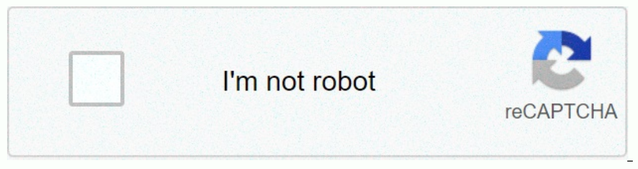

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Oh, IB Biology. I took IB Biology SL back in my high school days. If you are looking at this syllabus, you are likely interested in taking the course or are currently enrolled in the course. In this article, I will walk you through the topics covered in the IB Biology Standard Level and IB Biology Higher Level, as well as the number of hours dedicated to each subject along with what IB expects you to understand for each subject. 2020 IB Biology exam Cancelled Due to COVID-19 Due to COVID-19 (coronavirus) pandemic, all IB exams for May 2020 have been cancelled and courses deadlines have been extended for schools that have closed. (Yep, which includes IB Biology SL/HL exams as well.) Stay up to date with the latest information on what this means for IB diplomas, course credit for IB classes and much more with our IB COVID-19 FAQ article. IB Biology SL and HL Core Both IB Biology SL and HL consist of the same core requirements (95 hours). Both classes cover the same six subjects in the order listed below with the same subtopics listed below: Subject 1: Cell Biology-15 Hours for Both SL and HL Subtopic Subtopic Number IB Points to Understand Introduction to Cells 1.1 According to cell theory, living organisms are composed of cells. Organisms consisting of only one cell perform all the functions of life in that cell. Surface area to volume ratio is important in the limitation of cell size. Multicellular organisms have properties that arise from the interaction of their cellular components. Specialized tissues can be developed by cell differentiation in multicellular organisms. Differentiation involves the expression of certain genes and not others in a cell's genome. The capacity of stem cells to divide and differentiate along different pathways is necessary in embryonic development and also makes stem cells suitable for therapeutic use. Ultrastructure of cells 1.2 Prokaryotes have a simple cell structure without flailing. Eukaryotes have a compartmentalization cell structure. Electron microscopes have a much higher resolution than light microscopes. Membrane structure 1.3 Phospholipids form bilayers in water due to the ampholipid properties of phospholipid molecules. Membrane proteins are different in terms of structure, position in the membrane and function. Cholesterol is a component of animal cell membranes. Membrane transport 1.4 Particles move across membranes through simple diffusion, facilitated diffusion, osmosis and active transport. The fluidity of membranes allows material to be absorbed into cells by endocytosis or released by exocytosis. Vesicles move materials within cells. The origin of cells 1.5 Cells can only be formed by the division of existing cells. The first cells must have arisen from non-living materials. The origin of eukaryotic cells can be explained by the endosymbiotic theory. Cell division 1.6 Mitos is the division of the core of two identical daughter nuclei. Chromosomes condense by supercoiling during mitosis. Cytokinesis occurs after mitosis and is different in plant and animal cells. Interphase is a very active phase of the cell cycle with many processes occurring in the nucleus and cytoplasm. Cylinesare involved in the control of the cell cycle. Mutagens, oncogenes and metastasis are involved in the development of primary and secondary tumors. Subject 2: Molecular biology—21 Hours for both SL and HL Subtopic subtopic number IB points to understanding molecules to metabolism 2.1 Molecular biology explains living processes regarding the chemical substances involved. Carbon atoms can form four covalent bonds that allow a diversity of stable compounds to exist. Life is based on carbon compounds including carbohydrates, lipids, proteins and nucleic acids. Metabolism is the network of all the enzyme-catalysed reactions in a cell or organism. Anabolism is the synthesis of complex molecules from simpler molecules including the formation of macromolecules from monomers through condensation reactions. Catabolism is the breakdown of complex molecules into simpler molecules including hydrolysis of macromolecules in monomers. Water 2.2 Water molecules are polar and hydrogen bonds are formed between them. Hydrogen bonding and dipolarity explain the cohesive, adhesive, thermal and solvent properties of water. Substances can be hydrophilic or hydrophobic. Carbohydrates and lipids 2.3 Monosaccharide monomers are linked by condensation reactions to form disaccharides and polysaccharide polymers. Fatty acids can be saturated, monounsaturated or polyunsaturated. Unsaturated fatty acids can be cis or trans isomer. Triglycerides are formed by condensation from three fatty acids and one glycerol. Proteins 2.4 Amino acids are linked by condensation to form polypeptides. There are 20 different amino acids in polypeptides synthesized on ribosomes. Amino acids can be linked together in any sequence providing a huge variety of possible polypeptides. The amino acid sequence of polypeptides is encoded by genes. A protein may consist of a single polypeptide or more than a polypeptide linked. The amino acid sequence determines the three-dimensional conformation of a protein. Living organisms synthesize many different proteins with a wide range of functions. Each individual has a unique proteome. Enzymes 2.5 Enzymes have an active place to which specific substrates bind. Enzyme catalysis involves molecular movement and collision of substrate with the active area. Temperature, pH and substrate concentration affect the activity rate of the enzyme. Enzymes can be denatured. Immobilized enzymes are widely used in industry. Structure of DNA and RNA 2.6 Nucleic acids DNA and RNA are polymers of nucleotides. DNA differs from RNA in the number of model, base composition and type of pentosis. DNA is a double spiral made of two antiparallel strands of nucleotides connected by hydrogen bonding between complementary base pairs. DNA replication, transcription and translation 2.7 The replication of DNA is semi-conservative and depends on complementary base mating. Helicase unwinds the double spiral and separates the two strands by breaking hydrogen bonds. DNA polymerase links nucleotides to form a new string, using the existing string as a template. Transcription is the synthesis of mRNA copied from the DNA base sequences of RNA polymerase. Translation is the synthesis of polypeptides on ribosomes. The amino acid sequence of polypeptides is determined by mRNA according to the genetic code. Codons of three bases of mRNA correspond to an amino acid in a polypeptide. Translation depends on complementary base pairing between codon on mRNA and anticodons on tRNA. Cell respiking 2.8 Cell respirating is the controlled release of energy from organic compounds to produce ATP. ATP from cellular respiking is immediately available as an energy source in the cell. Anaerobic cell respirating provides a small yield of ATP from glucose. Aerobic cellular respiking requires oxygen and provides a large yield of ATP from glucose. Photosynthesis 2.9 Photosynthesis is the production of carbon compounds in cells using light energy. Visible light has a series of wavelengths with violet the shortest wavelength and red longest. Chlorophyll absorbs red and blue light most effectively and reflects green light more than other colors. Oxygen is produced in photosynthesis from photolysis of water. Energy is needed to produce carbohydrates and other carbon compounds from carbon dioxide. Temperature, light intensity and carbon dioxide concentration are possible limiting factors at the rate of photosynthesis. Topic 3: Genetics-15 Hours for both SL and HL Subtopic Subtopic Number IB Points to Understand Genes 3.1 A gene is a heritable factor that consists of a length of DNA and affects a specific property. A gene occupies a specific position on a chromosome. The different specific forms of a gene are allegreens. Alleels differ from each other by one or only a few bases. New alles are formed by mutation. The genome is the whole of the genetic information of an organism. The entire base sequence of human genes was sequenced in the Human Genome Project. Chromosomes 3.2 Prokaryotes have a chromosome consisting of a circular DNA molecule. Some prokaryotes also have plasmids but eukaryotes do not. Eukaryote chromosomes are linear DNA molecules associated with histone proteins. In a eukaryotic species there are different chromosomes that carry different genes. Homologous chromosomes carry the same sequence of genes, but not necessarily the same allevis of these genes. Diploid nuclei have pairs of homologous chromosomes. Haploid cores have a of each pair. The number of chromosomes is a characteristic feature of members of a species. A karyogram shows the chromosomes of an organism in homologous pairs of decreasing length. Sex is determined by sex chromosomes and autosomes are chromosomes that do not determine sex. Meios 3.3 A diploid nucleus parts of meiosis to produce four haploid nuclei. The halving of the chromosome number allows for a sexual life cycle with fusion of caving. DNA is replicated before meiosis so that all chromosomes consist of two sister chromatotids. The early stages of meiosis involve pairing of homologous chromosomes and crossing over followed by condensation. Orientation of pairs of homologous chromosomes before separation is random. Separation of pairs of homologous chromosomes in the first division of meiosis halves the chromosome number. Crossing over and random orientation promotes genetic variation. Fusion of gametes from different parents promotes genetic variation. Heritage 3.4 Mendel discovered the principles of inheritance with experiments where large numbers of pea plants were crossed. Gameter is haploid so contains only one allele of each gene. The two alleels of each gene separate into different haploid daughter nuclei during meiosis. Fusion of gametes results in diploid zygotes with two alleles of each gene that may be the same allele or different alleles. Dominant alleers mask the effects of recessive allese but co-dominant alleers have common effects. Many genetic diseases in humans are due to recessive alleviators of autosomal genes, although some genetic diseases are due to dominant or co-dominant alleviaries. Some genetic diseases are gender-related. The pattern of inheritance is different with sex-related genes because of their placement on sex chromosomes. Many genetic diseases have been identified in humans but most are very rare. Radiation and mutagenic chemicals increase the frequency of mutations and can cause genetic diseases and cancer. Genetic modification and biotechnology 3.5 Gel electrophoresis is used to separate proteins or fragments of DNA according to size. PCR can be used to amplify small amounts of DNA. DNA profiling involves comparing DNA. Genetic modification is carried out by gene transfer between species. Clones are groups of genetically identical organisms, derived from a single original parent cell. Many plant species and some animal species have natural methods of cloning. Animals can be cloned at the embryo stage by breaking up the embryo into more than one group of cells. Methods have been developed for cloning adult animals using differentiated cells. Topic 4: Ecology-12 Hours for both SL and HL Subtopic Subtopic Number IB Points to Understand Species, Communities and Ecosystems 4.1 Species are groups of organisms that can potentially interbreed to produce fertile offspring. Members of a species may be reproductively isolated in Populations. Species have either an autotrophic or heterotrophic method of nutrition (some species have both methods). Consumers are heterotrous fish that feed on living organisms by ingestion. Detritivores are heterotrohers that obtain organic nutrients from the detritus through internal digestion. Saprotrophs are heterotrohers that obtain organic nutrients from dead organisms through external digestion. A community is formed by populations of different species that live together and interact with each other. A society forms an ecosystem through its interactions with the abiotic environment. Autotrofish obtain inorganic nutrients from the abiotic environment. Administration of inorganic nutrients is maintained by nutrient cycling. Ecosystems have the potential to be sustainable over long periods of time. Energy flow 4.2 Most ecosystems depend on energy supply from sunlight. Light energy is converted into chemical energy in carbon compounds through photosynthesis. Chemical energy in carbon compounds flows through food chains using feeding. Energy released from carbon compounds by breathing is used in living organisms and converted into heat. Living organisms cannot convert heat into other forms of energy. Heat is lost from ecosystems. Energy losses between trophic levels limit the length of food chains and the biomass of higher trophic levels. Carbon cycling 4.3 Autotrophs convert carbon dioxide into carbohydrates and other carbon compounds. In aquatic ecosystems, carbon is present as dissolved carbon dioxide and hydrogen carbonate ions. Carbon dioxide spreads from the atmosphere or water to autotrophs. Carbon dioxide is produced by breathing and spreads organisms into the water or atmosphere. Methane is produced from organic matter under anaerobic conditions by methanogenic archaeans and some diffuse into the atmosphere or accumulate in the soil. Methane is oxidized into carbon dioxide and water in the atmosphere. Peat is formed when organic matter is not completely decomposed due to acidic and/or anaerobic conditions in waterlogged soils. Partially decomposed organic matter from previous geological epochs was converted either into coal or into oil and gas accumulated in porous rocks. Carbon dioxide is produced by the combustion of biomass and fossilised organic matter. Animals such as reef-building corals and mollusca have hard parts consisting of calcium carbonate and can become fossilized in limestone. Climate change 4.4 Carbon dioxide and water vapour are the most significant greenhouse gases. Other gases including methane and nitrogen oxides have less impact. Engas' influence depends on its ability to absorb long-wave radiation and its concentration in the atmosphere. The warmed soil emits longer wavelength radiation (heat). Longer wave radiation is absorbed by greenhouse gases that retain heat in the atmosphere. Global temperatures and patterns are affected by concentrations of greenhouse gases. There is a correlation between rising atmospheric concentrations of carbon dioxide since the beginning of the Industrial Revolution 200 years ago and average global temperatures. The recent increases in carbon dioxide in the atmosphere are largely due to an increase in the combustion of fossilised organic matter. Topic 5: Evolution and Biodiversity-12 Hours for both SL and HL Subtopic Subtopic Number IB Points to Understand Evidence for Evolution 5.1 Evolution occurs when heritable properties of a species change. The fossil record provides evidence of evolution. Selective breeding of domesticated animals shows that artificial selection can cause evolution. Evolution of homologous structures through adaptive radiation explains similarities in structure when there are differences in function. Populations of a species can gradually diverge into separate species through evolution. Continuous variation between the geographic area of related populations matches the concept of gradual divergence. Natural selection 5.2 Natural selection can only occur if there is variation among members of the same species. Mutation, meiosis and sexual reproduction cause variation between individuals in a species. Adaptations are qualities that make an individual suitable for their environment and lifestyle. Species tend to produce more offspring than the environment can support. Individuals who are better adapted tend to survive and produce more offspring while the less well-adjusted tend to die or produce fewer offspring. Individuals who reproduce pass on properties to their offspring. Natural selection increases the frequency of properties that allow individuals to adapt better and reduce the frequency of other characteristics that lead to changes within the species. Classification of biodiversity 5.3 The binomal system of names for species is universal among biologists and has been agreed and developed at a number of congresses. When species are discovered they are given scientific names using the binomial system. Taxonomists classify species by means of a hierarchy of taxa. All organisms are divided into three domains. The main treasure for classifying eukaryotes is kingdom, fylum, class, order, family, genus and species. In a natural classification, the genus and the accompanying higher taxa consist of all the species that have evolved from an ordinary ancestral species. Taxonomists sometimes reclassify groups of species when new evidence shows that a previous taxon contains species that have evolved from different ancestral species. Natural classifications help in the identification of species and allow prediction of characteristics shared by species within a group. Cladistics 5.4 A cleave is a group of organisms that have evolved from a common ancestor. Evidence of which species are included in a cedcan can be from a gene's base sequences or equivalent amino acid sequence of a protein. Sequence differences accumulate gradually so there is a positive correlation between the number of differences between two species and the time since they deviated from a common ancestor. Properties can be analog or homologous. Cladograms are tree diagrams that show the most likely sequence of divergence in clades. Evidence from the clalist has shown that classifications of certain groups based on structure did not correspond to the evolutionary origins of a group or species. Topic 6: Human Physiology—20 Hours for both SL and HL Subtopic Subtopic Number IB Points to Understand and Digestion absorption 6.1 The contraction of circular and longitudinal muscles in the small intestine mixes food with enzymes and moves it along the intestine. The pancreas secretes enzymes in the lumen of the small intestine. Enzymes digest most macromolecules in food into monomers in the small intestine. Villi increase the surface of the epithelium over which absorption is carried out. Villi absorbs monomers formed by digestion as well as mineral ions and vitamins. Different methods of membrane transport are required to absorb different nutrients. The blood system 6.2 Arteries transmit blood at high pressure from the ventricles to the tissues of the body. Arteries have muscle cells and elastic fibers in their walls. The muscle and elastic fibers help maintain blood pressure between pump cycles. Blood flows through tissues of capillaries. Capillaries have permeable walls that allow the exchange of material between cells in the tissue and blood in the capillary. Veins collect blood at low pressure from the tissues of the body and return it to the atria of the heart. Valves in veins and the heart ensure the circulation of blood by preventing backflow. There is a separate circulation for the lungs. Heart rhythm is initiated by a group of specialized muscle cells in the right atrium called the sinoatrial node. The sinotrial node acts as a pacemaker. The sinotrial node emits an electrical signal that stimulates contraction as it propagates through the atria walls and then the walls of the ventricles. Heart rate can be increased or reduced by impulses brought to the heart by two nerves from medulla in the brain. Adrenaline increases heart rate to prepare for vigorous physical activity. Defense against infectious disease 6.3 The skin and mucous membranes form a primary defense against pathogens that cause infectious disease. Cuts in the skin are sealed by blood clotting. Clotting factors are released from platelets. The cascade results in rapid conversion of fibrinogen into fibrin by thrombin. Ingestion of pathogens through phagocytic white blood cells provides non-specific immunity to diseases. Production of antibodies of lymphocytes in response to pathogens provide specific immunity. Antibiotics block processes that occur in prokaryotic cells but not in eukaryotic cells. Viruses lack a metabolism and therefore cannot be treated with antibiotics. Some strains of bacteria have been developed with genes that provide resistance to antibiotics and some strains of bacteria have multiple resistance. Gas exchange 6.4 Ventilation maintains concentration gradients of oxygen and carbon dioxide between air in alveoli and blood flowing in adjacent capillaries. Type I pneumocytes are extremely thin alveolar cells that are adapted to conduct gas exchange. Type II pneumocytes secrete a solution containing surfactant material that creates a damp surface inside the alveoli to prevent the alveolus sides from joining each other by reducing surface tension. Air is carried to the lungs of the trachea and bronchi and then to the alveoli in the bronchi. Muscle contractions cause pressure changes inside the chest that force air in and out of the lungs to ventilate them. Different muscles are required for inspiration and expiration dates because the muscles only work when they contract. Neurons and synapses 6.5 Neurons transmit electrical impulses. The myelination of nerve fibers allows for salt conduction. Neurons pump sodium and potassium ions over their membranes to generate a resting potential. An action potential consists of depolarization and repolarization of the neuron. Nerve impulses are action potentials propagated along the axons of neurons. Propagation of nerve impulses is the result of local currents that cause each successive part of the axon to reach threshold potential. Synapses are crossbreeds between neurons and between neurons and receptor or effector cells. When presynaptic neurons are depolarized they release a neurotransmitter into the synapse. A nerve impulse begins only if the threshold potential is reached. Hormones, homeostasis and reproduction 6.6 Insulin and glucagon are excreted by β and α of the pancreas respectively to control blood glucose concentration. Thyroxine is secreted by the thyroid gland to regulate metabolism and help control body temperature. Leptin is secreted by cells in adipose tissue and acts on the hypothalamus of the brain to inhibit appetite. Melatonin is secreted by the pineal gland to control circadian rhythms. A gene on the Y chromosome causes embryonic genitalia to develop as testicles and secrete testosterone. Testosterone causes prenatal development of male genitalia and both sperm production and development of male secondary sexual characteristics during puberty. Estrogen and progesterone cause prenatal development of female reproductive organs and female secondary sexual characteristics during puberty. The menstrual cycle is controlled by negative and positive feedback mechanisms involving ovarian and pituitary hormones. Further higher level Only students taking IB Biology HL cover these subjects. They consist of 60 hours of study. Topic 7: Nucleic Acids-9 Hours for HL Only Subtopic Subtopic Number IB Points to Understand DNA Structure and Replication (HL ONLY) 7.1 Nucleosomes help to supercoilERa DNA. DNA structure suggested a mechanism for DNA replication. DNA polymerases can only add nucleotides to the 3' end of a primer. THE DNA replication is continuous on the conductive string and discontinuous on the trailing string. DNA replication is performed by a complex system of enzymes. Some regions of DNA do not encode for proteins but have other important functions. Transcription and gene expression (HL ONLY) 7.2 Transcription occurs in a 5' to 3' direction. Nucleosomes help regulate transcription in eukaryotes. Eukaryotic cells modify mRNA after transcription. Splicing of mRNA increases the number of different proteins an organism can produce. Gene expression is regulated by proteins that bind to specific base sequences in DNA. The environment in a cell and of an organism has an impact on gene expression. Translation (HL ONLY) 7.3 Initiation of translation involves the assembly of the components that perform the process. Synthesis of the polypeptide involves a repeated cycle of events. Disassembly of the components follows the termination of translation. Free ribosomes synthesize proteins for use mainly within the cell. Bound ribosomes synthesize proteins primarily for excretion or for use in lysosomes. Translation can occur immediately after transcription in prokaryotes due to the absence of a nuclear membrane. The sequence and number of amino acids in the polypeptide is the primary structure. The secondary structure is the formation of alpha-helices and beta pleated sheets stabilized by hydrogen bonding. The tertiary structure is the additional folding of the polypeptide stabilized through interactions between R-groups. The quaternary structure is found in proteins with more than one polypeptide chain. Do you want to build the best possible college application? We can help. PrepScholar Admissions is the world's best admissions consulting service. We combine world-class admissions advisors with our data-driven, proprietary admission strategies. We have monitored thousands of students entering their best choice schools, from state colleges to the Ivy League. We know what types of students colleges want to recognize. We want you accepted to your dream schools. Learn more about PrepScholar Admissions to maximize your chance of getting in. Topic 8: Metabolism, Cell Respiration, and Photosynthesis-14 Hl Only Subtopic Subtopic Number IB Hours Points to Understanding Metabolism (HL ONLY) 8.1 Metabolic Pathways consist of chains and cycles of enzyme-catalysed reactions. Enzymes lower the activation energy of the chemical reactions they catalyze. Enzyme inhibitors can be competitive or non-competitive. pathways can be controlled by end-product inhibition. Cell respination (HL ONLY) 8.2 Cell respination involves oxidation and reduction of electron carriers. Phosphorylation of molecules makes them less stable. In glycolysis, glucose is converted into pyruvate in the cytoplasm. Glycolysis provides a small net gain of ATP without the use of oxygen. In aerobic cell respiration pyruvate is decarboxylated and oxidized, and converted into acetyl compound and attached to coenzyme A to form acetyl coenzyme A in the link reaction. In the Krebs cycle, the oxidation of acetyl groups is linked to the reduction of hydrogen carriers, which releases carbon dioxide. Energy released by oxidation reactions is carried to the cristae of the mitochondria by reduced NAD and FAD. Transfer of electrons between carriers in the electron transport chain in the membrane of cristae is linked to proton pumping. In chemiosmosis protons diffuse by ATP synthase to generate ATP. Oxygen is needed to bind with the free protons to maintain the hydrogen gradient, resulting in the formation of water. The structure of the mitochondria is adapted to the function it performs. Photosynthesis (HL ONLY) 8.3 Light-dependent reactions take place in the intermembrane space of the thylakoids. Light-independent reactions take place in stroma. Reduced NADP and ATP are produced in the light-dependent reactions. Absorption of light through photosystems generates excited electrons. Photolysis of water generates electrons for use in the light-dependent reactions. Transmission of excited electrons occurs between carriers in thylacoid membranes. Excited electrons from Photosystem II are used to help generate a proton gradient. ATP synthase in thylacoids generates ATP using the proton gradient. Excited electrons from Photosystem I are used to reduce NADP. In the independent reactions a carboxylas carboxylation of ribulosabisphosphate is catalyses. Glycerat 3 phosphate is reduced to triophosphate using reduced NADP and ATP. Triophosphate is used to regenerate RuBP and produce carbohydrates. Ribusa bisphosphosphate is reformed using ATP. The structure of chloroplast is adapted to its function in photosynthesis. Topic 9: Plant biology-13 HL Only Subtopic Subtopic Hours Number IB Points to understand transport in xylem of plants (HL ONLY) 9,1 Transpiration is the inevitable consequence of gas exchange in the blade. Plants transport water from the roots to the leaves to compensate losses from transpiration. The cohesive nature of the water and the structure of the xylem vessels allow transport under voltage. The adhesive property of water and evaporation generates voltage forces in leaf cell walls. Active uptake of mineral ions in the roots causes absorption of water through osmosis. Transport in plant phloem (HL ONLY) 9.2 Plants transport organic compounds from sources to The incontivisibility of water allows transport along hydrostatic pressure gradients. Active transport is used to load organic compounds into phloem sieve tubes at the source. High concentrations of solutes in phloem at source lead to water uptake through osmosis. If hydrostatic pressure is brought up, the contents of the phloemen flow towards sinks. Growth in plants (HL ONLY) 9.3 Undifferentiated cells in the meristems of plants allow for indefinite growth. Mitosis and cell division in the shot apex provide cells needed for extension of the stem and the development of leaves. Plant hormones control the growth of the shovel tip. Plant shoots respond to the environment through tropisms. Auxin efflux pumps can set concentration gradients of auxin in plant tissue. Auxin affects cell growth rates by changing the gene expression pattern. Reproduction in plants (HL ONLY) 9.4 Flowering involves a change in gene expression in the shot apex. The transition to flowering is a response to the length of light and dark periods in many plants. Success in plant reproduction depends on pollination, fertilization and seed dispersion. Most flowering plants use mutualistic relationships with pollinators in sexual reproduction. Topic #10: Genetics and evolution-8 hours for HL Only Subtopic Subtopic Number IB Points to understand Meiosis (HL ONLY) 10.1 chromosomes replicate in interphase before meiosis. Crossing over is the exchange of DNA material between non-sister homologous chromatids. Crossing over produces new combinations of alleels on the chromosomes of the haploid cells. Chiasmata formation between non-sister chromatids can result in an exchange of alles. Homologous chromosomes separately in meiosis I. Sister chromatids separately in meiosis II. Independent range of genes depends on random orientation of pairs of homologous chromosomes in meiosis I. Inheritance (HL ONLY) 10.2 Gene loci are said to be reconnected on the same chromosome. Unlinked genes segregate independently as a result of meiosis. The variation can be discrete or continuous. The phenotypes of polygenic properties tend to show continuous variation. Chi-squared tests are used to determine whether the difference between an observed and expected frequency distribution is statistically significant. Gene pools and species formation (HL ONLY) 10.3 A gene pool consists of all genes and their different allestations, which are found in an interbreeding population. Evolution requires all-allele frequencies to change over time in populations. Reproductive isolation of populations can be temporal, behavioural or geographical. Speciation due to divergence of isolated populations may occur gradually. Speciation may occur abruptly. Topic 11: Animal Physiology-16 Hours for HL Only Subtopic Subtopic Number IB Points to Understand Antibody Production and Vaccination (HL ONLY) 11.1 Each organism has unique molecules on the surface of its Pathogens can be species-specific although others may cross species barriers. B lymphocytes are activated by T lymphocytes in mammals. Activated B cells multiply to form clones of plasma cells and memory cells. Plasma cells secret antibodies. Antibodies aid the destruction of pathogens. White cells release histamine in response to allergens. Histamines cause allergic symptoms. Immunity is due to persistent memory cells. Vaccines contain antigens that trigger immunity but do not cause the disease. Fusion of a tumor cell with an antibody-producing plasma cell creates a hybridomcell. Monoclonal antibodies are produced by hybridoma cells. Movement (HL ONLY) 11.2 Bones and exoskeletons provide anchoring for muscles and act as levers. Synovial joints allow some movements but not others. Movement of the body requires muscles to work in antagonistic pairs. Skeletal muscle fibers are multinucleate and contain specialized endoplasmic reticulum. Muscle fibers contain many myofibrils. Each myofibril consists of contractile sarcomas. Contraction of the skeletal muscle is achieved by sliding the actin and myosin filaments. ATP hydrolysis and cross bridge formation are necessary for the filaments to slip. Calcium ions and the proteins tropomyosin and troponin control muscle contractions. Kidney and osmoregulationen (HL ONLY) 11.3 The animals are either osmoregulators or osmoconformers. The malpighiska tubule system of insects and the kidney performs osmoregulation and removal of nitrogenous waste. The composition of blood in the renal artery differs from that of the renal vein. The ultrastructure of glomerulus and Bowman's capsule facilitate ultrafiltration. The proximal intricate tubule selectively reabsorbs useful substances through active transport. The loop of Henle maintains hypertonic conditions in the medulla. ADH controls the reabsorption of water in the collection channel. The length of the loop of Henle is positively correlated with the need for water conservation in animals. The type of nitrogenous waste in animals is correlated with evolutionary history and habitat. Sexual reproduction (HL ONLY) 11.4 spermatogenesis and oogenesis alike involve mitosis, cell growth, two divisions of meiosis, and differentiation. Processes in spermatogenesis and oogenesis result in different number of gametes with different amounts of cytoplasm. Fertilization in animals can be internal or external. Fertilization involves mechanisms that prevent polyspermy. Implantation of blastocyst in the lining of the uterus is crucial for continued pregnancy. HCG stimulates the ovary to secrete progesterone during early pregnancy. The placenta facilitates the exchange of material between the mother and the fetus. Estrogen and progesterone are excreted by the placenta after it has formed. Birth is conveyed by positive feedback involving estrogen and One of the single most important parts of your college application is which classes you choose to take in high school (related to how well you do in these classes). Our team of PrepScholar admissions experts have compiled their knowledge into this single guide to plan out your high school course schedule. We advise you on how to balance your schedule between regular and honor/AP/IB courses, how to choose your leisure activities, and which classes you can't afford not to take. Options As part of the IB Biology class, cover an additional topic from the options below. (Usually you don't choose, but rather your teacher does.) Whichever option you or your teacher choose, you cover three or four subjects (15 hours in total) for SL and another two or three subjects (25 hours in total) for HL. Option A: Neurobiology and Behavior—15 Hours for SL and 25 hours for HL Subtopic Subtopic Number IB Points to Understand Neural development A.1 The neural tube of embryonic chordats is formed by infolding of the ectoderm followed by elongation of the tube. Neurons are initially produced by differentiation in the neural tube. Immature neurons migrate to a final location. An axon grows from each immature neuron in response to chemical stimuli. Some axons extend beyond the neural tube to reach other parts of the body. A developing neuron forms several synapses. Unused synapses do not persist. Neural pruning involves loss of unused neurons. The plasticity of the nervous system allows to change with experience. The human brain A.2 The anterior part of the neural tube expands to form the brain. Different parts of the brain have specific roles. The autonomic nervous system controls involuntary processes in the body using centers located mainly in the brainstem. The cerebral cortex forms a larger proportion of the brain and is more developed in humans than other animals. The human cortex has been enlarged mainly by an increase in the total area with extensive folding to accommodate it within the skull. The hemispheres are responsible for higher order functions. The left cerebral hemisphere receives sensory input from sensory receptors in the right side of the body and the right side of the field of vision in both eyes and vice versa for the right hemisphere. The left hemisphere controls muscle contraction in the right side of the body and vice versa for the right hemisphere. The metabolism of the brain requires large energy inputs. Perception of stimuli A.3 Receptors detects changes in the environment. Rods and cones are photoreceptors located in the retina. Rods and cones differ in their sensitivities to light intensities and wavelengths. Bipolar cells send the impulses from rods and cones to ganglion cells. Ganglion cells send messages to the brain through the optic nerve. The information from the right vision from both eyes is sent to the left part of the visual cortex and vice versa. Structures in the middle ear transmit and amplify sound. Sensory hairs in the cochlea detect sounds of specific wavelengths. Impulses caused by sound perception are transmitted to the brain via the auditory nerve. Hair cells in the semicircular channels detect the movement of the head. Additional HL Neurobiology and Behavioral Topics—10 More hours for HL Innate and Learned Behavior (HL ONLY) A.4 Congenital behavior is inherited from parents and so develops independently of the environment. Autonomic and involuntary responses are referred to as reflexes. Reflex arcs consist of neurons that mediate reflexes. Reflex conditioning involves forming new associations. Learned behavior develops as a result of experience. Imprinting is learning occurs in a particular life stage and is independent of the consequences of behavior. Operant conditioning is a form of learning consisting of trial and error experiences. Learning is the acquisition of skill or knowledge. Memory is the process of encoding, storing, and accessing information. Neuropharmacology (HL ONLY) A.5 Some neurotransmitters excite nerve impulses in postynaptic neurons and others inhibit them. Nerve impulses are initiated or inhibited in post-synaptic neurons as a result of summation of all excitatory and inhibitory neurotransmitters received from presynaptic neurons. Many different slow-acting neurotransmitters modulate rapid synaptic transmission in the brain. Memory and learning involve changes in neurons caused by slowly acting neurotransmitters. Psychoactive drugs affect the brain by either increasing or reducing postynaptic transmission. Anesthetics work by interfering with neural transmission between areas of sensory perception and the CNS. Stimulant drugs mimic stimulation provided by the sympathetic nervous system. Addiction may be affected by genetic predisposition, social environment and dopamine secretion. Ethology (HL ONLY) A.6 Ethology is the study of animal behavior in natural conditions. Natural selection may change the frequency of observed animal behavior. Behavior that increases the chances of survival and reproduction will become more common in a population. Learned behavior can spread through a population or be lost from it faster than innate behavior. Option B: Biotechnology and Bioinformatics-15 Hours for SL and HL Subtopic Subtopic Number IB Points to Understand Microbiology: organisms in industry B.1 Microorganisms are metabolically different. Microorganisms are used in industry because they are small and have a rapid growth rate. Pathway engineering optimizes genetic and regulatory processes within microorganisms. Pathway engineering is used industrially to produce metabolites of interest. Fermenters allow large-scale production of metabolites of microorganisms. per batch or continuous culture. Microorganisms in fermenters become limited by own waste products. Probes are used to monitor conditions within fermenters. Conditions are maintained at optimal levels for the growth of the micro-organisms grown. Biotechnology in agriculture B.2 Transgenic organisms produce proteins that were not previously part of the species' proteome. Genetic modification can be used to overcome environmental resilience to increase harvests. Genetically modified crops can be used to produce new

products. Bioinformatics plays a role in identifying target genes. The target gene is associated with other sequences that control its expression. An open reading frame is a significant length of DNA from a starting codon to a stop codon. Marker genes are used to indicate successful uptake. Recombinant DNA must be inserted into the plant cell and absorbed by its chromosome or chloroplast DNA. Recombinant DNA can be inserted into whole plants, foliage or protoplastics. Recombinant DNA can be introduced by direct physical and chemical methods or indirectly by vectors. Environmental protection B.3 Responses to pollution incidents may involve bioremediation combined with physical and chemical procedures. Microorganisms are used in bioremediation. Some impurities are metabolized by microorganisms. Cooperative aggregates of microorganisms can form biofilms. Cinema films possess emerging properties. Microorganisms that grow in a biofilm are very resistant to antimicrobials. Microorganisms in biofilms cooperate through quorum sensing. Bacteteiofasis is used in the disinfection of water systems. Additional HL Biotechnology and Bioinfomatics Topics-10 More Hours for HL Medicine (HL ONLY) B.4 Infection of a pathogen can be detected by the presence of its genetic material or by its antigens. Predisposition to a genetic disease can be detected by the presence of markers. DNA microarrays can be used to test for genetic predisposition or to diagnose the disease. Metabolites indicating disease can be detected in blood and urine. Tracking experiments are used to obtain information about the localization and interaction of a desired protein. Biopharming uses genetically modified animals and plants to produce proteins for therapeutic use. Virus vectors can be used in gene therapy. Bioinformatics (HL ONLY) B.5 Databases give researchers easy access to information. The amount of data stored in databases increases exponentially. BLAST scans can identify similar sequences in different organisms. Gene function can be studied using model organisms with similar sequences. Sequence customization software allows comparison of sequences from different organisms. BLASTn allows nucleotide sequence adjustment while BLASTp allows protein alignment. Databases can be searched to compare newly identified sequences with sequences known function in other organisms. Multiple sequence targeting is used in the study of phylogenetics. EST is an expressed sequence tag that can be used to identify potential genes. Option C: Ecology and Conservation-15 Hours for SL and HL Subtopic Subtopic Number IB Points to Understand Species and Communities C.1 The distribution of species is affected by limiting factors. The community structure can be strongly influenced by keystone species. Each species plays a unique role within a community because of the unique combination of its spatial habitat and interactions with other species. Interactions between species in a community can be classified according to their effect. Two species cannot survive indefinitely in the same habitat if their niches are identical. Societies and ecosystems C.2 Most species occupy different trophic levels in several food chains. A food web shows all sorts of food chains in a community. The percentage of energy consumed converted into biomass depends on the rate of respiration. The type of stable ecosystem that will occur in an area is predictably based on climate. In closed ecosystems energy but no matter is exchanged with the environment. Disturbances affect the structure of change and the rate of change in ecosystems. Human impact on ecosystems C.3 Introduced alien species can escape into local ecosystems and become invasive. Competitive exclusion and the absence of predators can lead to a reduction in the number of endemic species when alien species become invasive. Pollutants become concentrated in the tissues of organisms at higher trophic levels through biomagnification. Macroplastics and microplastic debris have been collected in marine environments. Biodiversity conservation C.4 An indicator species is an organism used to assess a specific environmental condition. Relative numbers of indicator species can be used to calculate the value of a biotic index. In situ conservation may require active management of nature reserves or national parks. Ex situ conservation is the conservation of species outside their natural habitats. Biogeographical factors affect species diversity. Wealth and smoothness are components of biodiversity. Additional HL Ecology and Conservation Substances-10 More Hours for HL Population Ecology (HL ONLY) C.5 Sampling techniques are used to estimate population size. The exponential growth pattern occurs in an ideal, unlimited environment. Population growth slows as the population reaches the environmental capacity. The phases shown in the sigmoid curve can be explained by relativeity of natality, mortality, immigration and emigration. Limiting factors can be top-down or bottom-up. Nitrogen and phosphorus cycles (HL ONLY) C.6 Nitrogen-fixing bacteria convert atmospheric nitrogen into ammonia. Rhizobium associates with roots in a mutualistic relationship. In the absence of oxygen bacteria reduce nitrate in the soil. Phosphorus can be added to the phosphorus cycle by applying fertilisers or removed by harvesting arable crops. The turnover rate of the phosphorus cycle is much lower than the nitrogen cycle. The availability of phosphate may be limited to agriculture in the future. Leaching of mineral nutrients from agricultural land to rivers causes eutrophication and leads to increased biochemical oxygen demand. Option D: Human Physiology—15 Hours for SL and HL Subtopic Subtopic Number IB Points to Understand Human nutrition D.1 Essential nutrients cannot be synthesized by the body, therefore they must be included in the diet. Dietary minerals are important chemical elements. Vitamins are chemically different carbon compounds that cannot be synthesized by the body. Some fatty acids and certain amino acids are essential. Lack of essential amino acids affects the production of proteins. Malnutrition can be caused by a deficiency, imbalance or excess of nutrients in the diet. Appetite is controlled by a center of the hypothalamus. Obese individuals are more likely to suffer from high blood pressure and type II diabetes. Starvation can lead to the breakdown of body tissue. Digestion D.2 Nervous and hormonal mechanisms control the secretion of digestive juices. Exocrine glands secrete to the surface of the body or lumen of the intestine. The volume and content of gastric secretions are controlled by nervous and hormonal mechanisms. Acid conditions in the stomach favor certain hydrolysis reactions and help control pathogens in ingested food. The structure of cells in the epithelium of the sewing is adapted to the absorption of food. The rate of transit of materials through the large intestine is positively correlated with their fiber content. Materials that are not absorbed are egested. Functions of the liver D.3 The liver removes toxins from the blood and detoxifies them. Components of red blood cells are recovered by the liver. The breakdown of erythrocytes begins with phagocytosis of red blood cells of Kupffer cells. Iron is carried to the bone marrow to produce hemoglobin in new red blood cells. Excess cholesterol is converted into bile salts. Endoplasmatically reticulum and Golgiapparat i hepatocytes produce plasma proteins. The liver picks up blood from the intestine to regulate nutrient levels. Some nutrients in excess can be stored in the liver. Heart D.4 The structure of heart muscle cells allows for the propagation of stimuli through the heart wall. Signals from the sinotrial node that cause contraction cannot pass directly from the atria to the ventricles. There is a delay between arrival and passing on of a stimulus at the atrioventricular node. This delay allows time for atrial atrial sytole before the atrioventricular valves close. Lead fibers ensure coordinated contraction of the entire gastric wall. Normal heart sounds are of atrioventricular valves and semiluna closure valves causing changes in blood flow. Additional HL Human Physiology Topics-10 More Hours for HL Hormones and Metabolism (HL ONLY) D.5 Endocrine Glands Secrete Hormones Directly into the Bloodstream. Steroid hormones bind to receptor proteins in the cytoplasm in the target cell to form a receptor hormone complex. The receptor hormone complex promotes the transcription of specific genes. Peptide hormones bind to receptors in the plasma membrane of the target cell. Binding hormones to membrane receptors activates a cascade mediated by a second messenger inside the cell. The hypothalamus controls hormone secretion of the anterior and posterior lobes of the pituitary gland. Hormones secreted by pituitary gland control growth, developmental changes, reproduction and homeostasis. Transport of airway gases (HL ONLY) D.6 Oxygen dissociation curves show the affinity of hemoglobin for oxygen. Carbon dioxide is carried in solution and bound to hemoglobin in the blood. Carbon dioxide is converted in red blood cells into hydrogen carbonate ions. The Bohr shift explains the increased release of oxygen by hemoglobin into respiring tissues. Chemoreceptors are sensitive to changes in blood pH. The ventilation speed is controlled by the respiratory control centre in medulla oblongata. During exercise the speed of ventilation changes in response to the amount of CO2 in the blood. Fetal hemoglobin differs from adult hemoglobin allowing the transfer of oxygen in the placenta on fetal hemoglobin. Practical Scheme of Work You must also complete experiments and experimental reports as part of any IB Science course. For SL there are 40 hours of material. For HL there are 60 hours of material. Here are the activities: Practical activities: 20 hours for SL and 40 hours for HL Lab work in class count against these hours Individual investigation (internal assessment IA): 10 hours for SL and HL A lab project along with a report that counts as 20% of your IB exam points (written count exams for the other 80%) Group 4 Projects:10 hours for SL and HL Students are divided into groups and must conduct an experiment and write a report. Experiments may not be this cool. What's next? Looking to take AP Biology instead? Read about what's covered in an AP Bio here. Looking for more in-depth explorations of the topics mentioned on this syllabus? Read our subject-specific articles on topics that vary from the photosynthesis equation to homologous and analog structures to cell biology (including cell theory, enzymes, and how the cell membrane and endoplasmic reticulum works). Do you hope to squeeze in some extra IB classes? Read about the IB courses offered online. Study for the SAT? Check out our complete guide to SAT. With the SAT next month? Check out our guide to studying. Not where you want to go to college? Check out our guide to finding your target school. Want to improve your SAT score by 160 points or your ACT score by 4 points? We have written a guide for each test about the 5 strategies you need to use to have a chance to improve your score. Download it for free now: now: