Topic 5: On the Wild Side

1 Demonstrate knowledge and understanding of the *How Science Works* areas listed in the table on page 13 of this specification.

2 Describe the structure of chloroplasts in relation to their role in photosynthesis.

Stroma – matrix which surrounds the membrane stacks on a chloroplast. The location of the light independent reactions of photosynthesis. Contains all the enzymes needed for photosynthesis

Granum – Stacks of thylakoid

Thylakoid – Where chlorophyll is found.

Chlorophyll has different pigments for maximum absorption.

Two distinct photosystems

3 Describe the overall reaction of photosynthesis **as requiring energy from light to split apart the strong bonds in water molecules, storing the hydrogen in a fuel (glucose) by combining it with carbon dioxide and releasing oxygen into the atmosphere.**

4 Describe the light-dependent reactions of photosynthesis including how light energy is trapped by exciting electrons in chlorophyll and the role of these electrons in generating ATP, and reducing NADP in photophosphorylation and producing oxygen through photolysis of water.

- **The aim of the reaction is to produce ATP and split water into hydrogen ions to reduce CO_2 & produce carbohydrates**
- **In cyclic photophosphorylation, a photon hits a chlorophyll molecule exciting an electron from photosystem I. The electron leaves the chlorophyll molecule and is accepted by an electron acceptor. This begins an electron transport chain; a series of redox reaction resulting in the synthesis of ATP. The electron returns to photosystem 1.**
- **In non-cyclic photophosphorylation, a photon hits a chlorophyll molecule exciting an electron from photosystem I. The excited electron leaves the chlorophyll molecule and is picked up by electron acceptor NADP. H^+ ions from dissociated water reduces NADP to NADPH. When an electron is excited from Photosystem II, it leaves the chlorophyll molecule and is picked up by an electron acceptor starting an electron transport chain leading to the production of ATP. The transported electron replaces the electron lost from photosystem I. Electron from the photolysis of water replaces lost electron from Photosystem II.**
- **Photolysis of water- The splitting of a water molecule by light.** $H_2O \rightarrow O_2 + 2H^+ + 2e^-$

5 Describe how **phosphorylation of ADP requires energy and how hydrolysis of ATP provides an immediate supply of energy for biological processes.**

6 Describe the light-independent reactions as reduction of carbon dioxide using the products of the light-dependent reactions (carbon fixation in the Calvin cycle, the role of GP, GALP, RuBP and RUBISCO) and describe the products as simple sugars that are used by plants, animals and other organisms in respiration and the

synthesis of new biological molecules (including polysaccharides, amino acids, lipids and nucleic acids).

The Calvin's cycle uses NADPH and ATP from the light dependent stage and each stage is controlled by enzymes. CO_2 combines with RuBP, catalysed by RUBISCO creating an unstable 6 carbon compound which splits to form 2 molecules of GP. GP is reduced to GALP. The reducing power is taken from the hydrogen from NADPH and energy from ATP. Some GALP is synthesized to make glucose while the rest is turned back to RuBP from the first stage.

7 Carry out calculations of net primary productivity and explain the relationship between gross primary productivity, net primary productivity and plant respiration.

NPP =GPP – plant respiration.

8 Calculate the efficiency of energy transfers between trophic levels.

9 Discuss how understanding the carbon cycle can lead to methods to reduce atmospheric levels of carbon dioxide (including the use of biofuels and reforestation).

Biofuels – Carbon neutral as they absorb the carbon they emit during their life time

Reforestation – Absorbs excess carbon dioxide in the atmosphere

10 Explain that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.

- **Biotic factors – The living elements of a habitat which affect the ability of an organism to survive there. These include: Predation; finding a mate; territory; parasitism & disease.**
- **Abiotic factors – The non-living elements of the habitat of an organism. These include: edaphic factors; light; temperature; oxygen availability; wind and water currents.**

11 Describe how to carry out a study on the ecology of a habitat to produce valid and reliable data (including the use of quadrats and transects to assess abundance and distribution of organisms and the measurement of abiotic factors, eg solar energy input, climate, topography, oxygen availability and edaphic factors).

Quadrat – A small square used to isolate a sample. Makes counting easier

Transect – A path along which one records and counts occurrences. An interrupted belt transect records all the species found in each quadrat placed at certain intervals along a line.

Edaphic - Measure pH of soil by putting a pH meter in soil. Take a sample of the soil and measure the amount of leaching.

Topography – Measuring the shape and features of the earth's surface

12 Explain how the concept of niche accounts for distribution and abundance of organisms in a habitat.

If two species occupy a similar niche, they will compete for similar resources such as food. Therefore, the sources become limited and less available for both species. As a result, fewer individuals of both species will be able to survive in the area; the population of both species decreases.

A species can only survive where all the condition that make up their niche exists. Therefore if the conditions does not exist, they cannot exist in the area and must migrate or die out in the area.

13 Describe the concept of succession to a climax community.

Primary succession – Starts with an empty inorganic surface. The first plants are oppurtunists or pioneer species. These organisms penetrate the rock surface causing it to break leading to the production of humus. Humus over time forms soil. Grasses and ferns establish root systems. More soil develops. The diversity of species increases until a climax community is reached; biodiversity is constant

Secondary succession – Starts with soil but no vegetation. For example when rivers shift the courses, after fires and flood. The number of species is high from the start. The time to get to a climax community is dependent on a number of factors such as temperature, rainfall and soil fertility. A plagioclimax community is often reached.

14 Outline the causes of global warming – including the role of greenhouse gases (carbon dioxide and methane, CH_4) in the greenhouse effect.

Greenhouse gases reduce heat loss from earth's surface. This is known as the greenhouse effect. When radiation from the sun reaches the earth, some is reflected back into space by the atmosphere. Some of this radiation is absorbed and reradiated back to the earth's surface by greenhouse gases such as Carbon dioxide, Methane and water vapour. This maintains the temperature of the earth at a higher level.

15 Describe the effects of global warming (rising temperature, changing rainfall patterns and seasonal cycles) on plants and animals (distribution of species, development and life cycles).

Change in rainfall patterns - More rainfall leads to increased risk of flooding. Low rainfall means people are short of water for their crops and for drinking.

Rising temperature – Ice caps melt leading to increased risk of flooding. If the temperature increase beyond the optimum temperature for enzyme controlled reactions in organisms, their enzymes will denature and the reaction rate falls. As a result increasing temperature has an effect on rate of growth and reproduction. If plants grow faster, they will be able to take up more carbon dioxide from the atmosphere. Organisms between the tropics have little tolerance for change as conditions remain constant all year round. A change of a few degrees can be fatal to some organisms. In higher latitudes, plants and animals reproduce earlier. For some animals, breeding earlier in the year means they can fit more than one breeding cycle in a year.

Species distribution – Because animals can move more easily than plants, they are able to survive change more easily. So as areas become warmer, organisms extend their range northwards and become extinct in the south. Others may be able to colonise a larger area. There could be an increase in insect-borne disease in the UK.

16 Explain the effect of increasing temperature on the rate of enzyme activity in plants, animals and micro-organisms.

Increasing temperature increases the rate of enzyme activity in organisms. This is because the enzyme and substrate increase in kinetic energy. This increase in kinetic energy means that the enzyme and substrates collide more often. More enzyme substrate complexes are formed.

17 Describe how to investigate the effects of temperature on the development of organisms (eg seedling growth rate, brine shrimp hatch rates).

Brine Shrimp hatch rates

- Decide on the range of temperatures to be tested
- Place a tiny pinch of egg cysts onto a large sheet of white paper
- Wet the piece of graph paper using a few drops of salt water. Dab the paper onto the white sheet to pick up approximately 40 eggs
- Put the paper with the 40 eggs into the beaker (eggs-side down). After 3 minutes, use a pair of forceps to gently remove the paper, making sure that all the egg cysts have washed off into the water
- Repeat for all the temperatures that are to be investigated
- Incubate the beakers at the appropriate temperatures, controlling exposure to light as far as possible
- The next day count the number of hatched larvae in each of the beakers. Do this for several days
- Record the number of larvae that have successfully hatched at each temperature

18 Analyse and interpret different types of evidence for global warming and its causes (including records of carbon dioxide levels, temperature records, pollen in peat bogs and dendrochronology) recognising correlations and causal relationships.

Frozen Isotopes – Ice cores taken from the antartic and Greenland. Air is trapped in the layers of ice. The records of oxygen isoptopes in the melted ice cores reflect the air temperature of the time (The proportion of O^{18} to O^{16}). Atmospheric carbon dioxide can be also be measured.

Dendrochronology – Dating of past events using tree ring growth. When conditions are good (hot and moist) cells are large. As conditions become worse, cells are small. Eventually, growth stops for the year until the next spring. The approximate age of a tree can be found by counting the rings. Many factors such as sunlight, temperature, CO_2 levels and rainfall affect tree ring growth making dendrochronology somewhat unreliable. Coral reef data complements dendrochronological data.

Peat Bogs – Made up of partly decomposed plant material. Pollen grains, moss spores and plant tissue are preserved in it due to its acidity, cool and anaerobic conditions. Different plants grow in the different climatic conditions, therefore analysis of what pollen/spores in the peat gives an idea of what the temperature was like. The lower you go into the peat bog, the longer the time difference.

Correlation – When one variable changes, another changes

Causation – when one variable causes change in another.

19 Describe that data can be extrapolated to make predictions, that these are used in models of future global warming, and that these models have limitations.

Data can be extrapolated to make predictions. In order to increase the reliability of data, wiggle matching is used.

20 Discuss the way in which scientific conclusions about controversial issues, such as **what actions should be taken to reduce global warming or the degree to which humans are affecting global warming, can sometimes depend on who is reaching the conclusions.**

21 Describe how evolution (a change in the allele frequency) can come about through gene mutation and natural selection.

A mutation is a change in a single base pair. Mutations increase the size of the gene pool by increasing the number of different alleles. If a mutation is advantageous, the allele will be selected for and will therefore increase in frequency. Changes in allele frequency due to natural selection may lead to evolution of new species.

22 Explain how reproductive isolation can lead to speciation.

There are two types of reproductive isolation, prezygotic (stops the zygote from forming) and postzygotic(the zygote fails or is unable to breed). Examples of prezygotic include: Habitat isolation; temporal isolation; mechanical isolation; behavioural isolation and gametic isolation. Examples of postzygotic include: Low hybrid zygote vigour (zygote fails to develop properly); Low hybrid adult viability(offspring fail to thrive and grow properly) and hybrid infertility.

23 Describe the role of the scientific community in validating new evidence (including molecular biology, eg DNA, proteomics) supporting the accepted scientific theory of evolution (scientific journals, the peer review process, scientific conferences).

New evidence includes DNA profiling. Fossils are unreliable as some species may have similar features as they occupy the same niche but they may not be related.

Topic 6: Infection, immunity and forensics

2 Explain the nature of the genetic code (triplet code, non-overlapping and degenerate).

Triplet code – Three bases which code for a single amino acid
Degenerate – Only the first two of 3 bases count in determining the amino acid. If the last base is altered, the same amino acid can still be coded for. This protects living organisms from mutations
Non-overlapping – If it is overlapping a single point mutation will affect 3 amino acids. Non-overlapping means a point mutation affects only one amino acid.

3 Explain the process of protein synthesis (transcription, translation messenger RNA, transfer RNA, ribosomes and the role of start and stop codons) and explain the roles of the template (antisense) DNA strand in transcription, codons on messenger RNA, anticodons on transfer RNA.

DNA unwinds exposing base triplet code of the gene. mRNA is built up using the antisense strand as a template via complementary base pairing (transcriptions). mRNa moves into the cytoplasm and combines with the ribosomes. Amino acids attached to tRNA molecules are transported to the ribosomes. Anticodons on the tRNA molecules pair up with codons on mRNA. Amino acids are joined by peptide bonds. Start and stop codons determine the length of the amino acid chain.

4 Explain how one gene can give rise to more than one protein through post-transcriptional changes to messenger RNA.

Posttranscriptional changes lead to a greater variety in the phenotype than is coded for. Introns are removed and exons are joined together to form a single long molecule via a process called RNA splicing. This is catalysed by enzymes called spliceosomes. Sometimes exons are removed which lead to mRNA strands from the same DNA strand leading to slightly different amino acids.

5 Describe how DNA profiling is used for identification and determining genetic relationships between organisms (plants and animals).

Introns are observed. They have a huge variation of repeats so the likelihood of two individuals having the same pattern is very low bar identical twins. DNA is chopped up into fragments using restriction endonucleases. Each enzyme cuts the DNA at specific sites called recognition sites.

6 **Describe how DNA can be amplified using the polymerase chain reaction (PCR).**

A sample sample of DNA can be amplified. Small sequences of DNA called primers join to the beginning of the separated stands before copying begins. The mixture of primers and nucleotide bases is heated to 90 degrees which cause the DNA strands to separate, hydrogen bonds are broken. The mixture is cooled to 55 degrees so the primers nind to the single DNA strand. The mixture is then heated to 75 degrees for the DNA polymerase enzyme to build the complementary strands of DNA.

7 **Describe how gel electrophoresis can be used to separate DNA fragments of different length.**

- **The DNA is cut into fragments using restriction endonucleases**
- **The DNA fragments are placed into wells in agarose gel.**
- **An electric current is passed through. The negatively charged DNA fragments are attracted to the positive electrode.**
- **Lighter fragments are able to move faster and travel further up the gel while heavier fragments move more slowly.**
- **Southern Blotting allows the fragments to be seen. An alkaline buffer is added and a nylon filter is placed over the gel. Dry absorbent paper is used to draw the solution containing DNA fragments to filter, leaving them as blots on the paper**

8 Distinguish between the structure of bacteria and viruses.

Structural features	Bacteria	Virus

Average Size	0.5 – 10 µm	0.02 – 0.3 µm
Genetic material	Plasmid	Single stranded DNA or RNA
Outer Layers	Cell Wall. Capsule or slime Layer	May have outer envelope. Protein coat
Internal Components	Small ribosomes; mesosome; cytoplasm; Glycogen granules	DNA/RNA
Movement	Sometimes Flagellum	Passive movements

9 Describe the role of micro-organisms in the decomposition of organic matter and the recycling of carbon.

Microorganisms convert carbon containing compounds to carbon dioxide when they respire and nitrogen containing compound into ammonia. The Carbon dioxide is then fixed by plants during photosynthesis.

10 Describe the major routes pathogens may take when entering the body and explain the role of barriers in protecting the body from infection, including the roles of skin, stomach acid, gut and skin flora.

Ways pathogens enter the body include: Vectors (live organisms carry the pathogen); fomites (inanimate objects) ; direct contact; inhalation (tiny droplets of bacteria inhaled); ingestion (contaminated food); inoculation(break in the skin)

Skin – Contains keratin a protein which makes it hard. It forms a physical barrier between pathogens and the body. Contains sebum which inhibits the growth of microorganisms.

Stomach Acid – Low pH destroys the majority of microorganisms ingested

Gut – Mucus produced in the epithelial layer contains lysozymes. Lysozymes destroy microbial cell walls causing the cell to lyse

Skin flora – Bacteria on the skin outcompete pathogens

11 Explain how bacterial and viral infectious diseases have a sequence of symptoms that may result in death, including the diseases caused by *Mycobacterium tuberculosis* (TB) and Human Immunodeficiency Virus (HIV).

TUBERCULOSIS

- **Caused by mycobacterium tuberculosis and infects the lungs.**
- **It is transmitted by droplet infection**
- **In the body, TB reproduces in the lungs producing toxins which damage the lung tissue.**
- **Symptoms of TB include: coughing; breathlessness; weight loss; lack of appetite; fever; fatigue**

HIV

- **Caused by the Human Immunodeficiency Virus.**
- **Spread by direct contact (sexual contact and blood-to-blood transfer)**
- **Three phases of HIV infection**
- **Phase 1 (Acute phase) HIV binds to CD4 receptor on Helper T cells. The HIV infects the helper T Cells and virus population increases quickly. At the same time, the population of helper T Cells fall rapidly. This phase ends when Killer T cells recognise the infected helper cells and kill them. This slows down the replication of the virus.**
- **Phase 2 (Chronic Phase) Virus continues to replicate. The immune system is weakened therefore, other opportunistic infections like TB are likely to occur.**
- **Phase 3 (disease phase) The immune system becomes weaker and weaker and eventually an opportunistic infection occurs that the immune system cannot combat. The person will die from the secondary infection.**
- **Symptoms include: Karposi's Sarcoma; excessive sweating; TB; Pneumonia; opportunistic infection; weight loss; extreme lethargy**

12 Describe the non-specific responses of the body to infection, including inflammation, lysozyme action, interferon and phagocytosis.

Inflammation – Histamines are released by mast cells. Vasolidation, increased bloodflow to the area meaning more white blood cells are there. Localised heat to kill pathogens. Leakage of plasma cells

13 Explain the roles of antigens and antibodies in the body's immune response including the involvement of plasma cells, macrophages and antigen-presenting cells.

Antigens are unique markers on the surface of every cell

Antibodies are produced by plasma cells. An antibody is a protein which binds to a specific antigen on the pathogen that has triggered the immune system

When an antigen-antibody complex is formed, they clump together making it easier for macrophages to engulf and digest them.

Antigen presenting is when the macrophage with antigen/MHC complex is displayed on the cell surface. This is can be done my macrophages and B cells. Antigen presenting cells display foreign antigens on their surface. This enables T-Cells to recognise infected cells.

14 Distinguish between the roles of B cells (including B memory and B effector cells) and T cells (T helper, T killer and T memory cells) in the body's immune response.

The function of B cells is to make antibodies against antigens and present antigens.

B memory cells are formed so that if the body is infected by the same pathogen again, antibodies specific to that pathogen can be produced quicker.

B effector cells proliferate to Plasma cells which secrete antibodies and present antibodies on their MHC proteins for recognition by the CD4 receptors on T helper cells

T helper cells direct and activate other immune system cells. They produce cytokines which stimulate B cells to proliferate and produce B memory cells and B effector cells.

T memory cells – cloned cells which remain in the body and rapidly become active if the same antigen is encountered again.

T killer cells bind to infected cells and interact with the cell membrane to destroy the infected cell and pathogens with it.

15 Explain how individuals may develop immunity (natural, artificial, active, passive).

Natural active immunity The immunity which results from natural infection of the body and the production of antibodies by the immune system.

Natural passive immunity Immunity which results from passing naturally from a mother to her baby via the placenta, in the colostrum and in the milk.

Artificial passive - immunity which results when antibodies formed in one individual are extracted and injected into another individual

Artificial active – immunity induced by the use of a small amounts of antigen (vaccine) to trigger an active immune response

16 Discuss how the theory of an 'evolutionary race' between pathogens and their hosts is supported by the evasion mechanisms as shown by Human Immunodeficiency Virus (HIV) and *Mycobacterium tuberculosis* (TB).

TB is treated with combinational therapy over a long period of time. This ensures that if the mycobacteria is resistant to some of the drugs, there will be others that will destroy the rapidly reproducing bacteria and also attack ones that are slowly mutating. Immunisation is also used to reduce the number of cases of TB

HIV is incurable as the virus mutates rapidly. However preventative measures such as using condoms, less promiscuous sex and using clean needles reduce the prevalence of HIV

17 Distinguish between bacteriostatic and bactericidal antibiotics.

Bacteriostatic – Inhibit the growth of bacteria

Bactericidal – Kill bacteria

18 **Describe how to investigate the effect of different antibiotics on bacteria**.

- **Spread a lawn of bacteria on a petri dish**
- **Place discs soaked in different antibiotics on the lawn of bacteria**
- **Seal the petridish and incubate for 24 hours at 25 degrees**
- **Measure the clear areas around each disc**
- **The larger the clear area, the more effective the antibiotic is.**

19 Describe how an understanding of the contributory causes of hospital acquired infections have led to codes of practice relating to antibiotic prescription and hospital practice relating to infection prevention and control.

- **Controlling use of antibiotic - every course of antibiotics should be completed. Using different antibiotic encourages faster evolution.**
- **Hygiene measures – regular hand washing and using alcohol gels kills bacteria. Thorough cleaning of hospital wards, toilets and equipment**
- **Isolation of patients stops infection spreading**
- **Prevention of infection coming into the hospital**
- **Monitoring levels of healthcare acquired infection holds hospitals accountable which leads to increased efforts to reduce the problem**

20 Describe how to determine the time of death of a mammal by examining the **extent of decomposition, stage of succession, forensic entomology, body temperature and degree of muscle contraction.**

Additional Notes

1. How can succession account for the changes in the types of organisms found on a body?
   Sucession is the change of organisms with time in an environment. The first inhabitants change the environment to one which is more suitable to newer inhabitants.
2. What is an antibiotic
   A substance or chemical that kills or inhibits the growth of an organism produced by microorganisms
3. How penicillin affects bacteria
   It affects the cell wall. Interfers with the synthesis of the cell wall by preventing the formation of cross links between peptidoglycan molecules making the cell more susceptible to osmotic shock.
4. Latency of HIV infection
   In latency, there is a delay between infections and symptoms. During this period, viral genetic material is incorporated into the host's DNA. This makes the host cell produce viral proteins. Symptoms are expressed when the host cells is activated.

Keywords

Autotrophic – organisms which can make their own food

Photosynthesis – the process by which plants make food from carbon dioxide and water using energy from the sun trapped using chlorophyll contained in the chloroplast.

Heterotrophic – Organisms which eat other organisms to get their food

ATP – Molecules that releases energy when the terminal phosphate bond is broken to form ADP

Redox – Linked oxidation/reduction reactions

Hydrogen acceptor – molecules that accept hydrogen in cellular reactions

Electron transport chain – Series of carriers along which an electron is passed in a series of redox reactions resulting in the production of ATP

Grana – Stacks of thylakoid within a chloroplast

Thylakoid – membrane disc which is a unit of granum in a chloroplast

Stroma – matrix which surrounds the membrane stacks in a chloroplast

Photosystem I – Chlorophyll complex involved in cyclic and noncyclic photophosphorylation

Photosystem II – Chlorophyll complex involved in noncyclic photophosphorylation

Photochemical reaction- Reaction which depends on light

Photophosphorylation – Process by which ATP is made in plants whereby an excited electron from PS I is passed along an electron transport chain to produce ATP and returned to PS I

Photolysis – The splitting of a water molecule by light

Calvin cycle – Series of reactions which make up the light independent stage of photosynthesis resulting in the synthesis of carbohydrates from carbon dioxide

RuBP – 5 carbon compound found in the calvin cycle

RUBISCO – Enzyme involved in the removal of a molecule of CO_2 from RuBP

GP – Phosphorylated 3 carbon compound in the Krebs cycle

GALP – Reduced form of GP also part of the Krebs cycle

Ecosystem – Environment including all the living organisms interacting, the cycling of nutrients and the physical and chemical environment in which the organisms are living

Habitat – Place where an organism lives

Population – Group of organisms of the same species living and breeding together in a particular niche in a habitat

Community – All of the population of living organisms which live in a habitat at any one time

Ecological niche - The role of an organism within an ecological community

Habitat niche – The role of an organism in relation to a specific habitat

Abiotic factors - nonliving elements of the ecosystem

Biotic factors – The living elements of a habitat the affect an organisms ability to survive there.

Biosphere – all areas of the earth's surface where living organisms survive

Biomes – Major ecosystems of the world

Succession – Process by which communities of organisms colonising an area change over time

Opportunist/ Pioneer Species – Organisms which are the first to colonise bare rock or sand

Humus – organic component of soil

Climax community – A self sustaining community with relatively constant biodiversity and species range. The most productive group of organisms that a given environment can support long term

Plagioclimax – a climax community brought about by human intervention

Microclimate – small areas with a distinct climate which is different to the surrounding areas

Leaching - Loss of minerals from soil as water passes through rapidly

Loam – ideal soil with a wide range of particle sizes and plenty of humus

Intraspecific competition – Competition between members of the same species for the same resources within a community

Interspecific competition – Competition between members of different species for the same resources within a community

Endemic – found in a particular region or country

Biomass – Mass of biological material in a given organism or habitat

GPP – percentage of the energy from the sun which is transferred into plant material

NPP – percentage of the sun's energy converted into plant biomass

Food Chain – Simple feeding interactions between organisms in a community

Trophic level - Feeding positions in a food chain or web

Food web – more complex food interaction between organisms in a community

Decomposers – An organism which breaks down dead plant and animal matter

Secondary production – Energy used to make new animal biomass

Carbon sinks - reservoirs where carbon is removed from the atmosphere and locked up in organic material or inorganic compounds

Greenhouse effect – The way in which greenhouse gases reduce the amount of heat lost from the surface of the earth

Temperature proxies – Indirect or inferred measurements of the temperature of the earth

Error lines – Indications of the range of error in a given measurement or inference

Mean values – The value obtained by dividing the sum of a set of values by the number of values in the set

Interglacial – periods between ice ages

Wiggle matching – A process used to calibrate inferred, indirect, or imprecise way of measuring.

Calibration – checking adjusting or standardising a piece of measuring equipment

Correlation – A factor that appears to be linked to a change or event.

Causal relationship – one factor directly causes an effect in another

Extrapolate – Use available data on which to base estimations of value which fall outside the known range

Optimum temperature – Temperature at which enzymes work best

Denature – When the tertiary and quaternary structure of the protein is destroyed

Biofuels – Fuels produced from biomass

Genome – All the DNA of an individual

Proteome – All the proteins produced from the DNA of an individual

Allele frequency – The relative frequency of a particular allele in a population

Gene families – A group of closely related genes

Sickle cell disease – A genetic disease affecting the formation of haemoglobin, which in turn affects the shape of the red blood cells

DNA profiling - using a sample of DNA to identify an individual.

Rigor mortis – the stiffening of the muscles which takes place within a few hours of death as the cells run out of ATP

Forensic Entomology - The study of insect life in relation to crime

Ribosomes – Cell organelle that is the site of protein synthesis

Triplet Code – Three bases of DNA which code for a single amino acid

Codon – Three base pairs of DNa or RNA coding for a particular amino acid

Transcription – production of mRNA from a DNA strand

Translation – The conversion of the information in mRNA into a polypeptide or protein

mRNA – RNA that carries information from the DNA in the nucleus out into the cytoplasm to be translated into proteins on the ribosomes

DNA-directed RNA polymerase – enzyme involved in making an RNA copy from a DNA template using transcription in the nucleus

Template Strand – The DNA strand which provides the template for ordering the sequence of nucleotides in the mRNA

Sense strand – The DNA strand which has the same sequence as the resulting RNA

Antisense strand – The strand of DNA which acts as a template for the formation of mRNA

tRNA – small unit of RNA that codes for a specific amino acid and attaches to it in the cytoplasm before carrying it to the surface of a ribosome for protein synthesis

rRNA – RNA which makes up the bulk of the ribosomes

Anticodon – The three base sequences of tRNA which is complementary to the RNA codon of the mRNA on the surface of a ribosome

Mini satellite – 20-50 base sequence repeated 50-several hundred times in DNA introns

Micro satellite – 2-4 base sequence repeated 5-15 times in a DNA intron

Restriction endonucleases – Enzymes used to chop DNA molecules into fragments at particular point in the intron sequences

Gel Electrophoresis – Type of chromatography where individual DNA fragments are separated using an electric current

Southern Blotting – A process in the production of a DNA profile

Gene probe – Short DNA sequences used to identify specific sequences in the production of a DNA profile

Short tandem repeats – micro-satellite regions of the DNA widely used in DNA identification

Pathogen – A microorganism that causes disease

Toxin – A poison produce by a pathogen and causes disease

Tobacco mosaic virus – First virus to be identified

Envelope – a lipid outer layer found in some viruses

Capsid – protein coat of virus

Capsomeres – Repeating protein units which make up the capsid

Bacteriophages – viruses which infect bacteria

Reverse transcriptase – enzyme used by viruses to produce DNA molecules which correspond to the viral genome

Plasmid – extra circular strand of DNA, separate from the main chromosome found in bacteria

Lysogenic Pathway – Stage in viral lifecycle when the viral DNA is inserted into the host DNA so it is replicated everytime the host cell reproduces. The virus is dormant – it does not cause disease

Non virulent – not disease causing

Provirus – Viral DNA inserted into the DNA of the host cell so that it is replicated everytime the host cell replicates

Lytic pathway – Stage in viral lifecycle when the viral DNA is replicated is replicated independently of the host cell DNA and the virus is virulent

Virulent – capable of causing disease

Retrovirus – Viruses with RNA as their genetic material and relatively complex lifecycles

Exocytosis – moving substances out of a cell by emptying a membrane bound vesicle

Hypertonic – a solution with a higher solute concentration than the cell contents

Mesosome – infolding of the cell membrane seen in some bacteria

Capsule – Layer of starch, gelatin, protein or glycolipid which protects bacteria from phagocytosis by white blood cells. This is a slime layer if it is very thin

Pilli – Thread like protein projections from the surface of some bacteria which seem to be used for attachment to the host cell and for sexual reproduction

Flagella – Thin extension made up of many stranded helix of the protein flagelin which makes about 100 revolutions per second and moves the bacterium along

Peptidoglycan – Parallel polysaccharide chains with short peptide cross-linkages found in bacterial cell walls

Gram staining – one way of identifying different types of bacteria

Gram positive – Bacteria which stain purply-blue with gram staining

Teichoic acid – chemical found in the walls of gram positive bacteria which binds to the crystal violet colour in the gram stain to give the typical gram positive colour

Gram negative – Bacteria which stain red with gram staingin

Cocci – spherical bacteria often linked together in chains

Bacilli – Rod shaped bacteria

Spirilla – Bacteria with a twisted shape

Vibrios – comma shaped bacteria

Obligate aerobes – organisms which cannot survive without oxygen for cellular respiration

Faculative anaerobes – organisms which use oxygen for cellular respiration if it is available but can manage without it

Obligate anaerobe – organism which cannot survive with oxygen for cellular respiration

Generation time – Time between divisions of bacteria

Transformation – a way in which genetic material from one bacterium can be taken in and used as part of the DNA of another bacterium

Binary Fission – Type of asexual reproduction which involves simple splitting in two

Transduction – A way in which genetic material from one bacterium is transferred to another through a bacteriophage

Transducing particles – small pieces of bactericidal DNA included in the protein coat of a phage virus and so is carried from one bacterium to another in the process of transduction

Conjugation – method by which bacteria exchange genetic information

Sex pilus – strand of cytoplasm between to bacteria during sexual reproduction

Endotoxins – lipopolysaccharides which are part of the outer layer of gram negative bacteria which cause symptoms of disease

Exotoxins – soluble proteins produced and released into the body by bacteria which often cause severe symptoms of disease

Communicable – disease which can be spread from one person to another

Vectors – means of carrying new gene into host DNA during genetic modification

Sebum – oily substance produced by the skin which contains chemicals which inhibit the growth of microorganisms

Lysozymes – enzymes found in mucus and tears which are capable of destroying microbial cell walls. Part of the nonspecific defence system

Biopsies – A sample of tissue removed from the body to be examined for signs of disease

Antigens – unique markers on the surface of every cell

Inflammation – nonspecific response to infection which involved the release of histamines, raising of temperature locally, dilation of blood vessels and swelling

Mast cells – Cells found in many tissues as part of the immune response. They secrete histamins

Histamines – chemical released in both inflammatory and allergic responses

Odema – Accumulation of fluid in a tissue

Fever – Raising of the normal body temperature

Phagocytosis – The process by which phagocytes engulf and digest bacteria or other pathogens

Granulocytes – White blood cells which have granules that can be stained in their cytoplasm

Phagocyte – General term to describe white blood cells which engulf and digest pathogens

Interferons – proteins that inhibit viral replication within cells

B cells – A type of lymphocyte involved in the specific immune response

Immunoglobins – membrane bound antibodies

T cells – Cells of the immune system made in the white bone marrow but activated in the thymus gland

T killer cells – T cells of the immune system which bind to infected cells and interact with the cell membrane to destroy the infected cell and pathogens with it

T helper cells – T cells of the immune system which produce cytokines in the specific immune response

MHCs – proteins which display antigens on the surface of cells

Antigen processing – The process by which pathogens are broken down by macrophages and the antigens separated out

Antigen presenting – Macrophages with antigen/MHC complex displayed on the cell surface

T memory cells – cloned cells which remain in the body and rapidly become active if the same antigen is encountered again

B effector cells – precursors of plasma cell clones which produce antibodies

B memory cells – very long lived cells which allow the body to respond rapidly to the second invasion by a particular pathogen

Clonal selection- cloning of B-cells which are producing the right antibody to bind to and destroy a particular pathogen

Plasma cell – part of the immune response

Antibody – protein produced in response to the presence of a specific antigen on the surface of a foreign cell

Clone – Genetically identical individuals that result from asexual reproduction

Objective evidence – Disease specific signs such as a characteristic rash

Symptoms – what an individual feels when suffering from a disease

Subjective evidence – Evidence about a disease based on how an individual feels

Phenol – compound with disinfectant and antiseptic properties

Disinfectants – chemicals used to destroy bacteria in the environment

Antibiotics – chemicals that kill or inhibit the growth of bacteria and fungi

Selective toxicity – chemicals which interfere with the metabolism or functioning of a pathogen with minimal damage to the human host

Antimetabolites – antibiotics which interrupt the metabolic pathways of pathogens

Protein synthesis inhibitors – Antibiotics which interfere with the process of protein synthesis within bacteria

DNA gyrase inhibitos – Inhibit the coiling of bacterial DNA

Bacteriostatic – A chemical which stops bacteria from growing

Bactericidal – A chemical which kills bacteria

Broad spectrum antibiotics – kills or inhibits a wide range of different bacteria

Narrow spectrum antibiotics – Targets one or two specific pathogens

MRSA – Bacterium which is resistant to most commonly used antibiotics

Clostridium difficile – anaerobic antibiotic-resistant gut bacterium

Health acquired infections – Infections which are commonly acquired in hospitals and care homes where people are already frail and ill and where surgery and antibiotic use are high

Natural active immunity – The immunity which results from natural infection of the body and the production of antibodies by the immune system

Natural passive immunity – Immunity resulting from antibodies passing naturally from a mother to her baby through the placenta

Immunisation – the process of protecting people from infection by giving them artificial passive or active immunity

Vaccination – the procedure by which you immunise people to produce immunity to disease

Artificial passive immunity – immunity which results when antibodies formed in one individual are extracted and injected into another individual

Tetanus – the state of a muscle fibre when it is completely contracted as a result of a series of rapid stimuli and remains in that state

Artificial active immunity – immunity induced by the use of small amounts of antigen to trigger an active specific immune response

Attenuated – inactivated, dead or weakened pathogens which are safe to use in vaccines

Adjuvant – material which enhances the effects of a vaccine yet has nothing to do with the specific immune response

Herd immunity – The benefit to society of large cohorts of the population being vaccinated against a particular disease. Herd immunity means that the weakest members who cannot be or are not vaccinated for any reason are protected by the fact that everyone else is immune to the disease so there is no pool of infection in the community

Tubercle – Mass of tissue formed in the lung or elsewhere as a result of the inflammatory response to infection by mycobacterium tuberculosis

Active tuberculosis – stage of tuberculosis when the bacteria are actively growing and dividing and symptoms are apparent

AIDS – disease caused by HIV

HIV – causes AIDS

HIV positive – testing positive for antibodies to the HIV virus indicating that infection has taken place.