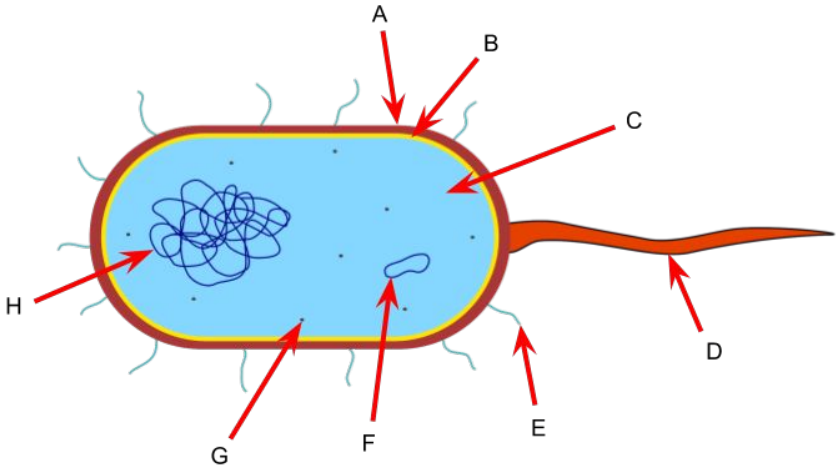
Edexcel IAL Biology A-level

6.5-6.15 - Disease and Defence

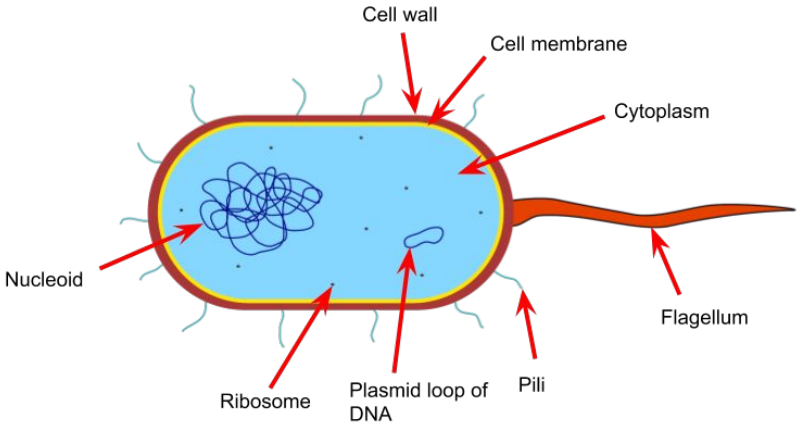
Flashcards

Label this diagram of a bacterium

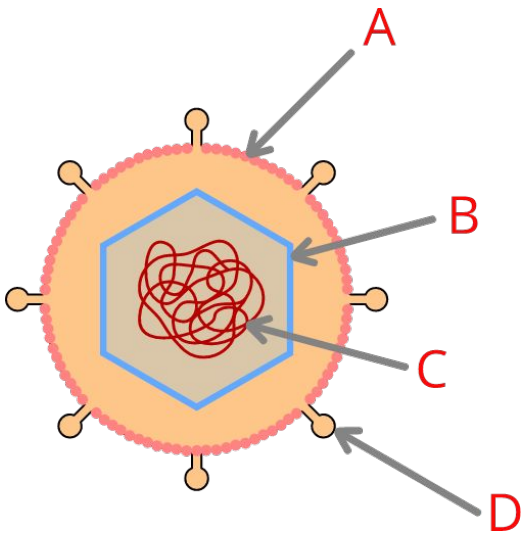


Label this diagram of a bacterium

A	Cell wall (on the outside)	E	Pili
B	Cell membrane (on the inside)	F	Plasmid loop of DNA
C	Cytoplasm	G	Ribosome
D	Flagellum	H	Nucleoid

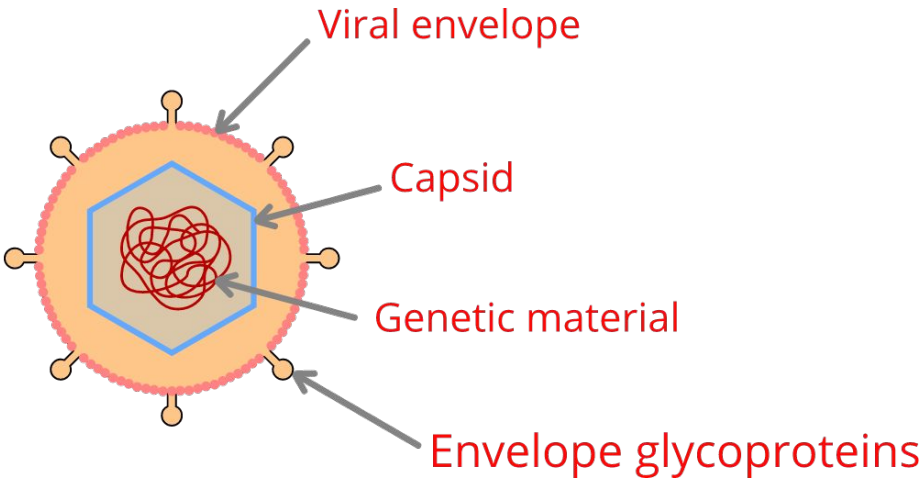


Label this diagram of a virus



Describe the structure of a virus

A	Viral envelope
B	Capsid
C	Genetic material
D	Envelope glycoprotein



Why are viruses classified as non-living?

Why are viruses classified as non-living?

They are acellular: no cytoplasm, no metabolism and cannot self-replicate

Name three types of virus and give examples

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- **DNA virus** e.g. lambda (λ) phage
- **RNA virus** e.g. tobacco mosaic virus and Ebola
- **RNA retrovirus** e.g. human immunodeficiency virus (HIV)

Describe Ebola

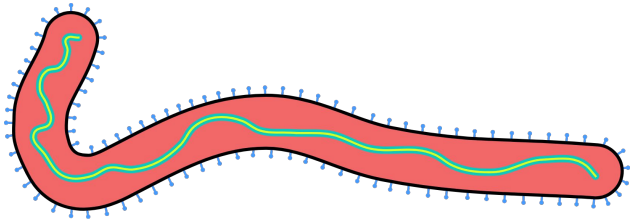
Describe Ebola

- Caused by Ebola **virus**
- Spread by direct contact with infected **body fluids** e.g. blood, semen, saliva, mucus, vomit
- Symptoms: fever, diarrhoea, vomiting, internal bleeding

What virus causes ebola?

What virus causes ebola?

Ebola can be caused by different viruses which are all members of the *Ebolavirus* **genus** which is a part of the *Filoviridae* (filament shaped) **family** of viruses



Compare and contrast the tobacco mosaic virus and Ebola

Compare and contrast the tobacco mosaic virus and Ebola

- Both are RNA viruses
- Tobacco mosaic virus contains ssRNA, which can be directly translated into proteins by ribosomes
- Ebola contains negative ssRNA, which needs to be transcribed to produce mRNA before translation.

How does the tobacco mosaic virus cause disease?

How does the tobacco mosaic virus cause disease?

Affects plants. Mainly transmitted via infected sap

Contains ssRNA, which is directly transcribed by host cell to assemble new virions

Virions enter other cells via plasmodesmata then enter xylem & phloem

Causes stunted growth & mottled leaves

What is tuberculosis?

What is tuberculosis?

A bacterial disease, caused by *Mycobacterium tuberculosis* and *M. bovis*, that damages lymph nodes in the lungs and neck, and weakens the immune system

How is tuberculosis transmitted?

How is tuberculosis transmitted?

Airborne droplet transmission

What is the lambda (λ) phage virus?

What is the lambda (λ) phage virus?

A type of bacteriophage virus which infects E. coli bacteria

Describe the general structure of a lambda (λ) phage virus

Describe the general structure of a lambda (λ) phage virus

It has a head and tail region. The head region contains a double stranded DNA genome. The tail facilitates attachment and the insertion of the viral DNA into the bacterium

Describe the lysogenic pathway

Describe the lysogenic pathway.

1. Non-virulent viruses inject DNA into host cell DNA as provirus. Viral DNA replicates when host cell divides
2. Virus produces repressor proteins to inhibit transcription
3. Latent virus enters lytic pathway when host cell is damaged or immune system weakens.

Describe the lytic cycle

Describe the lytic cycle

1. Virulent viruses inject nucleic acid into host cell cytoplasm. Viral genetic information replicates immediately, independent of host cell DNA
2. Many virions assemble, causing cell lysis

Describe HIV

Describe HIV

- Caused by human immunodeficiency **virus**
- Spread by direct contact with infected **body fluids** e.g. blood, semen, breast milk
- Destroys white blood cells making the individual immunodeficient and increasingly susceptible to other diseases. Leads to **AIDS**

How does HIV result in the symptoms of AIDS?

How does HIV result in the symptoms of AIDS?

1. Attachment proteins bind to complementary CD4 receptor on T_H cells
2. HIV particles replicate inside T_H cells, killing or damaging them
3. AIDS develops when there are too few T_H cells for the immune system to function
4. Individuals cannot destroy other pathogens and suffer from secondary diseases/ infections. May cause death

What is the latency period?

What is the latency period?

The period of time following infection before symptoms appear

What is a ‘pathogenic’ organism?

What is a ‘pathogenic’ organism?

An organism that has the ability to cause damage to a host

Give four major routes of infection in humans

Give four major routes of infection in humans

- Droplet infection (coughing/sneezing)
- Direct contact (skin to skin contact or contact with infected fluids)
- Oral (ingesting contaminated food/drink)
- Airborne (small infected particles which can travel in the air)

What is indirect transmission?

What is indirect transmission?

Transmission which requires a **vector** intermediate

Outline the natural defences in the body that reduce the risk of infection

Outline the natural defences in the body that reduce the risk of infection

- **Skin** - protective layer
- **Skin flora** - protection from harmful pathogens, compete with them for nutrients
- **Blood clotting** - seals wounds
- **Lysozymes** - tears, hydrolyse bacterial cell walls
- **Hydrochloric acid** - stomach, kills bacteria
- **Mucous membranes** - trap pathogens and may secrete antimicrobial enzymes
- **Phagocytosis** - destroys pathogens
- **Inflammation** - localises and eliminates the cause of injury

What are skin flora?

What are skin flora?

Microorganisms which naturally live on the skin. They are usually harmless to humans but act as a useful defence against pathogens

How do skin flora help to prevent infections?

How do skin flora help to prevent infections?

They compete with pathogenic microorganisms for resources and nutrients. This hinders the growth of harmful microorganism colonies

What are non-specific immune responses?

What are non-specific immune responses?

Defences which do not target a single type of antigen or pathogen but rather a wide range of different pathogens. Some examples include inflammation and phagocytosis

Name four ways the nonspecific immune system responds to infection

Name four ways the nonspecific immune system responds to infection

- inflammation
- phagocytosis
- digestive action of lysozymes
- production of interferon (antiviral agent)

What are interferons?

What are interferons?

A type of signalling molecule involved in the non-specific immune response. It is secreted by virus infected cells to alert nearby cells and activate immune cells

Outline the process of phagocytosis

Outline the process of phagocytosis

1. Phagocyte moves towards pathogen via **chemotaxis**
2. Phagocyte engulfs pathogen via endocytosis to form a **phagosome**
3. Phagosome fuses with lysosome (**phagolysosome**)
4. Lysozymes **digest pathogen**
5. Phagocyte absorbs the products from pathogen hydrolysis

What are lysozymes?

What are lysozymes?

Digestive enzymes. Often found in secretions e.g. tears & mucus. Damage bacterial cell walls, causing osmotic lysis

Outline the general process of inflammation

Outline the general process of inflammation

1. Damaged vessels release histamines, causing vasodilation
2. Blood flow & permeability of blood vessels increase
3. White blood cells & plasma enter the infected tissue

Explain the role of antigen-presenting cells (APCs)

Explain the role of antigen-presenting cells (APCs)

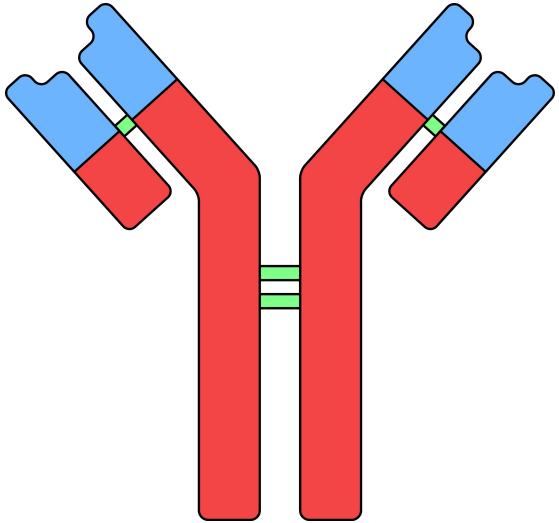
Macrophage displays antigen from pathogen on its surface (after hydrolysis in phagocytosis)

Enhances recognition by T_H cells, which cannot directly interface with pathogens/ antigens in body fluid

What are antibodies?

What are antibodies?

Y-shaped proteins which are secreted by plasma cells. They bind complementarity to antigens on pathogens and aid in the specific immune response



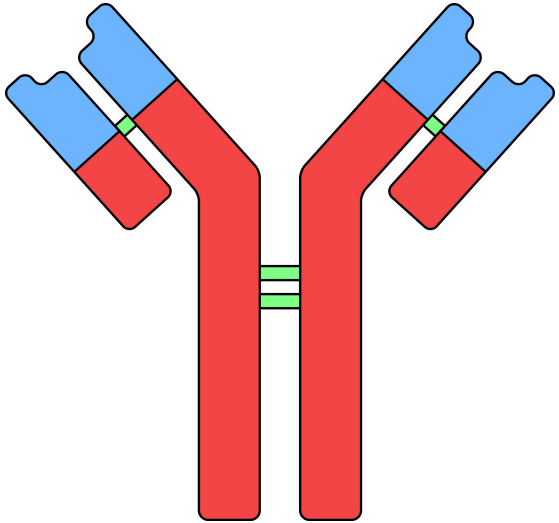
Describe the structure of antibodies

Describe the structure of antibodies

quaternary structure: 2 '**light chains**' held by **disulfide bridges**, 2 longer '**heavy chains**'

Binding sites on **variable region** of light chains have specific tertiary structure **complementary to an antigen**.

The rest of the molecule is known as the **constant region**



How do antibodies lead to the destruction of a pathogen?

How do antibodies lead to the destruction of a pathogen?

- Formation of antigen-antibody complex results in agglutination
- Activation of complement
- Opsonisation (marks microbes for phagocytes)
- Precipitation/neutralisation (makes toxins insoluble)

What is an antigen?

What is an antigen?

- Cell-surface molecule can stimulate immune response
- Usually (glyco)protein, sometimes (glyco)lipid or polysaccharide
- Immune system recognises as “self” or “non-self” = enables identification of cells from other organisms of same species, pathogens, toxins & abnormal body cells

What are antigen presenting cells (APCs)?

What are antigen presenting cells (APCs)?

Any type of immune cell which displays parts of a pathogen (antigens) on its surface to elicit an immune response

What are plasma cells?

What are plasma cells?

A type of fully matured and differentiated B-lymphocyte which produces a specific antibody

Name the two types of specific immune response.

Name the two types of specific immune response.

- Cell-mediated
- Humoral

Name the two main types of B-lymphocyte

Name the two main types of B-lymphocyte

- B memory cell
- B effector cell

Name the three main types of T-lymphocyte

Name the three main types of T-lymphocyte

- T killer cell
- T memory cell
- T helper cell

Outline the process of the cell-mediated response.

Outline the process of the cell-mediated response.

1. **Complementary** T_H lymphocytes bind to foreign antigen on APC
2. Stimulates:
   a. clonal expansion of complementary T_H cells: become **memory cells** or trigger **humoral response**
   b. clonal expansion of **cytotoxic T cells** (T_C): secrete enzyme **perforin** to destroy infected cells

What is clonal selection?

What is clonal selection?

The process by which a specific antigen activates a certain B cell by binding to a unique and highly specific receptor on the B lymphocytes. This causes it to undergo cell division to produce many identical clones

What is clonal expansion?

What is clonal expansion?

T/ B cells that are complementary to an antigen undergo rapid mitotic division to form many cloned cells

Outline the process of the humoral response

Outline the process of the humoral response.

1. **Complementary** T_H lymphocytes bind to foreign antigen on antigen-presenting T cells
2. Release cytokines that stimulate clonal expansion of **complementary B lymphocytes**
3. B cells differentiate into **plasma cells**
4. Plasma cells secrete **antibodies** with complementary variable region to antigen.

What is the function of T and B memory cells?

What is the function of T and B memory cells?

They remain in the body for a long time following an infection and provide long-term immunity. If the same pathogen is encountered in the future, they can divide rapidly to provide an effective secondary immune response

What is the function of T helper cells?

What is the function of T helper cells?

They regulate the adaptive immune response through the release of cell signalling molecules called cytokines. They activate many effector cells in the adaptive immune system like T killer cells and B lymphocytes

What is the function of T killer cells?

What is the function of T killer cells?

T killer cells induce apoptosis (programmed cell death) in virus infected, damaged or cancerous cells

Compare the primary and secondary immune responses

Compare the primary and secondary immune responses

- **Primary immune response** - initial response when a pathogen is first encountered. A small number of antibodies are produced slowly
- **Secondary immune response** - pathogen encountered for a second (third, fourth…etc.) time. Immunological memory gives a rapid production of a large number of antibodies

What is happening during the latent period of the primary immune response?

What is happening during the latent period of the primary immune response?

- Antigen-presenting cells carrying out phagocytosis
- T helper cells detect antigens and secrete cytokines
- Proliferation and differentiation of specific B and T cells

Define active immunity

Define active immunity.

Resistance in an organism that has developed through the **production of specific antibodies** in response to a pathogen. It provides **long-lasting immunity** as memory cells are produced

What are the two types of active immunity?

What are the two types of active immunity?

- **Natural active immunity** - production of antibodies by the immune system following infection
- **Artificial active immunity** - production of antibodies by the immune system following the exposure to a weakened, attenuated or dead pathogen

Give an example of artificial active immunity

Give an example of artificial active immunity

Vaccination against rubella

How do vaccinations that use antigens provide long-lasting immunity?

How do vaccinations that use antigens provide long-lasting immunity?

- Antigens in vaccine trigger primary immune response without infection
- If a pathogen is encountered, secondary immune response destroys the pathogen before symptoms develop

Define passive immunity

Define passive immunity

Resistance in an organism acquired via the **transfer** of antibodies. It provides **short-term immunity** as no memory cells are produced

What are the two types of passive immunity?

What are the two types of passive immunity?

- **Natural passive immunity** - immunity acquired by an infant mammal when antibodies are transferred through the placenta and the colostrum from the mother
- **Artificial passive immunity** - immunity acquired from the administration of specific antibodies from another organism

Give an example of artificial passive immunity

Give an example of artificial passive immunity

Treatment of rabies

How do vaccinations that use antibodies provide short-term immunity?

How do vaccinations that use antibodies provide short-term immunity?

- Antibodies give rapid protection against a harmful microorganism
- Allows time for the development of an active immune response

Why is there an ‘evolutionary race’ between pathogens and their host?

Why is there an ‘evolutionary race’ between pathogens and their host?

- Host defences are selection pressure for bacteria. Random genetic mutations may enable bacteria to evade these defences
- Hosts with phylogenetic characteristics that reduce likelihood & symptoms of infection have a selective advantage

What are bactericidal antibiotics?

What are bactericidal antibiotics?

A class of antibiotics which kill bacteria by inhibiting major metabolic processes and biosynthesis pathways

What are bacteriostatic antibiotics?

What are bacteriostatic antibiotics?

A class of antibiotics which prevent bacteria from growing by interfering with processes required for their growth such as metabolism or DNA replication

How do hospitals minimise the spread of antibiotic resistant bacteria?

How do hospitals minimise the spread of antibiotic resistant bacteria?

- Screening and quarantine of affected patients
- Hygiene code of practice e.g. alcohol-based antibacterial gels
- Antibiotics prescribed only when necessary and course completed to minimise selection pressure