Definitions and Concepts for OCR (A) Biology A-Level

Topic 4 - Biodiversity, Evolution and Disease

Topic 4.1: Communicable disease, disease prevention and the immune system

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.

Agglutinins: Chemicals that cause pathogens to aggregate together, aiding phagocytosis. Antibodies can act as agglutinins.

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.

Antigen-presenting cell: A macrophage that displays foreign antigens.

Anti-toxins: Chemicals produced by white blood cells that neutralise toxins released by pathogens.

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

Artificial passive immunity: The immunity acquired from the administration of specific antibodies from another organism, e.g: by vaccination.

Athlete's foot: A form of ringworm in humans that affects the feet, resulting in cracking and scaling of the skin.

Autoimmune disease: A condition in which the immune system attacks and destroys healthy body tissue, e.g: arthritis, lupus.

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

Bacterial meningitis: A severe form of meningitis caused by bacterial infection of the meninges. Complications of bacterial meningitis include septicaemia; a symptom of this is a rash of purple discolouration that does not fade when a glass is pressed against it.

B effector cells: A type of B lymphocyte that divides to form plasma cells.

Black sigatoka: A fungal disease in tomatoes caused by *Mycosphaerella fijiensis*, the hyphae of which penetrate and digest host leaf cells, turning them black.

B lymphocytes: Lymphocytes that mature in the bone marrow. There are three main types; plasma cells, B effector cells and B memory cells.

B memory cells: B lymphocytes that provide immunological memory.

Callose: A plant polysaccharide that contains β-1,3 and β-1,6 linkages between glucose molecules. It is deposited between the cell walls and cell membrane in cells adjacent to infected cells, serving as a defence against pathogens. It is also found in the cell walls of infected cells and the plasmodesmata between infected cells.

Chitinases: Enzymes that degrade chitin in fungal cell walls.

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.

***Clostridium difficile*:** A type of bacteria found in the gut of some individuals which is resistant to most antibiotics.

Communicable disease: A disease that is caused by a pathogen and transmitted directly between organisms.

Cytokines: Cell-signalling molecules produced by mast cells in damaged tissue. They attract white blood cells to the site of damage.

Direct transmission: The transfer of a pathogen directly from one organism to another. This can occur via direct contact, ingestion or the sharing of contaminated needles.

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

Expulsive reflexes: Coughs or sneezes initiated upon irritation of the respiratory tract. They remove microorganism-containing mucus from the gaseous exchange system.

Fungi: Eukaryotic, often multicellular organisms that may cause disease. They digest and destroy cells, and produce spores that can spread rapidly between organisms.

Glucanases: Enzymes produced by plants that decompose glucans, polysaccharides found in oomycete cell walls.

Histamine: A chemical produced by mast cells in damaged tissue. It makes blood vessels dilate and causes their walls to become leakier.

Human Immunodeficiency Virus (HIV): An infectious virus that destroys T helper cells, weakening the immune system of the body. HIV makes an individual more susceptible to opportunistic infections and can lead to AIDS (Acquired Immunodeficiency Syndrome).

Indirect transmission: The transfer of a pathogen indirectly between organisms via fomites, vectors, droplet infection or soil contamination.

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.

Interleukins: Cytokines produced by T helper cells that stimulate B cells.

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

Lysosome: A membrane-bound organelle that contains hydrolytic enzymes.

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.

Mast cells: Specialised cells in connective tissue that are important in the inflammatory response, releasing histamines and cytokines.

MRSA: A type of bacteria that is resistant to the antibiotic methicillin.

Mucous membranes: The membranes lining body cavities that secrete a sticky mucus.

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

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

Non-specific defences: Defenses that are always present and are the same for all organisms, e.g: skin, blood clotting, inflammation, mucous membranes and expulsive reflexes.

Opsonins: Chemicals that bind to and tag foreign cells, making them easily recognisable to phagocytes.

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.

Penicillin: The first conventional, effective and safe antibiotic derived from the mould *Penicillium chrysogenum*. It was discovered by Alexander Flemming.

Personalised medicine: A form of medical care that enables doctors to provide healthcare that is customised to an individual's genotype.

Phagocytes: Specialised white blood cells that engulf and destroy pathogens. There are two types: neutrophils and macrophages.

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

Phagolysosome: A vesicle within a phagocyte formed by the fusion of a phagosome and lysosome.

Phagosome: The vacuole inside a phagocyte in which a foreign particle is engulfed.

Plasma cells: B lymphocytes that produce antibodies specific to a particular antigen.

Potato blight: A disease caused by the fungi-like protoctist *Phytophthora infestans* whose hyphae penetrate host cells, causing the collapse and decay of the leaves, fruit and tubers. Also known as tomato blight or late blight.

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.

Ring rot: A bacterial disease in tomatoes, potatoes and aubergines that results in damage to the leaves, fruit and tubers. It is caused by the *Clavibacter michiganensis* bacterium.

Ringworm: A fungal disease that affects mammals, causing grey-white, circular, crusty lesions on the skin.

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.

Synthetic biology: The design and construction of new biological entities, as well as the reconstruction of pre-existing natural biological systems.

T helper cells: T lymphocytes with CD4 receptors on the cell surface membrane. These bind to antigens on antigen-presenting cells and secrete interleukins.

T killer cells: T lymphocytes that produce perforin, destroying pathogens with a specific antigen.

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

T memory cells: T lymphocytes that provide immunological memory.

Tobacco mosaic virus (TMV): A virus that infects many species of plants, in particular tobacco plants. It damages the leaves, flowers and fruit, and stunts plant growth.

T regulator cells: T lymphocytes that regulate the immune response by suppressing other T cells and maintaining tolerance to self-antigens.

Tuberculosis (TB): A bacterial disease, caused by *Mycobacterium tuberculosis* and *M. bovis*, that damages lung tissue and weakens the immune system.

Vaccination: The deliberate exposure of an individual to antigens from a pathogen 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.

Topic 4.2: Biodiversity

Adaptation: A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural.

Belt transect: A line along a sampled area upon which quadrats are placed at intervals to determine the abundance and distribution of organisms in an ecosystem.

Binomial system: The universal system of naming organisms. It is made up of two parts; the first gives the genus and the second, the species e.g. *Homo sapiens*.

Biodiversity: The variety of living organisms in an ecosystem.

Charles Darwin: The scientist who developed the theory of evolution by natural selection.

Classification: The organisation of organisms into groups.

Community: All of the populations of different species living together in a habitat.

Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources.

Continuous variation: When a characteristic can have any value within a given range e.g. height, mass, heart rate.

Convention on Biological Diversity (CBD): A treaty that promotes the sustainable use of and maintenance of biodiversity. One of three Rio Conventions.

Convention on International Trade in Endangered Species (CITES): A treaty that regulates the trade of plants and wild animals across international borders.

Convergent evolution: The process by which unrelated species evolve similar traits due to exposure to similar environments or selection pressures.

Countryside Stewardship Scheme (CSS): A scheme in England (1991-2014) that aimed to provide financial incentives to farmers to enhance and conserve the environment. Replaced by the Environmental Stewardship Scheme (ESS).

Discontinuous variation: When a characteristic can only take certain values e.g. sex, eye colour, blood group.

Domain: The highest taxonomic rank. There are three domains; Archaea, Bacteria and Eukaryota.

Evolution: The gradual change in the allele frequencies within a population over time. Occurs due to natural selection.

***Ex situ* conservation:** A type of conservation that takes place outside of an organism's natural habitat e.g. zoos, botanic gardens, seed banks.

Fossil: The remains of dead organisms found in rocks which are millions of years old.

Fungi: A biological kingdom consisting of mushrooms, yeasts and moulds.

Genetic biodiversity: A measure of the variety of genes that make up a species.

Habitat biodiversity: A measure of the number of different habitats found within an area.

***In situ* conservation:** A type of conservation that takes place within an organism's natural habitat e.g. wildlife reserves, marine conservation zones.

Interspecific variation: Differences between members of different species.

Intraspecific variation: Differences between members of the same species.

Keystone species: A species which has an unexpectedly large effect on the environment and is crucial for the maintenance of biodiversity.

Kick-sampling: A method used to sample organisms living on the bed of a river. It involves disturbing an area of river bed before placing a net downstream to capture released organisms.

Kingdom: The second highest taxonomic rank. There are five kingdoms: Prokaryotae, Protoctista, Fungi, Plantae and Animalia.

Line transect: A line along a sampled area. The species touching the transect at regular intervals are recorded to determine the abundance and distribution of organisms in an ecosystem.

Monoculture: The growth of one crop in a given area.

Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time.

Non-random sampling: A sampling method in which a sample is not chosen randomly. Three types; opportunistic, stratified and systematic.

Opportunistic sampling: A type of non-random sampling that involves drawing a sample from part of the population that is conveniently available.

Phylogenetic tree: A diagram used to show the evolutionary relationships between organisms.

Phylogeny: The evolutionary relationships between individuals or groups of organisms.

Pitfall trap: A device used to catch small ground surface invertebrates. It consists of a container buried beneath the ground and a roof structure.

Pooters: A device used in the collection of small insects. It consists of two tubes, one connecting the holding chamber to a mouthpiece (with a filter) and the other to an inlet tube.

Prokaryotae: A biological kingdom consisting of unicellular prokaryotes (bacteria).

Proportion of polymorphic gene loci: A measure of genetic biodiversity. Calculated using:

$$\text{proportion of polymorphic gene loci} = \frac{\text{number of polymorphic gene loci}}{\text{total number of loci}}$$

Protoctista: A biological kingdom consisting of unicellular eukaryotes.

Quadrat: A square grid of known area used in sampling to determine the abundance of organisms in a habitat. There are two types; point quadrats and frame quadrats.

Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates.

Seed bank: A storage of seeds to preserve genetic material.

Selection pressures: Environmental factors that drive evolution by natural selection and limit population sizes e.g. competition, predation and disease.

Simpson's Index of Diversity (*D*): A measurement of diversity that considers both species richness and evenness. Calculated using the formula:

$$D = 1 - \sum \left(\frac{n}{N}\right)^2$$

Spearman's rank correlation coefficient: A statistical test used to determine the relationship between two variables.

Species biodiversity: A measure of species richness and species evenness.

Species evenness: The number of individuals of each species living together in a community.

Species richness: The number of different species found within an area.

Stratified sampling: A type of non-random sampling in which populations are divided into strata and a random sample is taken from each, proportional to its size.

Student's t-test: A statistical test used to analyse whether there is a significant difference between the means of data values of two populations.

Sweep nets: A funnel-shaped net used to catch insects and other small animals.

Systematic sampling: A type of non-random sampling in which samples are taken from different regions of a habitat.

Taxon: Each group within a phylogenetic classification system.

Taxonomic hierarchy: The arrangement of organisms into successive levels of classification known as taxonomic groups.

Three-domain system: A method of classification in which organisms are categorised into three domains and six kingdoms. Developed by Carl Woese.

Tullgren funnel: A device used to extract living organisms from a soil sample.

Variation: The differences between individuals due to genes, the environment or a combination of both.