Edexcel IAL Biology A-level

Topic 6: Microbiology, Immunity and Forensics

Definitions and Concepts

6.1-6.4: Microbiology

Agar plate: A Petri dish containing agar and nutrients used to culture microorganisms.

Aseptic techniques: A range of techniques used to culture microorganisms under sterile conditions in order to minimise contamination.

Batch fermentation: An industrial method of fermentation that runs for a set period of time. The culture broth is not removed until the fermentation is complete

Brewing: The production of beer from the steeping of barley in water, and the fermentation of the resulting product with yeast.

Broth cultures: The culturing of microorganisms using a liquid medium.

Cell counts: A method of measuring the number of microorganisms in a medium, often carried out using a piece of apparatus known as a hemocytometer.

Continuous fermentation: An industrial method of fermentation in which culture broth is continuously removed and extra nutrient medium is added. The fermentation conditions remain relatively constant.

Culture: The growth of living matter *in vitro* in suitable conditions.

Death phase: The decrease in the number of bacteria caused by the depletion of nutrients or other unfavourable conditions.

Dilution plating: The process of diluting a sample of microorganisms by a known amount so that the individual cells can be counted.

Exponential growth rate: The rate of exponential growth of a bacterial culture is expressed as generation time, also the doubling time of the bacterial population. Generation time (G) is defined as the time (t) per generation (n = number of generations). Thus, the exponential growth rate constant can be expressed by the formula G=t/n.

Fermentation: A type of anaerobic respiration that does not involve an electron transport chain.

Growth medium: A sterile liquid or gel which is used to support the growth of microorganisms by providing required nutrients in the correct quantities.

Hemocytometer: A type of microscope slide with a specific size chamber and grid used for counting the amount of cells in a specific volume.

Lag phase: The period of time where microorganisms adjust to a new environment and take up nutrients without significant amounts of division.

Log phase (exponential phase): A period of rapid cell proliferation where the population size increases exponentially.

Microbial turbidity: The cloudiness of a solution which is based on the amount of microorganisms in a solution and can be measured quantitatively to analyse microbial growth.

Selective media: A type of media which contains a specific mix of chemicals to promote the growth of certain microorganisms and inhibit the growth of other unwanted microorganisms.

Serial dilution: A sequence of dilutions, in which the dilution factor is constant, used to dilute a stock solution.

Spectrophotometer: An instrument that measures the amount of light that can pass through a solution.

Spectrophotometric analysis: A method of analysis based on turbidity, which indirectly measures how much bacteria, dead and alive, there is in a sample, by measuring the intensity of light (or optical density) as a beam of light passes through the sample solution.

Stationary phase: The period of time where the population size is constant following the log phase due to limiting factors like a lack of available nutrients.

Turbidity: A measure of the degree to which the water loses its transparency due to the presence of suspended particulates. The higher the turbidity, the higher the number of cells within the culture.

6.5-6.15: Disease and Defence

Acquired Immunodeficiency Syndrome (AIDS): The name given to the loss of immune function through the destruction of the immune system over time after infection by HIV.

Antibiotic: A type of antimicrobial designed to target bacterial infections within or on the body.

Antibody: A protein molecule which binds to an antigen and is produced by B cells in response to an infection.

Antigen presenting cell (APC): A type of cell which breaks down pathogens and presents the cellular fragments on their surface for detection by other immune cells.

Antigen: A foreign substance which is capable of triggering an immune response.

Artificial adaptive immunity: Immunity that is acquired by exposure to a dead or weakened version of a pathogen in the form of a vaccine.

Artificial passive immunity: Immunity that is gained by the transfer of premade antibodies to an individual through an injection.

B effector cell: A form of B lymphocyte that actively produces and secretes antibodies in response to an infection.

B memory cell: A class of B lymphocytes which resides in the lymph nodes and provides

long term immunity to a pathogen.

Bacteria: A type of unicellular prokaryote which can exist alone or as a parasite.

Bacterial capsule: A polysaccharide layer that surrounds bacterial cells and provides strength.

Bactericidal antibiotics: A type of antibiotic which kills bacteria.

Bacteriophage: A virus that infects bacteria.

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

Broad spectrum antibiotic: An antibiotic that destroys a wide range of harmful bacteria, pathogens, neutral and good bacteria alike.

Capsid: The protein shell of a virus, which contains its genetic material. It is made up of simple repeating protein units called capsomeres.

Ebola virus: An RNA virus which causes major internal bleeding and is spread through contact with bodily fluids of an infected person.

Epithelial defences: Skin-based barriers which protect the body from infection. Skin prevents the entry of microorganisms into the body, and also produces sebum, which contains chemicals that inhibit the growth of microorganisms.

Evasion mechanisms: Strategies which bacterial pathogens use to avoid or inactivate host defenses and ensure their own survival within a host. They include: hiding from the immune system (e.g. within cells); interfering with the function of the immune system (e.g. blocking signals); and destroying elements of the immune system.

Host/Parasite Evolutionary race: The continual competition over time where infectious agents are evolving better infection mechanisms whilst the hosts are simultaneously evolving better defences.

Immunodeficiency Virus (HIV): A positive-sense, single-stranded RNA virus spread through bodily fluids that attacks the immune system and can lead to AIDS.

Inflammation: The immune response to tissue damage involving swelling though the accumulation of immune cells and fluids.

Interferon: A cytokine released by virus infected cells which alerts nearby cells and triggers immune defences.

Lambda phage (λ phage): A bacterial virus, or bacteriophage, that infects the bacterial species *E. coli*.

Lysogenic pathway/cycle: One of two pathways by which a virus can replicate its DNA using a host cell. In the lysogenic cycle, the DNA is only replicated, not translated into proteins.

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

Lytic pathway/cycle: One of two pathways by which a virus can replicate its DNA using a host cell. In the lytic cycle, the replication of a virus within a host cell which ultimately leads to the rupture and death of the host cell.

Macrophages: A type of immune cell originating from monocytes which are specialised for phagocytosis of pathogens and can act as antigen presenting cells.

Mesosomes: Invaginated structures that appear in some bacteria and are formed by infoldings of the plasma membrane. It is thought that they play a role in DNA replication and cell division and/or in excretion of exoenzymes.

Mycobacterium tuberculosis (TB) - The strain of bacteria which cause the disease tuberculosis by causing destruction of the lung tissue.

Narrow spectrum antibiotic: An antibiotic that targets one or two specific pathogens.

Natural adaptive immunity: Immunity that is gained from infection with a live pathogen.

Natural passive immunity: Immunity produced by the transfer of antibodies from a mother to a foetus through the placenta or to a baby through breastfeeding.

Nucleic acid: A chain of nucleotides which stores genetic information in biological systems. Two major types of nucleic acids are DNA and RNA.

Pathogen: A microorganism which causes disease.

Phagocytosis: The ingestion of solid material (particularly pathogens and foreign material) by phagocytic cells.

Pili: Small hair-like projections on the surface of bacterial cells used to adhere to other cells.

Plasma cell (B cell): A type of lymphocyte which matures in the bone marrow and produces antibodies.

Primary immune response: The initial response produced by the immune system when it encounters a pathogen for the first time.

Prokaryotic cell: A type of cell that does not contain any membrane bound organelles or a nucleus.

Secondary immune response: The response produced by the immune system to a pathogen which it has encountered previously.

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.

T cells: A type of lymphocyte that matures in the thymus gland and is involved in cell mediated immunity.

T helper cell: A type of T lymphocyte which regulates the immune response through the release of cytokines which stimulate activity of other T and B cells.

T killer cell: A type of T lymphocyte which triggers apoptosis in cells which are damaged or infected with viruses by producing a chemical called perforin.

T memory cell: A type of T lymphocyte with different subtypes found in different parts of the body which is used to provide long term immunity to a pathogen.

Tobacco mosaic virus: An RNA virus species in the genus Tobamovirus that infects a wide range of plants, especially tobacco. The infection causes characteristic patterns, such as mosaic-like mottling and leaf discoloration.

Viral envelope: The outermost layer of many types of viruses. The viral envelope protects the genetic material in their life cycle when traveling between host cells.

Viral latency: When a virus is present in the body but exists in a resting (latent) state without producing more virus. A latent virus can exist for a long time without becoming active and causing symptoms.

Virus: A non-living microorganism that consists of genetic material surrounded by a protein husk.

6.16-6.20: Forensic Techniques

Decomposition: The breakdown of dead organic matter, which allows the recycling of matter within an ecosystem.

DNA profiling: A method of comparing DNA sequences by cutting it into fragments and comparing the fragments with each other for genetic identification or determining genetic relationships.

Exons: Sections of genetic material which code for proteins.

Forensic entomology: The analysis of the insects found on decomposing tissue which is often used to determine the time of death.

Gel electrophoresis: A technique used to separate DNA fragments based on their size by their movement through a gel when an electric current is applied.

Introns: Sections of genetic material which do not code for proteins.

Mature mRNA: mRNA molecules after the removal of the intron sequences by the spliceosome.

Polymerase chain reaction (PCR): A laboratory technique used for the mass amplification of DNA using heat cycling and a thermostable form of DNA polymerase.

Pre-mRNA: mRNA molecules before the removal of introns.

Rigor Mortis: The stiffening of the body caused by muscles contracting due to chemical changes a few hours after death.

Spliceosomes: A complex usually found in the nucleus which removes introns from transcribed mRNA molecules.

Stage of succession (forensics): Using knowledge of ecosystem development around a decomposing body to determine the rough time of death.