

Appendix 5

IB Diploma Programme course outlines

Teachers responsible for each proposed subject must prepare a course outline following the guidelines below. While IB subject guides will be used for this exercise, teachers are expected to adapt the information in these guides to their own school's context. Please be sure to use IBO nomenclature throughout. The name of the teacher(s) who wrote the course outline must be recorded at the top of the outline.

Name of the teacher who prepared the outline:

Barbara Barry

Name of the course:

For example, English A1, HL.

IB Biology HL

Course description:

In two to three paragraphs, describe the course in terms of focus, purpose, aims and objectives, the inclusion of internationalism, the proposed process, and expected assessment. This should be a summary.

COURSE DESCRIPTION

IB Biology at Newport Harbor High is aimed at the student who is an interested and involved learner, eager to apply critical thinking skills to problem solving, able to make clear applications between content and the biological world around her. Through the acquisition of knowledge the student will demonstrate deeper understanding of the life sciences and other core areas. The program is two years and it includes the three components of core, AHL, and options D-H.

The IB program will build life-long learners in biology by encouraging students to incorporate the scientific method into all areas of science learning. Scientific inquiry as a process will foster student growth as she learns to develop questions about nature through experimentation, field studies, data, analysis and critical thinking. Inquiry-based learning will dominate in the classroom. Knowledge will be gained through instruction but also by doing. Classes will center around learning through the laboratory experience. Whenever possible, classes will move to the natural environment where core content will mix with the field experience to foster independent scientific thinkers.

The IB Program will also include character-building amongst its clientele. Students will be taught with consideration and respect and in turn these values will be expected from the group. Students will be well-rounded and involved in social and community concerns. It is expected they will work well together but maintain their individuality. They should be true to their core values but open to the differences within all groups. Ultimately, the course will develop scientists for the 21st century, dedicated to making the world a better place for future generations.

Topics:

In narrative or outline form, list what you will cover in your course to meet the IB syllabus requirements. In addition, if IB courses are going to be combined with Advanced Placement or other curriculums, outlines should address additional non-IB topics to be covered.

SYLLABUS OUTLINE

The Core

Teaching hours

80

Topic 1: Statistical Analysis

1.1.1 Error bars represent variability of data
2 hours

1.1.2 Calculation of mean and standard deviation

1.1.3 68% of all values fall within one standard-deviation of the mean

1.1.4 How does standard deviation compare the means and spread of data between two or more samples

11.5 What is the significance of the difference between two sets of data

11.6 The existence of a correlation does not prove a casual relationship exists between two variables

Topic 2: Cells

2.1 Cell Theory

3 hours

2.1.1 Cell Theory Outlined

2.1.2 Evidence for the Cell Theory

2.1.3 Unicellular organisms engage in all cell activities and functions

2.1.4 Range of cell molecules, organelles viruses and bacteria in size using SI

Units

2.1.5. Calculate magnification at cellular structures both linear and actual size

2.1.6 Explain surface area to volume ratio and how this affects cell size

2.1.7 Multicellular organisms display emergent properties

2.1.8 Cell differentiation occurs due to variable gene expression

2.1.9 Stem cells continue to differentiate as pluripotent cells

2.1.0 Explain how stem cell research is benefitting mankind

2.2 Prokaryotic Cells

1 hour

2.2.1 Illustrate the structure of *E. coli*

2.2.2 Explain the functions of *E. coli* structures

2.2.3 Recognize electron micrographs of *E. coli*

2.2.3 Prokaryotic reproduction is known as binary fission

2.3 Eukaryotic Cells

3 hours

- 2.3.1 Illustrate the structure of a human liver cell
- 2.3.2 List and describe the function of each organelle
- 2.3.4 Compare prokaryotic and eukaryotic cells
- 2.3.5 Compare and contrast plant and animal cells

2.4 Membranes

3 hours

- 2.4.1 Draw and label the plasma membrane
- 2.4.2 Explain the phospholipid bilayer and its chemical properties
- 2.4.3 Discuss membrane proteins function
- 2.4.4 Explain cellular transport processes; active and passive
- 2.4.5 Include the proton pump and sodium-potassium pump in discussion; explain how a membrane potential is developed
- 2.4.6 Explain membrane fluidity and how it facilitates endocytosis and exocytosis

2.5 Cell Division

2 hours

- 2.5.1 Teach the Cell Cycle
- 2.5.2 Explain the biology of cancer
- 2.5.3 Differentiate between Interphase and the M Phases
- 2.5.4 Explain the differences between sexual and asexual reproduction

TOPIC 3: THE CHEMISTRY OF LIFE

3.1 Chemical Elements and Water

- 3.1.1 Introduce the elements necessary for life; emphasize the four most important
- 3.1.2 Teach the roles of the most important biological elements
- 3.1.3 Introduce water as a polar molecule. Include bonds and the four properties of water
- 3.1.4 Relate the properties of water to their biological functions

3.2 Carbohydrates, Lipids and Proteins

2 hours

- 3.2.1 Contrast *organic* vs. *inorganic* compounds
- 3.2.2 Introduce the building blocks of polymers: monosaccharides, amino acids and fatty acids
- 3.2.3 Teach how monomer structure produces polymer function in carbohydrates, lipids and proteins

3.3 DNA Structure

1 hour

- 3.3.1 Explain nucleotide structure, function, variation of nitrogenous bases and types of bonds
- 3.3.2 Explain complementary base-pairing and significance of base sequences
- 3.3.3 Teach DNA structure

3.4 DNA Replication

1 hour

- 3.4.1 Explain DNA replication as a process including relevant enzymes
- 3.4.2 Relate base-pairing to DNA function, teach semi-conservative replication

3.5 Transcription and Translation

2 hours

- 3.5.1 Explain DNA unwinding and copying of RNA
- 3.5.2 Explain the process of Translation
- 3.5.3 Discuss the One Gene One Polypeptide Theory

3.6 Enzymes

2 hours

- 3.6.1 Introduce enzyme structure and relate to protein levels of structuring.
- 3.6.2 Teach active site and enzyme-substrate-specificity
- 3.6.3 Explain how temperature, pH, and other environmental factors alter enzymatic activity

3.7 Cell Respiration

- 3.7.1 Define *cell respiration*
- 3.7.2 Understand that during cellular respiration glucose is broken down into ATP
- 3.7.3 Explain the mechanisms of anaerobic respiration
- 3.7.4 Explain that aerobic respiration has a higher ATP yield than anaerobic respiration

3.8 Photosynthesis

3 hours

- 3.8.1 Sunlight travels in particles called photons and this light energy is utilized to make sugars
- 3.8.2 Different pigments absorb different light energy but chlorophyll is the main energy pigment
- 3.8.3 Photosynthesis involves the splitting of water molecules
- 3.8.4 Carbon Dioxide plus light energy are utilized to make sugars
- 3.8.5 Photosynthetic output can be measured by oxygen production
- 3.8.6 Temperature, light intensity and carbon dioxide affect photosynthetic output

TOPIC 4: GENETICS

4.1 Chromosomes, genes, alleles and mutations

2 hours

- 4.1.1 Eukaryotic chromosomes are composed of DNA and protein
- 4.1.2 Understand the meanings of: gene, allele, genome and mutation
- 4.1.3 Using sickle cell anemia as the example, explain how mutations affect life

4.2 Meiosis

- 4.2.1 Diploid chromosomes are reduced to haploid after *homologous chromosomes* form a tetrad, cross over chromosomal units, separate two times and divide
- 4.2.2 Errors in Meiosis are known as nondisjunction and can lead to Down Syndrome
- 4.2.3 Chromosome pictures are known as karyotypes; it is possible to determine gender and some chromosomal anomalies this way
- 4.2.4 Karyotyping occurs by sampling the chorion or performing amniocentesis

4.3 Theoretical Genetics

5 hours

- 4.3.1 Student must be able to define: *genotype, phenotype, dominant allele, recessive allele, codominant alleles, locus, homozygous, heterozygous, carrier* and *test cross*
- 4.3.2 Calculate offspring phenotypes and genotypes from a cross using a Punnett square
- 4.3.2 Some genes have multiple alleles
- 4.3.3 Describe the ABO Blood Group as an example of codominance
- 4.3.4 Explain the genetics of gender
- 4.3.5 Define sex linkage and crosses involving hemophilia and color blindness
- 4.3.6 Explain how males are more likely to inherit sex-linked disorders
- 4.3.7 Understand pedigrees and learn to make genetic predictions by reading pedigrees

4.4 Genetic Engineering and Biotechnology

5 hours

- 4.4.1 Explain how the Polymerase Chain Reaction amplifies DNA
- 4.4.2 Explain gel electrophoresis of DNA
- 4.4.3 Explain how DNA profiling is used to determine paternity and in forensics
- 4.4.4 Predict paternity by reading a DNA fingerprint
- 4.4.5 Explain benefits to humanity by the sequencing of the human genome
- 4.4.6 The Genetic Code is universal
- 4.4.7 Explain how biotechnology is helping improve crops and animals
- 4.4.8 Discuss the implications of genetic engineering to life on Earth
- 4.4.9 Define *clone* and the cloning technique
- 4.4.10 Discuss the ethics of cloning

TOPIC 5: ECOLOGY and ECOSYSTEMS

5.1 Communities and Ecosystems

5 hours

- 5.1.1 Define: *species, habitat, population, community, ecosystem, ecology*
- 5.1.2 Differentiate between *autotroph* and *heterotrophy*
- 5.1.3 Distinguish between different forms of obtaining nutrients:
consumers, detritivores, saprotrophs
- 5.1.4 Explain a food chain and a food web
- 5.1.5 Define *trophic level*
- 5.1.6 Construct a food web and label each trophic level. Include at least ten organisms interacting with each other within the food web
- 5.1.7 Explain how energy flows among trophic levels, beginning with light as the most significant source of energy
- 5.1.8 Explain that large amounts of energy are lost as heat between each trophic level
- 5.1.9 Explain energy pyramids, nutrient recycling and the importance of saprobes

5.2 The Greenhouse Effect

3 hours

- 5.2.1 Explain key components of the Carbon Cycle
- 5.2.2 Analyze data from Mauna Loa Mountain regarding carbon dioxide changes over the past 100 years
- 5.2.3 Explain how rising levels of carbon dioxide, methanes, and nitrogen oxides causes the greenhouse effect
- 5.2.4 Explain the precautionary principle
- 5.2.5 Evaluate the precautionary principle for effectiveness
- 5.2.6 Examine the global consequences of the greenhouse effect

5.3 Populations

2 hours

- 5.3.1 Explain how population size is affected by birth and death rates, immigration and emigration
- 5.3.2 Draw, label and explain an S-shaped growth curve
- 5.3.3 Explain exponential growth curves and factors that limit exponential growth

5.4 Evolution

3 hours

- 5.4.1 Devine *evolution*
- 5.4.2 Explain evidences for evolution
- 5.4.3 Explain that populations produce more offspring than can survive, and the variants nature favors will survive to reproduce
- 5.4.4 Explain how natural selection works and leads to evolution
- 5.4.5 Explain how environmental change causes evolution; include how prokaryotes are developing resistance to antibiotics

5.5 Classification

3 hours

- 5.5.1 Introduce Carolus Linnaeus and his system of binomial nomenclature
- 5.5.2 List the seven levels in the hierarchy of taxa and use an example of each
- 5.5.3 Distinguish between the phyla of plants and the phyla of animals

TOPIC 6: HUMAN HEALTH and PHYSIOLOGY

6.1 Digestion

3 hours

- 6.1.1 Explain why digestion of large food molecules is important to life; explain how enzymes function to break down food
- 6.1.2 Choosing an amylase, protease, and lipase enzyme: explain where each is formed, the food molecule it binds with, the products it produces, and its optimal pH
- 6.1.3 Illustrate and label the human digestive system
- 6.1.4 Describe the function of the stomach, large and small intestine
- 6.1.5 Define *absorption* and *assimilation*
- 6.1.6 Relate form and function to the villus of the small intestine

6.2 The Transport System

3 hours

- 6.2.1 Illustrate and label the 4-chambered heart. Include valves, vessels and direction of blood flow
- 6.2.2 State the function of the coronary arteries
- 6.2.3 State the action of the heart and how blood moves through the chambers and valves
- 6.2.4 Discuss the generation of the heart beat
- 6.2.5 Relate form to function of arteries, veins and capillaries
- 6.2.6 Discuss the components of blood and the contents moving throughout the blood to the cells

6.3 Defense Against Infectious Disease

3 hours

- 6.3.1 Define *pathogen*
- 6.3.2 Explain the action of antibiotics and why they fail to fight viruses
- 6.3.3 Explain how skin and mucous membranes act as a barrier against pathogens
- 6.3.4 Explain how white blood cells attack pathogens
- 6.3.5 Distinguish between *antibodies* and *antigens* and explain how antibodies are made
- 6.3.6 Discuss HIV, its effects upon the immune system and why Africa is home to so many AIDS patients

6.4 Gas Exchange

2 hours

- 6.4.1 Distinguish between *ventilation*, *gas exchange*, and *cell respiration*
- 6.4.2 Discuss how form fits function in alveoli, gas exchange and ventilation
- 6.4.3 Diagram and label the human respiratory system
- 6.4.4 Explain how the intercostals muscles, ribs, and diaphragm develop pressure gradients to assist in ventilation

6.5 Nerves, Hormones and Homeostasis

6 hours

- 6.5.1 Explain the central components of the human nervous system
- 6.5.2 Illustrate and label a human neuron
- 6.5.3 Explain how impulses travel through the peripheral nervous system to the central nervous system and back through the peripheral nervous system
- 6.5.4 Explain the resting and action potentials of neurons
- 6.5.6 Explain how an impulse travels along a non-myelinated neuron
- 6.5.7 Explain a synapse
- 6.5.8 Explain the endocrine system and its associated glands
- 6.5.9 Explain how homeostasis functions to maintain equilibrium between cells and their external environment
- 6.5.10 Explain feedback mechanisms to maintain body temperature
- 6.5.11 Explain feedback mechanisms regulating blood sugar levels
- 6.5.12 Explain type I and type II diabetes

6.6 Reproduction

3 hours

- 6.6.1 Illustrate and label the human male and female reproductive systems
- 6.6.2 Explain how hormones regulate the menstrual and ovarian cycles
- 6.6.3 Graph the changes during the 28-day menstrual cycle, following hormones, endometrial lining and egg development
- 6.6.4 Explain the roles of testosterone in males
- 6.6.5 Explain *in vitro fertilization*
- 6.6.6 Discuss the ethics of *in vitro fertilization*

AHL

TOPIC 7: NUCLEIC ACIDS and PROTEINS

7.1 DNA Structure

2 hours

- 7.1.1 Describe the structure of DNA including the direction of elongation, antiparallel strands, purines, pyrimidines and the nature of weak hydrogen bonds
- 7.1.2 Explain nucleosomes
- 7.1.3 Relate nucleosomes to DNA packing
- 7.1.4 Differentiate between DNA coding for polypeptides (genes) and noncoding DNA (satellite)
- 7.1.5 Explain introns and exons

7.2 DNA Replication

2 hours

- 7.2.1 Explain that DNA elongates in the 5'→3' direction
- 7.2.2 Explain DNA replication in prokaryotes and eukaryotes, including all relevant enzymes and Okazaki fragments
- 7.2.3 Explain that replication begins at many "points of origin" along the DNA strand

7.3 Transcription

2 hours

- 7.3.1 Explain that transcription of a gene follows the 5'→3' direction
- 7.3.2 Distinguish between the coding and noncoding strands of DNA
- 7.3.3 Explain transcription in prokaryotes and eukaryotes and distinguish between the two; include relevant enzymes, the promoter region and the termination region
- 7.3.4 Explain RNA Processing

7.4 Translation

2 hours

- 7.4.1 Explain how tRNA molecules bind to amino acids in the presence of aminoacyl-tRNA synthetase
- 7.4.2 Explain the structure of a ribosome and how it relates to translation
- 7.4.3 State the three components of translation
- 7.4.4 Remind students translation occurs in the 5'→3' direction
- 7.4.5 Illustrate a dipeptide and label the peptide bond
- 7.4.6 Explain how translation progresses, from the start codon to the stop codon
- 7.4.7 Explain how some polypeptides are synthesized in the rough endoplasmic reticulum

7.5 Proteins

1 hour

- 7.5.1 Explain the four levels of protein structuring
- 7.5.2 Using examples, differentiate between fibrous and globular proteins
- 7.5.3 Explain how the R groups in amino acids determine chemical properties of proteins
- 7.5.4 List and explain the functions of proteins, using examples of each

7.6 Enzymes

2 hours

- 7.6.1 Relate enzyme function to metabolic pathways
- 7.6.2 Describe induced fit
- 7.6.3 Define an enzyme and describe its biological function as a catalyst
- 7.6.4 Explain competitive and noncompetitive inhibition
- 7.5.7 Explain allosteric regulation in feedback pathways

TOPIC 8: CELL RESPIRATION AND PHOTOSYNTHESIS

8.1 Cell Respiration

5 hours

- 8.1.1 Explain the concepts of oxidation reduction reactions
- 8.1.2 Explain the first step of cellular respiration: Glycolysis
- 8.1.3 Illustrate and label a mitochondrion
- 8.1.4 Explain Krebs and the electron carriers
- 8.1.5 Explain oxidative phosphorylation and chemiosmosis
- 8.1.6 Relate mitochondrial form to function

8.2 Photosynthesis

5 hours

- 8.2.1 Illustrate and label a chloroplast
- 8.2.2 Explain the light dependent and independent reactions of photosynthesis
- 8.2.3 Explain photophosphorylation and chemiosmosis
- 8.3.4 Relate chloroplast form and function
- 8.3.5 Explain how amounts of carbon dioxide, light, temperature affect photosynthetic output

TOPIC 9: PLANT SCIENCE

9.1 Plant Structure and Growth

4 hours

- 9.1.1 Illustrate plant tissues in the leaf and stem of a dicotyledon
- 9.1.2 Differentiate between monocots and dicots in at least three ways
- 9.1.3 Explain how dicots transport liquids among its leaves and stems; explain how leaf tissues absorb light and exchange gases
- 9.1.4 Explain the various modifications in the roots and stems and leaves
- 9.1.5 Explain meristematic tissues in plants
- 9.1.6 Compare apical and lateral meristematic growth
- 9.1.7 Explain plant hormones and their functions in plant tissues

9.2 Transport in Angiosperms

4 hours

- 9.2.1 Explain how root systems function as water and mineral transport in plants
- 9.2.2 Discuss how proton pumps and fungal symbiotic relationships help move minerals into roots
- 9.2.3 Explain how lignified tissues, turgor and cellulose act as support systems in plants
- 9.2.4 Define *transpiration*
- 9.2.5 Explain how transpirational pull forms a negative pressure in plants to move substances against gravity
- 9.2.6 Discuss guard cell function
- 9.2.8 Explain how environmental factors affect transpiration rate in plants
- 9.2.9 Discuss adaptations of xerophytes in dry climates
- 9.2.10 Explain phloem transport in plants

9.3 Reproduction in Angiosperms

3 hours

- 9.3.1 Illustrate and label a dicot flower
- 9.3.2 Distinguish between *pollination*, *fertilization* and *seed dispersal*
- 9.3.3 Illustrate and label a dicot seed, both internal and external
- 9.3.4 Explain seed germination
- 9.3.5 Discuss the metabolic changes going on in a seed during germination
- 9.3.6 Explain long-day plants and short-day plants

TOPIC 10: GENETICS

10.1 Meiosis

2 hours

- 10.1.1 Describe chromosome movement during meiosis
- 10.1.2 Describe the chiasmata and relate its function to crossing over
- 10.1.3 Explain how crossing over offers genetic variation among sexually reproducing organisms
- 10.1.4 Relate Mendel's law of independent assortment to meiosis

10.2 Dihybrid Crosses and Gene Linkage

3 hours

- 10.2.1 Determine phenotypic and genotypic ratios from dihybrid crosses of unlinked genes
- 10.2.2 Differentiate between *autosomes* and *sex chromosomes*
- 10.2.3 Explain the concepts of linkage outlined by Thomas Hunt Morgan
- 10.2.4 Define *linkage group*
- 10.2.5 Explain genetics crosses involving linked genes
- 10.2.6 Explain the concept of recombinants in linked crosses

10.3 Polygenic Inheritance

1 hour

- 10.3.1 Define *polygenic inheritance*
- 10.3.2 Explain how polygenic inheritance causes traits such as skin color in humans

TOPIC 11: HUMAN HEALTH and PHYSIOLOGY

11.1 Defense Against Infectious Disease

4 hours

- 11.1.1 Explain the biochemistry of blood clotting
- 11.1.2 Explain how memory cells are produced in the immune response
- 11.1.3 Define *active* and *passive* immunity
- 11.1.4 Explain the humoral response and the production of antibodies
- 11.1.5 Describe monoclonal antibodies and how their presence implicates disease
- 11.1.6 Explain vaccines and the significance of vaccination in maintaining a healthy immune system
- 11.1.7 Discuss the dangers of vaccination

11.2 Muscles and Movement

4 hours

- 11.2.1 Explain how bones, tendons, ligaments, muscles and nerves contribute to movement
- 11.2.2 Illustrate and label the human elbow joint, including all relevant tissues
- 11.2.3 Outline the functions of the tissues on the elbow diagram
- 11.2.4 Compare hip joint to elbow joint movement
- 11.2.5 Discuss the structure of striated (skeletal) muscle
- 11.2.6 Explain in detail the components of a sarcomere
- 11.2.7 Explain the workings of skeletal muscle contraction
- 11.2.8 Recognize electron micrographs of skeletal muscle in different states of contraction

11.3 The Kidney

4 hours

- 11.3.1 Explain *osmoregulation* and *excretion*
- 11.3.2 Discuss the significance of water balance in animals, specifically human beings. Include terms related to kidney function
- 11.3.3 Explain filtrate and reabsorption. Include all tissue types related to these functions.
- 11.3.4 Relate hormones to water balance
- 11.3.5 Explain diabetes

11.4 Reproduction

5 hours

- 11.4.1 Explain the organs, cells and tissues of the male reproductive system.
- 11.4.2 Relate cell function to spermatogenesis
- 11.4.3 Discuss the roles of LH, testosterone and FSH in the male reproductive system
- 11.4.4 Diagram the human ovary and oogenesis
- 11.4.5 Discuss the roles of LH, estrogen, FSH and progesterone in the human female reproductive system

11.4.6	Illustrate the human sex cells
11.4.7	Explain gland significance in the male reproductive system
11.4.8	Compare spermatogenesis and oogenesis
11.4.9	Explain the cortical reaction and fast block to polyspermy
11.4.10	Discuss fertilization, embryonic development, the role of HCG, and the role of the placenta in human development
11.4.11	Discuss the relevance of the fetal extraembryonic membranes
11.4.12	Explain the exchange of blood, gases, nutrients and waste between the fetus and mother
11.4.13	Explain how birth control functions

OPTION D: EVOLUTION

D1 Origin of Life on Earth

4 hours

D.1.1	Describe the four processes necessary for the origin of life on Earth
D.1.2	Explain the work of Stanley Miller and Harold Urey
D.1.3	Discuss the atmosphere of early Earth and the conditions conducive to the formation of organic compounds
D.1.4	Explain that RNA was the first genetic material
D.1.5	Discuss protobionts and the evolution of the prokaryotic cell
D.1.6	Explain how prokaryotes contributed to an oxygen-rich atmosphere
D.1.7	Explain the Endosymbiotic Theory

D2 Species and Speciation

5 hours

D.2.1	Discuss relevant evolution terms
D.2.2	Explain allele frequency and how it changes in populations over time
D.2.3	Discuss prezygotic and postzygotic barriers
D.2.4	Explain how microevolution causes allele frequency changes in a population and macroevolution causes speciation
D.2.5	Compare allopatric speciation to sympatric speciation
D.2.6	Explain adaptive radiation, convergent and divergent evolution
D.2.7	Discuss how evolutionary biologists support the theory of punctuated equilibrium
D.2.8	Discuss transient polymorphism and balanced polymorphism

D3 Human Evolution

6 hours

- D.3.1 Explain radioactive dating
- D.3.2 Discuss *half-life* and how fossils are dated
- D.3.3 Discuss the features that define humans as primates and explain the branching points of early humans
- D.3.4 Remind students that early humans coexisted with other early species and the human evolutionary record is incomplete
- D.3.5 Explain that great change has occurred due to diet and nutrition
- D.3.6 Distinguish between the two types of human evolution and discuss each

HL D4 The Hardy-Weinberg Principle

2 hours

- D.4.1 Explain how the Hardy-Weinberg Equation is derived
- D.4.2 Calculate allele frequencies using Hardy-Weinberg
- D.4.3 Explain the requirements for Hardy-Weinberg equilibrium and how these conditions are never met

HL D5 Phylogeny and Systematics

5 hours

- D.5.1 Explain the Taxonomical System
- D.5.2 Explain how knowledge of DNA and proteins has changed traditional phylogenetic trees
- D.5.3 Explain *clade* and the science of *cladistics*
- D.5.4 Construct a cladogram and interpret cladograms as a means of understanding relationships among organisms

OPTION E: NEUROBIOLOGY and BEHAVIOR

E1 Stimulus and Response

2 hours

- E.1.1 Illustrate a neuron and label all components. Discuss how neurons receive stimuli, relay stimuli throughout the neuron and send the stimulus message across the synapse
- E.1.2 Explain the roles of different neurons
- E.1.3 Illustrate a reflex arc and discuss the role of the spinal cord and types of neurons in the reflex act
- E.1.4 Using examples explain how animal behavior is affected by natural selection

E2 Perception of Stimuli

4 hours

- E.1.1 Explain how diverse life forms respond to stimuli through various receptors
- E.1.2 Illustrate and label the human eye
- E.1.3 Study the structure of the retina, including rods and cones and their functions
- E.1.4 Explain how visual stimuli is processed
- E.1.5 Illustrate and label the human ear
- E.1.6 Explain how sound is received and vibrations are passed through the middle and inner ear

E3 Innate and Learned Behavior**4 hours**

- E.3.1 Distinguish between *innate* and *learned* behavior
- E.3.2 Design experiments to investigate innate behavior in invertebrates
- E.3.3 Analyze data from experiment
- E.3.4 Discuss how learning improves chances for survival
- E.3.5 Explain Pavlov's experiments
- E.3.6 Explain inheritance and learning in young birds

E4 Neurotransmitters and Synapses**5 hours**

- E.4.1 Explain how different neurons affect the transmission of the synapse
- E.4.2 Discuss how the CNS determines excitatory and inhibitory presynaptic activity
- E.4.3 Explain how psychoactive drugs affect the brain by the increasing or decreasing postsynaptic transmission
- E.4.4 List three examples of excitatory and inhibitory drugs and explain how these drugs affect the synapses of the brain
- E.4.5 Discuss addiction and its causes

E5 The Human Brain**4 hours**

- E.5.1 Illustrate, label, and define the functions of the human brain
- E.5.2 Explain how animal experiments and functional magnetic resonance imaging (fMRI) allow professionals to study and identify parts of the brain and its functions
- E.5.3 Explain the sympathetic and parasympathetic divisions of the autonomic nervous system
- E.5.4 Explain the pupil reflex
- E.5.5 Explain the pupil reflex in testing for death
- E.5.6 Discuss the science of pain and how pain medications are utilized

E6 Further Studies of Behavior

- E.6.1 Discuss the social behavior of honey bees
- E.6.2 Relate natural selection to colony behavior
- E.6.3 Discuss altruistic behavior using organisms other than humans
- E.6.4 Explain mate selection
- E.6.5 Discuss biorhythms and illustrate two examples

OPTION F: MICROBES AND BIOTECHNOLOGY

Core Material: F1-F4 are core material for SL and HL

Extension Material: F5-F6 are extension material for HL only

F1 Diversity of Microbes

5 hours

- F.1.1 Explain the three domains as part of the current Taxonomical system
- F.1.2 Explain the molecular biology behind the reclassification of life into three domains
- F.1.3 Distinguish between the characteristics of the three domains
- F.1.4 Explain the characteristics of Domain Archaea
- F.1.5 Discuss the diversity of Eubacteria
- F.1.6 Explain how some bacteria form aggregates
- F.1.7 Discuss how peptidoglycan results in gram positive or gram negative cells
- F.1.8 Explain viral structure
- F.1.9 Outline the diversity of microscopic eukaryotes, including yeast and protists

F2 Microbes and the Environment

4 hours

- F.2.1 List the roles of microbes in the ecosystems on Earth
- F.2.2 Illustrate and label the Nitrogen Cycle
- F.2.3 Explain the roles of the various bacteria involved in the Nitrogen Cycle
- F.2.4 Discuss the conditions favoring denitrification and nitrification
- F.2.5 Discuss how raw sewage and nitrates affect local environments
- F.2.6 Explain saprobes and their roles in sewage treatment
- F.2.7 Discuss biomass as a possible fuel source and how methane is produced through methanogenesis

F3 Microbes and Biotechnology

3 hours

- F.3.1 Explain the function of reverse transcriptase
- F.3.2 Distinguish between *somatic* and *germ line* therapy
- F.3.3 Discuss how viruses act as vectors in gene therapy
- F.3.4 Explain the risks of gene therapy

F4 Microbes and Food Production

3 hours

- F.4.1 Explain how yeast is used to make beer, bread and wine
- F.4.2 Explain how soy sauce is made using mold
- F.4.3 Outline the use of acids, salts and sugars to preserve food
- F.4.4 Explain the symptoms, transmission and treatment of food poisoning

F5 Metabolism of Microbes**2 hours**

- F.5.1 Explain the modes of obtaining nutrients in prokaryotes and state examples of each
- F.5.2 Compare the modes of obtaining nutrients in terms of carbon sources and energy sources
- F.5.3 Illustrate and label a filamentous cyanobacterium
- F.5.4 Explain how bacteria functions in bioremediation

F6 Microbes and Disease**5 hours**

- F.6.1 Explain how pathogens enter the body
- F.6.2 Discuss *intracellular* versus *extracellular*, *endotoxins* versus *exotoxins*
- F.6.3 Discuss modern methods to control bacterial growth
- F.6.4 Explain how antibiotics function
- F.6.5 Illustrate the lytic and lysogenic life cycles of viruses
- F.6.6 Define *epidemiology*
- F.6.7 Using a pandemic in history such as the influenza outbreak of 1918, discuss its epidemiology
- F.6.8 Illustrate the life cycle of *plasmodium* and discuss its effects upon the human in transmitting malaria
- F.6.9 Discuss prions and their structure and destructive tendencies in nervous tissue of animals

OPTION G: ECOLOGY and CONSERVATION**G1: Community Ecology****5 hours**

- G.1.1 Outline the factors involved in plant species distribution
- G.1.2 Explain the factors affecting distribution of animal species
- G.1.3 Explain how random sampling is used to compare the population sizes of plants or animals
- G.1.4 Explain how a transect is used to correlate the distribution of plant or animal species
- G.1.5 Explain what is meant by the niche concept
- G.1.6 Define and discuss terms related to species interactions
- G.1.7 Explain the competitive exclusion principle
- G.1.8 Distinguish between *fundamental* and *realized* niches
- G.1.9 Explain what *biomass* is
- G.1.10 Describe how biomass at different trophic levels is measured

G2 Ecosystems and Biomes**4 hours**

- G.2.1 Define terms relevant to productivity in ecosystems
- G.2.2 Calculate values for gross production and net production
- G.2.3 Explain the difficulty of classifying organisms into trophic levels
- G.2.4 Discuss why there are less organisms in higher trophic levels

G.2.5	Construct an energy pyramid
G.2.6	Distinguish between <i>primary</i> and <i>secondary</i> succession
G.2.7	Explain changes in species diversity during primary succession
G.2.8	Explain how living organisms affect the abiotic environment
G.2.9	Distinguish between <i>biome</i> and <i>biosphere</i>
G.2.10	Explain how rainfall and temperature affect biome distribution
G.2.11	Outline the characteristics of the six major biomes on Earth
G3 Impacts of Humans on Ecosystems	
6 hours	
G.3.1	Calculate the Simpson diversity index for two local communities
G.3.2	Using the Simpson index, analyze the biodiversity of the two local communities
G.3.3	Explain why the rainforests are significant contributors to biodiversity on Earth
G.3.4	Explain using examples how the introduction of foreign species affects ecosystems
G.3.5	Outline an example of how biological control can be used to halt an invasive species
G.3.6	Define <i>biomagnification</i> and its consequences, citing one example
G.3.7	Explain how UV light harms living tissues
G.3.8	Explain how CFC's are damaging the ozone layer
G.3.9	Discuss the function of the ozone layer
G4 Conservation of Biodiversity	
3 hours	
G.4.1	Explain how biotic indices and indicator species monitors environmental change
G.4.2	Choosing one specific animal, explain the factors that caused its extinction
G.4.3	Discuss the features of a nature reserve that preserve diversity of species
G.4.4	Discuss how conservation techniques can be actively managed
G.4.5	Discuss the advantages of <i>in situ</i> conservation
G.4.6	Explain <i>ex situ</i> conservation
G5 Population Ecology	
4 hours	
G.5.1	Distinguish between r-strategies and K-strategies
G.5.2	Discuss the environmental conditions favoring r-strategies and K-strategies
G.5.3	Using the concept of capture-mark-release-recapture method, explain how population size of animals is estimated
G.5.4	Explain how commercial fish stock size is estimated
G.5.5	Explain the concept of maximum sustainable yield in the conservation of fish stocks
G.5.6	Discuss how fish conservation can be successful internationally

OPTION H: FURTHER HUMAN PHYSIOLOGY

This option is available at HL only

H1 Hormonal Control

3 hours

- H.1.1 Define hormones by structure and function
- H.1.2 Distinguish between *steroidal* and *protein* hormones
- H.1.3 Discuss how the pituitary gland and the hypothalamus are related by function
- H.1.4 Explain how ADH functions in negative feedback

H2 Digestion

4 hours

- H.2.1 Explain the function and origin of digestive juices
- H.2.2 Explain the structure of exocrine gland cells
- H.2.3 Compare the composition of saliva, gastric juice and pancreatic juice
- H.2.4 Explain how digestive juice is controlled by the brain and hormones
- H.2.5 Discuss how membrane-bound enzymes function in epithelial cells of the small intestine
- H.2.6 Explain how the chemical bonds of cellulose affect its inability to be digested
- H.2.7 Discuss the roles of pepsin and trypsin in the human digestive tract
- H.2.8 Explain how the presence of *Helicobacter pylori* causes ulcers
- H.2.9 Discuss how bile plays a role in the breakdown of lipids

H3 Absorption of Digested Foods

2 hours

- H.3.1 Illustrate and label a diagram of the human ileum
- H.3.2 Explain how the villi of the small intestine function in the absorption of nutrients
- H.3.3 Explain how cellular transport mechanisms move nutrients across the villi and into the blood and lacteals
- H.3.4 List and explain the materials left undigested for excretion

H4 Functions of the Liver

3 hours

- H.4.1 Outline the circulation of blood through the liver
- H.4.2 Discuss the role of the liver in digestion of nutrients
- H.4.3 Discuss the role of the liver in the storage of nutrients and vitamins
- H.4.4 Explain the roles the liver plays in the synthesis of plasma proteins and cholesterol
- H.4.5 Explain how the liver detoxifies substances consumed with toxic subgroups

H.4.6	Describe red blood cell breakdown in the liver and the compounds formed as a result
H.4.7	Explain damage done to the liver because of excessive alcohol consumption
H5 The Transport System	
5 hours	
H.5.1	Explain the cardiac cycle its major events
H.5.2	Analyze data showing pressure and volume changes during the cardiac cycle
H.5.3	Discuss the mechanisms involved in the control of the heartbeat
H.5.4	Explain atherosclerosis and the causes of coronary thrombosis
H.5.5	Discuss the factors leading to heart disease
H6 Gas Exchange	
5 hours	
H.6.1	Define <i>partial pressure</i>
H.6.2	Explain oxygen dissociation curves of adult hemoglobin and fetal hemoglobin
H.6.3	Discuss how carbon dioxide is carried from the cells to the alveoli, including all enzymes and buffers involved in the process
H.6.4	Explain the Bohr shift
H.6.5	Explain how exercise affects ventilation rate variation
H.6.6	Discuss asthma and its causes
H.6.7	Discuss altitude affects on gas exchange

Assessment:

Knowledge of IBO-required assessments and descriptors should be evident. All parts of IB assessment should be addressed, both internal and external. In addition, examples of non-IB monitoring should be given, if they are part of the course.

Assessment

In May of second year of course students will take external assessment exam centered on the three papers below.

Paper 1

Multiple choice questions weighted at approximately 20%

Paper 2

Short answer questions and one or two data-based questions weighted at approximately 40%

Paper 3

Short answer questions and one extended-response question weighted at approximately 20%

Resources:

List the books and other resource materials and software that will be used in the course. Information should include what is currently available as well as what is being ordered.

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Teaching time:

List all classroom teaching hours for each HL and SL course. Explain how the hours are calculated.

HL/SL course	Teaching hours
Biology HL	270 hours
	(add rows as necessary)

In addition:**For group 1 subjects:**

- Does the course provide adequate preparation in oral and written expression and in analytical and critical thought?
- List the works for language A1 and explain how these works reinforce internationalism.
- Does your list of works reflect the requirements of both “genres” and “periods”, as explained in the language A1 syllabus and in the prescribed book list (PBL) for your language A1?
- Are there adequate materials, particularly in literature, criticism, and literary history?

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For group 2 subjects:

- Does the course provide adequate preparation in oral and written expression and in analytical and critical thought?
- Is provision made for individual practice in speaking and listening over and above what is possible within regular class hours, whether through a language laboratory or by other means?
- Is each language level grouped appropriately, allowing the teachers to provide specialized, intense instruction for each group?
- Explain how the resources and themes chosen will highlight or reinforce internationalism.
- Is the school well stocked with general high-interest reading material at all levels of proficiency in the languages being offered?
- Does the school subscribe to newspapers and periodicals in the language(s) being offered for student and staff use?

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For group 3 subjects:

- Where history will be offered at higher level, please indicate the regional option selected.

- Have the teachers organized appropriate optional topics for study where applicable? Does the course provide adequate preparation in oral and written expression and in analytical and critical thought?
- Explain how the topics chosen will be used to reinforce internationalism.
- Does the school subscribe to newspapers, periodicals, and current reference materials providing up-to-date information, for both staff and student needs, relevant to the group 3 courses offered at the school?
- Where history will be offered at higher level, are there adequate reference materials in the library to support the study of the regional option, as well as to provide sources for in-depth study?

For group 4 subjects:

- Have the teachers organized appropriate laboratory exercises and optional topics for study that conform to IBO requirements for the specific science course?
- Does the course provide adequate training in analytical and critical thought?
- Have science teachers collaborated and planned for the group 4 project?
- How do you envision that the methodology and resources with which the sciences are presented will enhance the international perspective of your students?
- Has there been an assessment of the laboratory facilities?
- Is there adequate instructional space for the group 4 courses?
- Are the science laboratories adequately equipped to perform those exercises required by the IB Diploma Programme curriculum?
- Does the school subscribe to appropriate scientific periodicals and journals and maintain balanced, current and adequate stocks in the life and physical sciences?

For group 5 subjects:

- Does the course provide adequate training in analytical and critical thought?
- Have courses been sequenced to provide appropriate preparation for the various mathematics options and computer science?
- How will the international perspective of your students be enhanced by the methodology and resources used in the teaching of mathematics/computer science?
- Does the classroom and/or library contain a variety of modern mathematics textbooks, technical reference materials and other supplementary instructional materials to support the course(s) in IB mathematics?
- Does the classroom and/or library contain sufficient materials to support the computer science course?

For group 6 subjects:

- Are all group 6 courses adequately supported with materials and laboratory/studio space?
- Does the course outline adequately demonstrate that the school has prepared for the required internal assessments for the subject(s)?

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For theory of knowledge:

- Is the TOK course designed to conform to IBO requirements in substance and classroom hours?
- Indicate the distribution of TOK topics over the two years of the IB Diploma Programme.
- Does the course provide adequate training in analytical and critical thought?

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For all subjects:

- Has a thorough review of the available resource materials and equipment (both within the department and in the library/media centre) been conducted?
- Are instructional materials available in sufficient quality, quantity and variety to give effective support to the aims and methods of the courses?
- Are community resources used both within the classroom and as part of regular field trips?
- Are the needs and projected costs of acquiring all necessary materials and equipment for each subject group clearly stated?
- Is an international perspective included?

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