin
Vb	Proconvertin
VIII	Antithrombin Factor
IX	Christmas Factor
X	Stuart Factor
XI	Hageman (Hagemann) Factor
XII	Hageman Factor
XIII	Fibrin Stabilizing 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.

Critical Role of Thrombin

Thrombin is the link between vascular injury, coagulation, and platelet activation

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.
 - Contributing factors:
 - Smoking
 - High cholesterol
 - High blood pressure
 - Diabetes
 - Obesity
 - Lack of exercise



Remember 6.2 Notes Applications and Skills

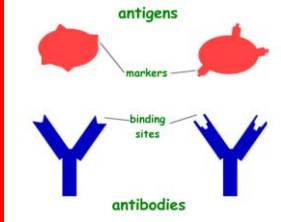
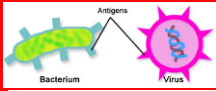
- Application: Causes and consequences of occlusion of the coronary arteries.
 - Atherosclerosis
 - Fatty bases (atheroma) buildup
 - LDLs (low density lipoproteins) accumulate and phagocytes are attracted
 - Phagocytes grow large and are encapsulated, creating a thrombus of the lumen.

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

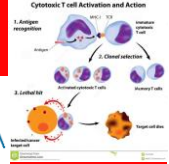
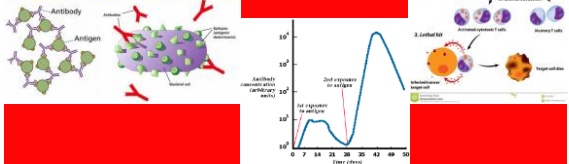
- Production of antibodies by lymphocytes in response to particular pathogens gives **specific immunity**.
 - Chemicals that stimulate an immune response are **antigens**.
 - Antigens stimulate the specific lymphocytes to divide (plasma cells).
 - Antibodies** are produced by lymphocytes in response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



Understandings

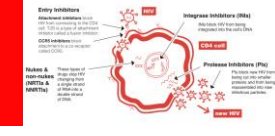
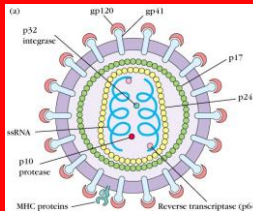
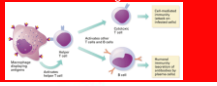
- Production of antibodies by lymphocytes in response to particular pathogens gives **specific immunity**.
 - Antibodies make a pathogen recognizable to phagocytes.
 - Antibodies bind to receptors on viruses.
 - Some lymphocytes become memory cells.
 - Memory cells allow for rapid antibody production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

Differences Between Antigen and Antibody



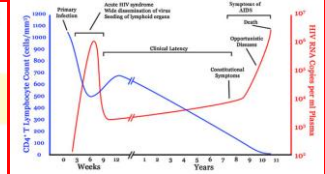
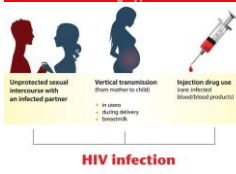
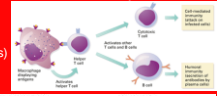
Applications and Skills

- 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.



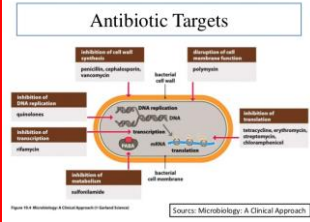
Applications and Skills

- 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.



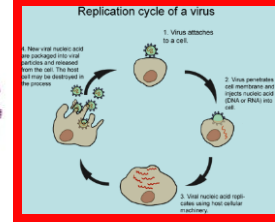
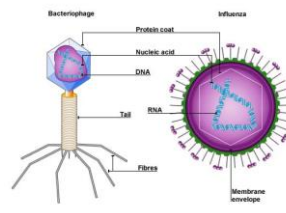
Understandings

- 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)



Drug-resistant TB
A dangerous variant of the tuberculosis (TB) bacteria

Resistance to the first-line drugs

- Resistant to the first-line drugs of the four first-line standard of drugs against TB
- First described in 2008 after an outbreak in South African town of Tugela Ferry
- More than 3,000 cases reported worldwide

How drug-resistant TB spreads

- Spread through air and is breathed into lungs
- More than 1,300 cases reported worldwide
- Drug resistance is caused by:
 - Incorrect prescription
 - Poor quality drugs
 - Erratic supply of drugs
 - Patient non-adherence

Regular TB kills around 2 million people a year, mostly in poor countries, leading access to medicines

ERYTHROMYCIN-RESISTANT GROUP A STREPTOCOCCUS

1,300 cases reported worldwide

160 cases reported worldwide

1-2.6 MILLION cases reported worldwide

ERYTHROMYCIN RESISTANT GROUP A STREPTOCOCCUS

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).



80% of All U.S. Antibiotics are Used On Factory Farm Animals

Antibiotic Resistance

STOP!

Patients, Visitors & Staff

Please use the hand hygiene gel provided, before, after, and during the visit or department.