WJEC (Eduqas) Biology A-level

Unit 4.A - Immunology and disease

Flashcards

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What is a ‘pathogenic’ organism?

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What is a ‘pathogenic’ organism?

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

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What is an ‘infectious’ disease?

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What is an ‘infectious’ disease?

Describes a disease that can be transmitted between individuals.

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Define carrier.

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Define carrier.

An infected individual that is asymptomatic but can spread the disease.

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What is the disease reservoir?

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What is the disease reservoir?

The environment (host) in which an infectious pathogen is found.

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Define endemic.

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Define endemic.

A disease that is ever-present in an area.

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Define epidemic.

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Define epidemic.

A rapid rise in the incidence of a communicable disease at a local or national level.

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What is a pandemic?

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What is a pandemic?

An epidemic that occurs worldwide, affecting a large number of individuals.

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Define vaccination.

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Define vaccination.

The deliberate exposure of an individual to non-pathogenic forms, antigens or products of pathogens to provide artificial active immunity.

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What is an antibiotic?

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What is an antibiotic?

A chemical or compound produced by a living organism that kills or prevents the growth of bacteria.

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What is an antigen?

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What is an antigen?

A chemical present on the surface of a cell that induces an immune response.

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Define antibodies.

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Define antibodies.

Immunoglobulins produced by B-lymphocytes in response to a specific antigen, triggering an immune response.

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What are antibiotic-resistant bacteria?

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What are antibiotic-resistant bacteria?

Bacteria that mutate to become resistant to an antibiotic, survive and reproduce very rapidly, passing on their antibiotic resistance.

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Define vector.

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Define vector.

A living or non-living agent that transmits a pathogen between organisms.

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What is a toxin?

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What is a toxin?

A substance produced by a pathogen that causes damage to its host.

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What are antigenic types?

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What are antigenic types?

Organisms that possess the same or similar antigens on their surface, e.g. strains of a bacteria.

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How are antigenic types usually identified?

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How are antigenic types usually identified?

Using antibodies from serum.

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What is a host?

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What is a host?

The organism from which a pathogen or parasite obtains nutrients and/or shelter.

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Give some examples of bacterial infections.

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Give some examples of bacterial infections.

- Cholera
- Tuberculosis

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What is cholera?

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What is cholera?

A disease caused by strains of the Gram negative bacterium, *Vibrio cholerae*, the toxins of which cause severe diarrhoea leading to dehydration.

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How is cholera spread?

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How is cholera spread?

- Fecal/oral transmission
- Ingesting contaminated food or water

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How is cholera treated?

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How is cholera treated?

- Rehydration (fluid and electrolytes)
- Antibiotics

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What is tuberculosis?

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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.

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How is tuberculosis transmitted?

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How is tuberculosis transmitted?

Airborne droplet transmission

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Describe the methods of tuberculosis prevention and treatment.

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Describe the methods of tuberculosis prevention and treatment.

- **Prevention** - BCG vaccination of children
- **Treatment** - extensive course of antibiotics

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Give some examples of viral infections.

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Give some examples of viral infections.

- Influenza
- Smallpox

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How is the influenza virus transmitted?

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How is the influenza virus transmitted?

- Droplet infection
- Contact with contaminated surfaces

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What tissue is affected by influenza?

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What tissue is affected by influenza?

Upper respiratory tract

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Describe the symptoms of influenza.

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Describe the symptoms of influenza.

Headache, coughing and sneezing, sore throat, vomiting, fever, muscular and joint pain.

May cause secondary bacterial infections.

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How is influenza treated?

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How is influenza treated?

- Quarantine
- Antiviral medication
- Antibiotics treat secondary bacterial infections
- Management of symptoms, e.g. painkillers

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What is smallpox?

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What is smallpox?

A disease caused by the virus *Variola major* that affects the skin and multiple other organs.

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How is smallpox spread?

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How is smallpox spread?

- Droplet transmission
- Bodily fluids

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Describe the symptoms of smallpox.

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Describe the symptoms of smallpox.

Symptoms include a headache, fever and pockmarking of the skin.

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Describe how smallpox has been eradicated.

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Describe how smallpox has been eradicated.

Due to a successful vaccination program.

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What properties of the smallpox virus made its eradication possible?

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What properties of the smallpox virus made its eradication possible?

- Little variation in antigens
- Low rate of antigenic mutation
- Immunogenic nature of antigens
- No animal reservoir

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Give an example of a protoctistan infection.

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Give an example of a protoctistan infection.

Malaria

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Name the malarial parasite.

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Name the malarial parasite.

Plasmodium spp.

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Outline the mode of transmission and infection of the *Plasmodium spp.* parasite.

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Outline the mode of transmission and infection of the *Plasmodium spp.* parasite.

- Female mosquito acts as vector when it transfers saliva to another organism during feeding
- Parasite reproduces asexually in red blood cells in liver, causing lysis

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Describe the effects of malaria on an infected individual.

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Describe the effects of malaria on an infected individual.

It causes recurrent episodes of fever and can be fatal.

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How is endemic malaria controlled?

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How is endemic malaria controlled?

- **Preventing mosquito bites** - mosquito nets, insect repellent
- **Controlling mosquito numbers** - pesticides, chemical treatment of standing water and sewage, introduction of predators for mosquitoes
- **Drug treatment**

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What are viruses?

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What are viruses?

Non-living infectious agents that invade host cells and take over cell metabolism, replicating within them.

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Outline the forms that the pathogenicity of viruses can take.

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Outline the forms that the pathogenicity of viruses can take.

- Cell lysis
- Cell transformation
- Production of toxins
- Immune system suppression

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What is cell lysis?

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What is cell lysis?

- The disruption of cell membranes, destroying the cell
- Virions released

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Describe cell transformation.

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Describe cell transformation.

Viruses can stimulate healthy cells to become cancerous.

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Give an example of a virus that suppresses the immune system of the host.

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Give an example of a virus that suppresses the immune system of the host.

HIV

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State the two types of antibiotics.

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State the two types of antibiotics.

- Bacteriostatic
- Bactericidal

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How do bacteriostatic antibiotics work?

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How do bacteriostatic antibiotics work?

Prevent bacteria from growing by interfering with processes required for their growth such as metabolism or DNA replication.

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What are bactericidal antibiotics?

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What are bactericidal antibiotics?

Antibiotics that kill bacteria.

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What is a narrow-spectrum antibiotic?

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What is a narrow-spectrum antibiotic?

An antibiotics that is only effective against a narrow range of bacteria.

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What is a broad-spectrum antibiotic?

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What is a broad-spectrum antibiotic?

An antibiotic that targets a wide range of bacteria.

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What are bacterial cell walls made up of?

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What are bacterial cell walls made up of?

A three-dimensional mesh of peptidoglycan (murein), a polymer of amino acids and sugars.

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Define Gram positive bacteria.

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Define Gram positive bacteria.

Bacteria that have a **thick peptidoglycan wall** and a **purple** appearance following gram staining.

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Define Gram negative bacteria.

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Define Gram negative bacteria.

Bacteria that have a **thin peptidoglycan wall** with an outer **lipopolysaccharide** membrane and a **red** appearance following gram staining.

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What type of antibiotic is penicillin?

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What type of antibiotic is penicillin?

Narrow-spectrum antibiotic

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Describe how penicillin affects bacteria.

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Describe how penicillin affects bacteria.

- Kills Gram-positive bacteria and damages Gram-negative bacteria
- Prevents the formation of cross-links between molecules in the peptidoglycan wall, so when osmotic changes occur, the cell undergoes lysis

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How does penicillin prevent the formation of cross-links in the peptidoglycan wall?

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How does penicillin prevent the formation of cross-links in the peptidoglycan wall?

- Transpeptidase catalyses the formation of cross-links in the peptidoglycan wall
- Penicillin is a competitive inhibitor of transpeptidase

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Why doesn’t penicillin kill Gram-negative bacteria?

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Why doesn't penicillin kill Gram-negative bacteria?

Gram-negative bacteria do not completely lose their cell walls due to the presence of an outer lipopolysaccharide membrane.

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What type of antibiotic is tetracycline?

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What type of antibiotic is tetracycline?

Broad-spectrum antibiotic

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Describe the effect of tetracycline on bacteria.

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Describe the effect of tetracycline on bacteria.

- Inhibits translation during protein synthesis
- Competitive inhibitor of an anticodon-binding site on the 30S ribosomal subunits, preventing the formation of new proteins

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Why do antibiotics not affect viruses?

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Why do antibiotics not affect viruses?

Viruses do not have metabolic pathways.

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Why are some bacteria resistant to treatment by antibiotics?

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Why are some bacteria resistant to treatment by antibiotics?

1. Random genetic **mutation**, often on plasmid, confers **resistance**, e.g. antigen shape changes

2. These bacteria have **selective advantage** in the presence of antibiotics, reproduce and pass allele for resistance to offspring

3. **Directional selection** results in resistant strain

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What are natural barriers?

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What are natural barriers?

Defences that are always present and are the same for all organisms.

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

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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

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Describe the specific immune response.

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Describe the specific immune response.

- Second line of defense against pathogens triggered by foreign antigens
- Two types: **humoral** immune response and **cell-mediated** immune response.

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What are T lymphocytes?

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What are T lymphocytes?

Lymphocytes that mature in the thymus gland.

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What are B lymphocytes?

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What are B lymphocytes?

Lymphocytes that are produced in the bone marrow and mature in the spleen and lymph nodes.

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Outline the process of the cell-mediated response.

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Outline the process of the cell-mediated response.

Complementary T helper lymphocytes bind to foreign antigens on **antigen-presenting cell**. T cells undergo clonal expansion. Three main types of T lymphocytes produced:

- T effector cells
- T helper cells
- T memory cells

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Explain the role of antigen-presenting cells.

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Explain the role of antigen-presenting cells.

- Macrophage displays antigen from pathogen on its surface (after hydrolysis in phagocytosis)
- Enhances recognition by T helper cells, which cannot directly interface with pathogens/antigens in body fluid
- Secrete cytokines that are involved in stimulating specific immune response

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What are T effector cells?

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What are T effector cells?

- T killer cells or cytotoxic T lymphocytes
- Causes lysis of damaged or infected cells

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Describe the role of T helper cells.

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Describe the role of T helper cells.

- Regulate the immune response through the release of cytokines
- Cytokines stimulate the proliferation of B lymphocytes

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Describe the role of T memory cells.

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Describe the role of T memory cells.

Remain in the blood and provide immunological memory.

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Outline the process of the humoral response.

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Outline the process of the humoral response.

1. **Complementary** T helper lymphocytes bind to foreign antigens on antigen-presenting T cells
2. Cytokines released that stimulate the clonal expansion of **complementary B lymphocytes**
3. B lymphocytes differentiate into **plasma cells**
4. Plasma cells secrete **antibodies** with complementary variable region to antigen. Antibodies destroy the pathogen

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Describe the structure of an antibody.

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Describe the structure of an antibody.

- Y-shaped
- Two '**light chains**' bonded to two longer '**heavy chains**'
- Two binding sites
- Specific to a particular antigen

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Compare the primary and secondary immune responses.

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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.

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

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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

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Define active immunity.

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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.

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What are the two types of active immunity?

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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

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Give an example of artificial active immunity.

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Give an example of artificial active immunity.

Vaccination against rubella.

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

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

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

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Define passive immunity.

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Define passive immunity.

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

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What are the two types of passive immunity?

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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

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Give an example of artificial passive immunity.

CC BY NC ND

Give an example of artificial passive immunity.

Treatment of rabies.

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

CC BY NC ND

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

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Describe the different levels of effectiveness of vaccination programmes against different diseases.

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Describe the different levels of effectiveness of vaccination programmes against different diseases.

- **Single round** of vaccinations protects against pathogens that have **low levels** of antigenic variation/mutation, e.g. Rubella
- **Repeated vaccinations** used against pathogens that have various antigenic types and mutate frequently, e.g. Influenza

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Outline the ethical considerations that must be considered when designing vaccination programmes.

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Outline the ethical considerations that must be considered when designing vaccination programmes.

- **Cost** of developing the vaccine
- **Effectiveness** of the vaccine
- Rights of the **individual** vs rights of the entire **population** to be protected
- Possible **side effects**
- **Religious concerns**
- Testing on **animals** and **unaffected** individuals

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