**Curriculum**

**IB Biology Y1**

**Course Overview**

IB Biology explores the world of living things from several perspectives, including structure and function, biological interactions, and evolution, while paying close attention to human impacts, ethics, and the science of biology through experimentation. The first year focuses on the Standard Level materials and some of the Higher Level content. Although always focused on the IB standards, the class explores many topics more broadly to ensure a thorough grounding in each content area. As experimentation and critical thinking are crucial to scientific advancement, they play an important role in the IB Biology class. In addition to many lab experiments, students participate in a larger collaborative, the Group Four Science Project, during the Second Semester.

**Department Standards**

**STANDARD 1: THE NATURE OF SCIENCE**

**STANDARD 2: SCIENCE AND TECHNOLOGY**

**STANDARD 3: THE PHYSICAL SETTING**

**STANDARD 4: THE LIVING ENVIRONMENT**

**STANDARD 5: SCIENCE AND SOCIETY**

**Benchmarks**:

[IB Benchmarks](http://acidale.on-rev.com/dante/Science/IBBiologyGuide.pdf)

**Performance Indicators**

**IB Biology Y1**

**Performance Indicators**

**First Quarter**

Generate multiple examples of levels of organization of the biosphere, for terrestrial and aquatic environments.

Explain characteristics of living organisms including organization, metabolism, reproduction, response to stimuli, adaptation, etc. Summarize the roles of various elements needed by living organisms, including sulfur, calcium, phosphorus, iron, and sodium. (IB 3.1.1-3.1.3)

Differentiate between ionic and covalent bonds, as well as intermolecular forces such as hydrogen bonding. Produce a diagram showing the structure of water molecules, polarity, and hydrogen bond formation, using a minimum of four molecules. (IB 3.1.4)

Analyze the thermal, cohesive and solvent properties of water and its uses in living organisms, as a coolant, medium for metabolic reactions and transport medium. (IB 3.1.5-3.1.6)

Differentiate between hydrolysis and condensation reactions in splitting and making organic compounds, including components of carbohydrates, proteins, and lipids. (IB 3.2.5)

Produce diagrams to differentiate the structures of amino acids, glucose, ribose and fatty acids. (IB 3.2.2)

Analyze specific formation and uses of various monosaccharides, disaccharides and polysaccharides in both plants and animals. (IB 3.2.3-3.2.5)

Compare the difference in function and energy storage of carbohydrates and lipids. (IB 3.2.6-3.2.7)

Differentiate the four levels of protein structure, indicating significant bonding. (IB 7.5.1, 7.5.3)

Analyze the structural and functional difference between fibrous and globular proteins. (IB 7.5.1-7.5.2)

Summarize at least four functions of proteins, giving a named example of each. (IB 7.5.4)

Analyze the effects of temperature, pH, and substrate concentration on enzyme activity. (IB 3.6.1-3.6.4, 7.6.3)

Critique the lock and key model and the induced fit model of enzymes. (IB 3.6.2, 7.6.2)

Differentiate between competitive and non-competitive inhibition and enzymes, including end-product inhibition of metabolic pathways. (IB 7.6.1, 7.6.4,7.6.5)

Execute calculations of mean and standard deviations using data sets. (IB 1.1.2-1.1.3)

Implement error bars on graphs. (IB 1.1.1, 1.1.3)

Analyze the significance between two sets of data using calculated values for t and appropriate tables. (IB 1.1.4-1.1.5)

Evaluate relationships between two variables. (IB 1.1.6)

Compare the uses and magnification provided by various microscopes, including Stereoscopic, Compound Light, SEM and TEM. (IB 2.1.4)

Differentiate the sizes of various images by calculating the linear maginfication of drawings and actual size of specimens in images of known magnification. (IB 2.1.5)

Analyze the differences in size of membranes, bacteria, organelles, and cells, using Transmission Electron Micrographs. (IB 2.1.4)

Evaluate the Cell Theory, form historical and current perspectives. (IB 2.1.1, 2.1.2)

Understand that unicellular organisms carry out all the functions of life. (IB 2.1.3)

Evaluate surface area and volume ratios in relation to cell size. (IB 2.1.6-2.1.8)

Apply the concept of emergent properties to cells and organization. (IB 2.1.7)

Generate a position paper on the use of a stem cells, focusing on a named therapy. (IB 2.1.9-2.1.10)

**Second Quarter**

Differentiate between prokaryotic cells and eukaryotic cell, noting structures and functions. (IB 2.2.1-2.2.4, 2.3.1-2.3.4)

Analyze the difference between animal and plant cells and their extracellular components. (IB 2.3.5-2.3.6)

Create a detailed diagram to show the various components in cell membranes. (IB 2.4.1)

Apply understanding of hydrophobic and hydrophilic properties to the fluidity of the plasma membrane. (IB 2.4.2)

Explain the functions of membrane proteins. (IB 2.4.3)

Differentiate between passive and active transport processes, including diffusion, osmosis, endocytosis, exocytosis and pumps. (IB 2.4.4-2.4.8)

Explain the cell cycle, including interphase, mitosis, and cytokinesis. (IB 2.5.1, 2.5.5, 2.5.6)

Differentiate between the G1, S, and G2 events of interphase. (IB 2.5.3)

Analyze the stages of mitosis and demonstrate understanding using manipulatives. (IB 2.5.4)

Plan an experiment related to transport of materials, where data can be analyzed using standard deviation. (IB 1.1.1-1.1.3, 1.1.6, 2.4.4)

Explain DNA nucleotide structure in terms of sugar, base and phosphate, antiparallel strands and types of bonding. (IB 3.3.1, 3.3.3-3.3.5, 7.1.1)

Differentiate between pyrimidines and purines. (IB 3.3.2, 7.1.1)

Understand the structure and function of nucleosomes. (IB 7.1.2, 7.1.3)

Differentiate between unique or single-copy genes and highly repetitive sequences in nuclear DNA. (IB 7.1.4)

Explain that eukaryotic genes contain exons and introns. (IB 7.1.5)

Analyze the process of DNA replication in terms of unwinding the double helix with helicase and the roles of DNA polymerase, RNA primase, DNA ligase, Okazaki fragments, and deoxynucleoside triphosphates. (IB. 3.4.1, 7.2.1-7.2.2)

Explain why DNA replication is considered semi-conservative, including the significance of complementary base pairings. (IB 3.4.2-3.4.3)

Understand that DNA replication is initiated at many points in eukaryotic chromosomes. (IB 7.2.3)

Compare the structure of RNA and DNA. (IB 3.5.1)

Explain DNA transcription in terms of the formation of an RNA strand complementary to the DNA strand by RNA polymerase. (IB 3.5.2)

Differentiate between the sense and antisense strands of DNA. (IB 7.3.2)

Analyze the process of trancription in prokaryotes, including the role of the promoter region, RNA polymerase, nucleoside triphosphates and the terminator. (IB 7.3.3)

Explain the genetic code in terms of codons composed of triplets and bases. (IB 3.5.3)

Understand the eukaryotic RNA needs the removal of introns to form mature mRNA. (IB 7.3.4)

Analyze the process of translation,consisting of initiation, elongation, translocation and termination to form a polypeptide. (IB 3.5.4, 7.4.1-7.4.4, 7.4.6)

Produce a diagram showing the structure of a peptide bond between two amino acids. (IB 7.4.5)

Evaluate the relationship between one gene and one polypeptide. (IB 3.5.5)

Analyze the structure and function of ribosomes, both free and bound ribosomes. (IB 7.4.2, 7.4.7)

Explain that eukaryotic chromosomes are made of DNA and proteins. (IB 4.1.1)

Differentiate between gene, allele, and genome. (IB 4.1.2)

Evaluate the consequence of a base substitution mutation in relation to the processes of transcription and translation, using the example of sickle cell anemia. (IB 4.1.3-4.1.4)

Classify homologous chromosomes. (IB 4.2.2)

Analyze the process of meiosis, including pairing of homologous chromosomes, crossing-over, followed by two divisions, which results in 4 haploid cells. (IB 4.2.1-4.2.3, 10.1.1-10.1.3)

Evaluate Mendel's Law of Independent Assortment, as it relates to meiosis. (IB 10.1.4-10.1.5)

Analyze human karyotypes to determine if nondisjunction as occurred. (IB 4.2.4-4.2.7)

**Third Quarter**

Understand the terms: genotype, phenotype, dominant and recessive alleles, codominant alleles, locus, homozygous, heterozygous, carrier test cross, autosomes, and sex chromosomes. (IB 4.3.1, 10.2.2)

Implement the use of Punnett grids to determine the genotypes and phenotypes of the offspring of monohybrid crosses. (IB 4.3.2)

Explain that some genes have more that two alleles. (IB 4.3.3)

Apply understanding of multiple alleles and codominance to the ABO blood group. (IB 4.3.4)

Explain how the sex chromosomes control gender by referring to the inheritance of X and Y chromosomes in humans. (IB 4.3.5-4.3.6)

Differentiate inheritance of x-linked traits (including hemophilia and color blindness) as compared to autosomal, unlinked traits. (IB 4.3.7-4.3.10)

Analyze the monohybrid crosses and the resulting genotypic and phenotypic ratios to determine the mode of inheritance. (IB 4.3.11)

Create a pedigree for a trait within a family and then predict the genotypes. (IB 4.3.12)

Analyze dihybrid crosses involving unlinked, autosomal genes to predict the genotypic and phenotypic ratios of offspring. (IB 10.2.1)

Apply understanding of prophase I to explain how non-sister chromatids of a homologous pair can exchange alleles if crossing over occurs. (IB 10.2.3)

Explain linkage group. (IB 10.2.4)

Analyze which of the offspring are recombinants in a dihybrid cross involving linked genes. (IB 10.2.5-10.2.6)

Differentiate polygenic inheritance from multiple alleles. (IB 10.3.1)

Apply understanding of polygenic inheritance to explain continuous variation of human skin color, eye color, and height. (IB 10.3.2)

Explain the use of the polymerase chain reaction to copy and amplify minute quantities of DNA. (IB 4.4.1)

Understand that in gel electrophoresis, fragments of DNA move in an electric field and are separated according to their size. (IB 4.4.2)

Evaluate the use of DNA profiling to determine paternity and in forensic investigations. (IB 4.4.3-4.4.5)

Produce a mock banding pattern using a model with restriction enzymes, etc. (IB 4.4.2-4.4.5)

Evaluate outcomes of the sequencing of the human genome. (IB 4.4.6)

Explain that when genes are transferred between species, the amino acid sequence of polypeptides translated from them is unchanged because the genetic code is universal. (IB 4.4.7)

Analyze common techniques used for gene transfer, including the use of plasmids, a host cell, restriction enzymes, and DNA ligase. (IB 4.4.8)

Evaluate the potential benefits and possible harmful effects of named examples of genetically modified crops and animals. (IB 4.4.9-4.4.10)

Analyze cloning, using differentiated animal cells. (IB 4.4.11-4.4.12)

Generate a position paper on the ethical issues of therapeutic cloning in humans. (IB 4.4.13)

**Fourth Quarter**

Analyze the importance of digestion and how enzymes are essential. (IB 6.1.1-6.1.2)

Differentiate between the source, substrate, products, and optimum pH for named examples of amylase, protease, and lipase. (IB 6.1.3)

Produce an annotated diagram of the digestive system, noting functions of each structure. (IB 6.1.4-6.1.5)

Analyze the difference between absorption and assimilation. (IB 6.1.6-6.1.7)

Produce an annotated diagram of the heart, showing associated blood vessels, valves, and the route of blood. (IB 6.2.1-6.2.3)

Analyze the control of heartbeat. (IB 6.2.4)

Differentiate between the structure and function of veins, arteries, and capillaries. (IB 6.2.6)

Explain the composition of blood and the materials transported by the blood. (IB 6.2.6-6.2.7)

Differentiate between ventilation, gas exchange, and cell respiration. (IB 6.4.1)

Produce an annotated diagram of the ventilation system, including an inset of the alveoli and gas exchange. (IB 6.4.2, 6.4.4-6.4.5)

Explain features of alveoli that adapt them to gas exchange. (IB 6.4.3)

Understand that cell respiration begins with the process of glycolysis. (IB 3.7.1-3.7.2, 8.1.2)

Apply understanding of electrons to oxidation and reduction reactions. (IB 8.1.1)

Analyze the production glycolysis in detail. (IB 8.1.2)

Analyze the process of anaerobic respiration, both in yeast and humans. (IB 3.7.3)

Produce an annotated diagram of the structure of the mitochondrion, as seen in electron micrographs. (IB 8.1.3, 8.1.6)

Analyze the process of aerobic respiration, including the link reaction, the Krebs cycle, the role of NADH + H+, the electron transport chain and the role of oxygen. (IB 8.1.4)

Explain oxidative phosphorylation in terms of chemiosmosis. (IB 8.1.5)

Explain how pathogenic microorganisms cause disease. (IB 6.3.1)

Differentiate between antigens and antibodies. (IB 6.3.5)

Explain non-specific defenses against disease, including the skin,mucous membranes, and phagocytes. (IB 6.3.3-6.3.4)

Analyze the effectiveness of antibiotics and how they are produced. (IB 6.3.2, 6.3.6, 11.1.4)

Explain specific defenses against disease. (IB 6.3.6, 11.1.2, 11.1.4)

Analyze the processes involved in the clotting of blood. (IB 11.1.1)

Differentiate between active and passive immunity. (IB 11.1.3)

Analyze the process involved in the production of monoclonal antibodies and their use in diagnosis and treatment. (IB 11.1.5)

Evaluate the benefits and dangers of vaccination. (IB 11.1.6-11.1.7)

**Assessments**

**IB Biology Y1**

**Assessments**

**First Quarter**

Homework

Quizzes

Tests

Laboratory Reports for IB Internal Assessments

**Second Quarter**

Homework

Quizzes

Tests

Laboratory Reports for IB Internal Assessments

**Third Quarter**

Homework

Quizzes

Tests

Laboratory Reports for IB Internal Assessments

**Fourth Quarter**

Homework

Quizzes

Tests

Laboratory Reports for IB Internal Assessments

**Core Topics**



**Specific Content**

**IB Biology Y1**

**Specific Content**

**First Quarter**

Levels of organization (from subatomic particles to biosphere)

Characteristics of living organisms

Elements and roles in their roles in organisms

Chemical bonding

Properties of water and importance to organisms

Hydrolysis and condensation reactions in organic molecules

Structure and function of carbohydrates

Structure and function of lipids

Structure and function of proteins

Enzyme-substrate specificity

Competitive and non-competitive inhibition

Standard Deviation

Error Bars

t-Tests

Correlations

Stereoscopic, compound light, SEM, TEM microscopes

Size estimations and magnification calculations

History of the development of the cell theory

Levels of organization in relation to cells

Surface area to volume ratio limiting cell size

Emergent properties

**Second Quarter**

Ultrastructure of prokaryotic cells (*E. coli*)

Cell division in prokaryotic cells

Ultrastructure of liver cell and functions of the organelles

Animal cells and plant Cells

Fluid mosaic model of Phospholipid Bilayer

Functions of membrane proteins and importance in transport

Transport of materials within and outside cells

Cell division through mitosis and cytokinesis

Results of uncontrolled cell division

Components of DNA

Discovery of structure of DNA double helix

Nucleosomes

Exons and introns

Replication of DNA in prokaryotic and eukarytoic organisms, including significance of enzymes

Transcription of DNA (antisense) and formation of complementary RNA strand Translation of codons to form polypeptides

Formation and structure of dipeptides

Functions of free ribosomes and bound ribosomes

**Third Quarter**

Genes, alleles, and Genomes

Gene mutations

Sickle cell anemia

Homologous chromosomes

Process of meiosis and the formation of gametes

Mendel's Law of Indepenedent Assortment

Nondisjunction of chromosomes

Karyotyping

Common terminology used in genetics

Monohybrid crosses

Codominance

Sex chromosomes and linkage

Patterns of inheritance

Pedigrees

Dihybrid Crosses with unlinked autosomal genes

Linked genes and dihybrid crosses

Examples of polygenic inheritance in humans

Polymerase chain reaction

Gel electrophoresis

DNA profiling

Human genome

Recombinant DNA using plasmids

Genetically modified organisms

Cloning

**Fourth Quarter**

Need for digestion

Enzyme activity and digestion

Structures and functions of the digestive system

Absorption

Assimilation

Structure and function of the heart

Heart cycle

Components of blood

Levels of organization for the circulatory system

Transported materials

Ventilation system

Gas exchange

Anaerobic respiration

Aerobic respiration

Structure and function of mitochondrion

Oxidative phosphorylation and chemiosmosis

Pathogens

Antigens

Antibiotic effectiveness

Non-specific defenses against pathogens

Specific defenses against pathogens

AIDS

Blood Clotting

Active and passive immunity

Monoclonal Antibodies

Vaccination

**Resources**

**IB Biology Y1**

**Resources**

*Advanced Biology: Principles and Applications*  by Clegg and Mackean. Publication date: 2000. Hodder Education.

*Biology for the IB Diploma* by Clegg. Publication date: 2007. Hodder Education.

*OSC IB Biology Revision Guides: Guide for Internal Assessment; Higher Level IB Biology* by Merson-Davies. Publication Date: 2008. OSC Publishing.

*IB Study Guides: Biology for the IB Diploma, Standard and Higher Level*  by Allott. Publication Date: 2007. Oxford University Press.