WJEC (Wales) Biology A-level

Option A - Immunology and Disease

Definitions and Concepts

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.

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

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

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

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

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

Artificial active immunity - The production of antibodies by the immune system following the exposure to a weakened, attenuated or dead pathogen, e.g. vaccination against rubella.

Artificial passive immunity - The immunity acquired from the administration of specific antibodies from another organism, e.g. treatment of rabies.

Bacteria - Prokaryotic cells that have cell walls but lack organelles. Some bacteria are pathogenic, producing toxins that damage host cells.

Bactericidal antibiotic - A type of antibiotic that kills bacteria.

Bacteriostatic antibiotic - A type of antibiotic that prevents bacteria from growing by interfering with processes required for their growth such as metabolism or DNA replication.

Blood clotting - The process by which blood forms a clot over a wound, preventing excessive bleeding.

B lymphocytes - Lymphocytes that are produced in the bone marrow and mature in the spleen and lymph nodes. There are two main types: plasma cells and memory cells.

Broad-spectrum antibiotics - Antibiotics that target a variety of different bacteria, e.g. tetracycline.

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

Cell-mediated immunity - A type of specific immune response that involves the destruction of pathogens, infected cells and cancerous cells by immune cells such as T lymphocytes rather than antibodies.

Cholera - A waterborne disease caused by strains of the Gram negative bacterium, *Vibrio cholerae*, the toxins of which cause severe diarrhoea leading to dehydration. Treatment involves rehydration, and in some cases antibiotics.

Ciliated mucous membranes - Membranes lining the respiratory tract that secrete mucus, trapping harmful microbes in inhaled air. Hair-like structures, known as cilia, waft the mucus up to the back of the throat where it is swallowed.

Clonal expansion - The mass proliferation of specific antibody-producing cells.

Clonal selection - The identification of an antibody-producing cell with complementary receptors to the shape of a specific antigen.

Disease reservoir - The environment in which an infectious pathogen is found.

Endemic - A disease that is ever-present in an area.

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

Gram negative - Describes bacteria that have a thin peptidoglycan wall with an outer lipoprotein and lipopolysaccharide membrane. This extra layer protects the bacteria from antibacterial agents such as penicillin.

Gram positive - Describes bacteria that have a thick peptidoglycan wall.

Host - The organism from which a pathogen or parasite obtains nutrients and/or shelter. The human body acts as a host to many different organisms.

Humoral immune response - A type of specific immune response that involves the production and secretion of antibodies specific to a particular antigen.

Infectious - Describes a disease that can be transmitted between individuals.

Inflammation - A localised response of vascular tissue to pathogens, damage or irritants. It is characterised by pain, redness, heat and swelling.

Influenza - A common viral infection caused by the family of viruses, *Orthomyxoviridae,* that destroys ciliated epithelial cells in the gaseous exchange system, exposing the airways to secondary infection.

Lymphocytes - White blood cells that contribute to the specific immune response.

Lysozyme - The enzyme present in secretions such as tears, saliva and mucous which breaks down bacterial cell walls.

Malaria - A disease caused by the protoctista *Plasmodium* that lives within two hosts, mosquitoes and humans. It causes recurrent episodes of fever and can be fatal. Drug treatments are available to reduce the risk of infection.

Memory cells - T or B lymphocytes that remain in the blood and provide immunological memory.

Narrow-spectrum antibiotics - Antibiotics that are only effective against a narrow range of bacteria, e.g. penicillin is used against Gram positive bacteria.

Natural active immunity - The production of antibodies by the immune system following infection.

Natural barriers - Defences that are always present and are the same for all organisms, e.g. skin, blood clotting, mucous membranes, inflammation and phagocytosis.

Natural passive immunity - The immunity acquired by an infant mammal when antibodies are transferred through the placenta and the colostrum from the mother.

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

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

Pathogen - A disease-causing microorganism. Includes bacteria, viruses, fungi and protoctista.

Pathogenicity - The capacity of a pathogen to cause disease or damage in a host.

Penicillin - A narrow-spectrum antibiotic that kills Gram positive bacteria. It prevents the formation of cross-links between molecules in the peptidoglycan wall, so when osmotic changes occur, the cell undergoes lysis.

Peptidoglycan - A polymer consisting of amino acids and sugars that forms a 3D mesh and makes up the cell walls of most bacteria.

Phagocytes - Specialised white blood cells that engulf and destroy pathogens.

Phagocytosis - The process by which phagocytes engulf and destroy pathogens.

Plasma cell - A type of B lymphocyte that produces antibodies specific to a particular antigen.

Primary immune response - The response of the immune system to a pathogen when it is first encountered. A small number of antibodies are produced slowly.

Protoctista - A group of eukaryotic, single-celled microorganisms that may cause disease. They digest cells and use the cell contents to reproduce.

Secondary immune response - The response of the immune system to a pathogen when it is encountered for a second (third, fourth…etc.) time. Immunological memory gives a rapid production of a large number of antibodies.

Skin flora - A group of typically harmless microorganisms which are found on the surface of the skin and provide protection from harmful pathogens by competing with them for nutrients.

Smallpox - A disease caused by the virus *Variola major*. Symptoms include a headache, fever and pockmarking of the skin. The World Health Organisation registers that the disease has been eradicated due to a successful vaccination program.

Specific immune response - The second line of defense against pathogens triggered by foreign antigens. There are two types: humoral immune response and cell-mediated immune response.

Tetracycline - A broad-spectrum bacteriostatic antibiotic that inhibits translation during protein synthesis. It acts as a competitive inhibitor of an anticodon-binding site on the 30S ribosomal subunits, preventing the formation of new proteins.

T helper cell - A type of T lymphocyte that regulates the immune response through the release of cytokines.

T killer cell - A type of T lymphocyte that causes lysis of damaged or infected cells.

T lymphocytes - Lymphocytes that mature in the thymus gland. There are three main types: T helper cells, T killer cells and T memory cells.

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

Tuberculosis (TB) - An airborne bacterial disease, caused by *Mycobacterium tuberculosis* and *M. bovis*, that damages lung tissue and weakens the immune system. Treatment involves an extensive course of antibiotics.

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

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

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