

# International Baccalaureate Course

The International Baccalaureate (IB) biology course is divided into three sections: core, additional higher level material, and option material. All **IB candidates** must complete the **core** topics. Higher level students are also required to undertake Additional Higher Level (**AHL**) material as part of the core. Options fall into three categories (see the following page): those specific to standard

level students (**OPT-SL**), one only specific to higher level students (**OPT-HL**) and those offered to both (**OPT-SL/HL**). All candidates are required to study two options. All candidates must also carry out **practical work** and must participate in the **group 4 project**. In the guide below, we have indicated where the relevant material can be found: SB1 for Senior Biology 1 and SB2 for Senior Biology 2.

Topic	See workbook
<b>CORE:</b> (All students)	
<b>1 Statistical analysis</b>	
1.1 Mean and SD, t-test, correlation.	SB1 Skills in Biology
• For this CORE topic also see TRC: Statistical Tests Supplement	
<b>2 Cells</b>	
2.1 Cell theory. Cell and organelle sizes. Surface area to volume ratio. Emergent properties. Cell specialization and differentiation. Stem cells.	SB1 Cell Structure, Cell Membranes Cell Division & Organization
2.2 Prokaryotic cells: ultrastructure & function.	SB1 Cell Structure
2.3 Eukaryotic cells: ultrastructure & function. Prokaryotic vs eukaryotic cells. Plant vs animal cells. Extracellular components.	SB1 Cell Structure, Cell Membranes
2.4 Membrane structure. Active and passive transport. Diffusion and osmosis.	SB1 Cell Membranes
2.5 Cell division and the origins of cancer.	SB1 Cell Division & Organization
<b>3 The chemistry of life</b>	
3.1 Elements of life. The properties and importance of water.	SB1 The Chemistry of Life
3.2 Structure and function of carbohydrates, lipids, and proteins.	SB1 The Chemistry of Life
3.3 Nucleotides and the structure of DNA.	SB1 Molecular Genetics
3.4 Semi-conservative DNA replication.	SB1 Molecular Genetics
3.5 RNA and DNA structure. The genetic code. Transcription. Translation.	SB1 Molecular Genetics
3.6 Enzyme structure and function.	SB1 The Chemistry of Life
3.7 Cellular respiration and ATP production.	SB1 Cellular Energetics
3.8 Biochemistry of photosynthesis. Factors affecting photosynthetic rates.	SB1 Cellular Energetics
<b>4 Genetics</b>	
4.1 Eukaryote chromosomes. Genomes. Gene mutations and consequences.	SB1 Genes & Chromosomes
4.2 Meiosis and non-disjunction. Karyotyping and pre-natal diagnosis.	SB1 Genes & Chromosomes
4.3 Theoretical genetics: alleles and single gene inheritance, sex linkage, pedigrees.	SB1 Inheritance
4.4 Genetic engineering and biotechnology: PCR, gel electrophoresis, DNA profiling. HGP. Transformation. GMOs. Cloning.	SB1 Aspects of Biotechnology
• For this CORE topic also see TRC: Biotechnology Supplement	
<b>5 Ecology and evolution</b>	
5.1 Ecosystems. Food chains and webs. Trophic levels. Ecological pyramids. The role of decomposers in recycling nutrients.	SB1 Ecosystems, Energy Flow & Nutrient Cycles
5.2 The greenhouse effect. The carbon cycle. Precautionary principle. Global warming.	SB1 Human Impact & Conservation
5.3 Factors influencing population size. Population growth.	SB1 Populations
5.4 Genetic variation. Sexual reproduction as a source of variation in species. Evidence for evolution: natural selection. Evolution in response to environmental change.	SB1 Genes & Chromosomes, SB2 The Origin & Evolution of Life, Speciation
5.5 Classification. Binomial nomenclature. Features of plant & animal phyla. Keys.	SB1 Classification
• For this CORE topic also see TRC: Ecology & Classification Supplement	
<b>6 Human health and physiology</b>	
6.1 Role of enzymes in digestion. Structure and function of the digestive system.	SB2 Diet & Animal Nutrition
6.2 Structure and function of the heart. The control of heart activity. Blood & vessels.	SB2 Animal Transport Systems

Topic	See workbook
6.3 Pathogens and their transmission. Antibiotics. Role of skin as a barrier to infection. Role of phagocytic leucocytes. Antigens & antibody production. HIV/AIDS.	SB2 Pathogens & Disease, Defense Against Disease
6.4 Gas exchange. Ventilation systems. Control of breathing.	SB2 Gas Exchange in Animals
6.5 Principles of homeostasis. Control of body temperature and blood glucose. Diabetes. Role of the nervous and endocrine systems in homeostasis. Nervous system.	SB2 Homeostasis & Excretion, Nerves, Muscles & Movement
6.6 Human reproduction and the role of hormones. Reproductive technologies and ethical issues.	SB2 Reproduction & Development
• For this CORE topic also see TRC: Animal Biology Supplement	
<b>COMPULSORY: AHL Topics (HL students only)</b>	
<b>7 Nucleic acids and proteins</b>	
7.1 DNA structure, exons & introns (junk DNA)	SB1 Molecular Genetics
7.2 DNA replication, including the role of enzymes and Okazaki fragments.	SB1 Molecular Genetics
7.3 DNA alignment, transcription. The removal of introns to form mature mRNA.	SB1 Molecular Genetics
7.4 The structure of tRNA and ribosomes. The process of translation. Peptide bonds.	SB1 Molecular Genetics, The Chemistry of Life
7.5 Protein structure and function.	SB1 The Chemistry of Life
7.6 Enzymes: induced fit model. Inhibition. Allostery in the control of metabolism.	SB1 The Chemistry of Life
<b>8 Cell respiration and photosynthesis</b>	
8.1 Structure and function of mitochondria. Biochemistry of cellular respiration.	SB1 Cellular Energetics
8.2 Chloroplasts, the biochemistry and control of photosynthesis, chemiosmosis.	SB1 Cellular Energetics
<b>9 Plant science</b>	
9.1 Structure and growth of a dicot plant. Function and distribution of tissues in leaves. Dicots vs monocots. Plant modifications. Auxins.	SB2 Plant Structure & Adaptation, Plant Responses & Reproduction
9.2 Support in terrestrial plants. Transport in angiosperms: ion movement through soil, active ion uptake by roots, transpiration, translocation. Abscisic acid. Xerophytes.	SB2 Plant Structure & Adaptation
9.3 Dicot flowers. Pollination and fertilization. Seeds: structure, germination, dispersal. Flowering and phytochrome.	SB2 Plant Responses & Reproduction
• For this CORE topic also see TRC: Plant Biology Supplement	
<b>10 Genetics</b>	
10.1 Meiosis, and the process of crossing over. Mendel's law of independent assortment.	SB1 Genes & Chromosomes
10.2 Dihybrid crosses. Types of chromosomes.	SB1 Inheritance
10.3 Polygenic inheritance.	SB1 Inheritance
• For this CORE topic also see TRC: Genetics Supplement	
<b>11 Human health and physiology</b>	
11.1 Blood clotting. Clonal selection. Acquired immunity. Antibodies and monoclonal antibodies. Vaccination.	SB2 Defense Against Disease
11.2 Animal Locomotion. Nerves, muscles, bones and movement. Joints. Skeletal muscle and contraction.	SB2 Nerves, Muscles & Movement
11.3 Excretion. Structure and function of the human kidney. Urine production. Diabetes.	SB2 Homeostasis & Excretion
11.4 Testis and ovarian structure. Spermatogenesis and oogenesis. Fertilization and embryonic development. The placenta. Birth. Role of hormones.	SB2 Reproduction & Development
• For this CORE topic also see TRC: Animal Biology Supplement	

**OPTIONS: OPT - SL (SL students only)**

**A Human nutrition and health**  
 A.1 Main constituents of diet. Balanced diet. Malnutrition. Deficiency & supplements. PKU. SB2 Diet & Animal Nutrition  
SB1 Molecular Genetics

A.2 Energy content of food types. BMI. Obesity and anorexia. Appetite control centre. SB2 Diet & Animal Nutrition  
 A.3 Special diet issues; breastfeeding vs bottle-feeding, type II diabetes, cholesterol. SB2 Aspects covered in Diet & Animal Nutrition

**B Physiology of exercise**  
 B.1 Locomotion in animals. Roles of nerves, muscles, and bones in movement. Joints. Skeletal muscle and contraction. SB2 Nerves, Muscles & Movement  
 B.2 Training and the pulmonary system. SB2 Gas Exchange  
 B.3 Training and the cardiovascular system. SB2 Transport Systems  
 B.4 Respiration and exercise intensity. Roles of myoglobin and adrenaline. Oxygen debt and lactate in muscle fatigue. SB2 Nerve, Muscles & Movement, Gas Exchange  
 B.5 Exercise induced injuries and treatment. Not yet covered

• For this OPTION topic also see TRC: Animal Biology Supplement

**C Cells and energy**  
 C.1 Protein structure and function. Fibrous and globular proteins. SB1 The Chemistry of Life  
 C.2 Enzymes: induced fit model. Inhibition. Allostery in the control of metabolism. SB1 The Chemistry of Life  
 C.3 Biochemistry of cellular respiration. SB1 Cellular Energetics  
 C.4 The biochemistry of photosynthesis including chemiosmosis. Action and absorption spectra. Limiting factors. SB1 Cellular Energetics

**OPTIONS: OPT - SL/HL (SL and HL students)**

**D Evolution**  
 D.1 Prebiotic experiments. Comets. Protobionts and prokaryotes. Endosymbiotic theory. SB2 The Origin & Evolution of Life  
 D.2 Species, gene pools, speciation. Types and pace of evolution. Transient vs balanced polymorphism. SB2 Speciation, Patterns of Evolution  
 D.3 Fossil dating. Primate features. Hominid features. Diet and brain size correlation. Genetic and cultural evolution. SB2 Patterns of Evolution Human Evolution

**D.4-D.5 is extension for HL only**

D.4 The Hardy-Weinberg principle. SB2 Speciation  
 D.5 Classification. Biochemical evidence for evolution. Biochemical variations indicating phylogeny. Cladistics and cladograms. SB1 Classification  
SB2 The Origin & Evolution of Life

• For this OPTION topic also see TRC: Human Evolution Supplement, Primate Supplement, Evolution Supplement

**E Neurobiology and behavior**  
 E.1 Stimuli, responses and reflexes in the context of animal behavior. Animal responses and natural selection. SB2 Nerves, Muscles & Movement, Animal Behavior  
 E.2 Sensory receptors. Structure and function of the human eye and ear. SB2 Nerves, Muscles & Movement  
 E.3 Innate vs learned behavior and its role in survival. Learned behavior and birdsong. SB2 Animal Behavior  
 E.4 Presynaptic neurons at synapses. Examples of excitatory and inhibitory psychoactive drugs. Effects of drugs on synaptic transmission. Causes of addiction. SB2 Aspects covered in Nerves, Muscles & Movement

**E.5-E.6 is extension for HL only**

E.5 Structure and function of the human brain. ANS control. Pupil reflex and its use in testing for death. Hormones as painkillers. SB2 Aspects covered in Nerves, Muscles & Movement  
 E.6 Social behavior and organization. The role of altruism in sociality. Foraging behavior. Mate selection. Rhythmical behavior. SB2 Animal Behavior

• For this OPTION topic also see TRC: Behavior Supplement, Sensory Supplement

**F Microbes and Biotechnology**  
 F.1 Classification. Diversity of Archaea and Eubacteria. Diversity of viruses. Diversity of microscopic eukaryotes. SB1 Classification, Cell Structure  
 F.2 Roles of microbes in ecosystems. Details of the nitrogen cycle including the role of bacteria. Sewage treatment. Biofuels. SB1 Energy Flow & Nutrient Cycles, Human Impact & Conservation

F.3 Reverse transcription. Somatic vs germline, gene therapy. Viral vectors. SB1 Aspects of Biotechnology  
 F.4 Microbes involved in food production of beer, wine, bread, and soy sauce. Food preservation. Food poisoning. SB1 Aspects of Biotechnology,  
SB2 Pathogens and Disease

**F.5-F.6 is extension for HL only**

F.5 Metabolism of microbes. Modes of nutrition. Cyanobacterium. Bioremediation. SB2 Diet & Animal Nutrition  
 F.6 Pathogens and disease: influenza virus, malaria, bacterial infections. Controlling microbes. Epidemiology. Prion hypothesis. SB2 Pathogens & Disease, Defense Against Disease

• For this OPTION topic also see TRC: Biotechnology Supplement

**G Ecology and conservation**  
 G.1 Factors affecting plant and animal distribution. Sampling. Ecological niche and the competitive exclusion principle. Species interactions. Measuring biomass. SB1 Ecosystems, Populations, Practical Ecology  
 G.2 Trophic levels. Ecological pyramids. Primary vs secondary succession. Biome vs biosphere. Plant productivity (includes calculating gross and net production, and biomass). SB1 Ecosystems, Energy Flow & Nutrient Cycles  
SB2 Plant Structure & Adaptation  
 G.3 Conservation of biodiversity. Diversity index. Human impact on ecosystems: alien species. Biological control. Effect of CFCs on ozone layer. UV radiation absorption. SB1 Ecosystems, Human Impact & Conservation

**G.4-G.5 is extension for HL only**

G.4 Monitoring environmental change. Biodiversity. Endangered species. Conservation Strategies. Extinction. SB1 Human Impact & Conservation  
SB2 Patterns of Evolution  
 G.5 r-strategies and K-strategies. Mark-and-recapture sampling. Fisheries conservation. SB1 Populations, Practical Ecology, Human Impact & Conservation

• For this OPTION topic also see TRC: Human Impact Supplement, Evolution Supplement, Ecology and Classification Supplement

**OPTION: OPT - HL (HL students only)**

**H Further human physiology**  
 H.1 Hormones and their modes of action. Hypothalamus and pituitary gland. Control of ADH secretion. SB2 Homeostasis & Excretion  
 H.2 Digestion and digestive juices. Stomach ulcers and stomach cancers. Role of bile. SB2 Diet & Animal Nutrition  
 H.3 Structure of villi. Absorption of nutrients and transport of digested food. SB2 Diet & Animal Nutrition  
 H.4 The structure and function of the liver (including role in nutrient processing and detoxification). Liver damage from alcohol. SB2 Homeostasis & Excretion, Diet & Animal Nutrition  
 H.5 The cardiac cycle and control of heart rhythm. Atherosclerosis, coronary thrombosis and coronary heart disease. SB2 Animal Transport System  
 H.6 Gas exchange: oxygen dissociation curves and the Bohr shift. Ventilation rate and exercise. Breathing at high altitude. Causes and effects of asthma. SB2 Gas Exchange in Animals  
SB2 Defense Against Disease

• For this OPTION topic also see TRC: Health & Disease Supplement, Animal Biology Supplement

**Practical Work (All students)**

Practical work consists of short and long term investigations, and an interdisciplinary project (The Group 4 project).

**Short and long term investigations**

Investigations should reflect the breadth and depth of the subjects taught at each level, and include a spread of content material from the core, options, and AHL material, where relevant.

**The Group 4 project**

All candidates must participate in the group 4 project. In this project it is intended that students analyze a topic or problem suitable for investigation in each of the science disciplines offered by the school (not just in biology). This project emphasizes the processes involved in scientific investigations rather than the products of an investigation.