

IB Biology Course Guidelines

I.B. Biology (HL)

Course description:

International Baccalaureate (IB) Biology is an intensive 2-year program that meets the IB “Higher Level” requirements.

The body of knowledge known as biology is growing at an immeasurable rate. Fortunately, scientists are also able to organize these many facts around several core concepts. In IB biology, students will learn to be the scientist in exploring the interrelationships between these core concepts using a variety of methods. These methods include a heavy emphasis on student investigation and inquiry, research, analysis, and application. Students will communicate their ability to apply, critique and revise their findings in many ways such as, professional-level oral, visual, and written communications. Students will develop a strong foundational understanding of the nature of science and describe how newly acquired knowledge leads to new and different questions.

Additionally, students will evaluate international perspectives of various environmental, social, and ethical issues in the area of biology. For example, many bioethical issues surrounding genetic testing of babies, stem cell use, ecological habitat destruction, and gene therapy/modification can be explored through a multicultural and international lens. Students will inquire into the relationships with other areas of science as well as other areas of the IB hexagon. This work will culminate in the group 4 research project.

External assessments will include a series of 3 externally derived and assessed papers to be given in May of the second year. This will comprise 76% of your final assessment. The remaining 24% of your final assessment will come from I.B. monitored, teacher evaluation of your practical investigations over the course of the two years. The areas of focus for these assessments include design, data collection/processing, conclusion and evaluation, manipulative skills, and personal skills. Assessments, which are not included in the formal IB evaluation, will include classroom tests, lab practical assessment and evaluation of laboratory reports and written exercises.

Topics: Cell biology, Chemistry of Life, Principles of Genetics, Ecology and Evolution and Human Health and Physiology

Topics:

<i>Topics:</i>	<i>Time:</i>
<i>Topic 1: Statistical Analysis</i>	2
<i>Topic 3: The Chemistry of Life</i>	
3.1 water	2
3.2 organic molecules	4
3.6, 7.6 enzymes	4
<i>Option D1: Origin of Life</i>	2
<i>Topic 2: Cells</i>	
2.1 cell theory	3
2.2 types of cells prokaryotic	1
2.3 types of cells eukaryotic	3
2.4 transport in cells	3
membranes	
passive and active transport methods	
<i>Topic 3 (Topic 8-AHL): Cell Respiration and Photosynthesis</i>	
3.8, 8.2 photosynthesis	8
3.7, 8.1 cellular respiration-aerobic and anaerobic	7
<i>Topic 2: Cells</i>	
2.5 reproduction of cells	5
cell cycle	
mitosis	
<i>Topic 4 (Topic 10 AHL): Genetics</i>	
4.1 chromosomes, genes, alleles and mutations	2
4.2, 10.1 meiosis and Mendel	4
4.3, 10.2 basic Mendelian Genetics	8
probability	
pedigrees	
punnett squares	
4.4 genetic biotechnologies	6
<i>Topic 10 (AHL): Genetics</i>	
10.3, 10.4, variations to Mendelian Genetics	3
sex linkage	
codominance	
incomplete dominance	
multiple alleles	
polygenic inheritance	
<i>Topic 3 (Topic 7 AHL): Molecular genetics</i>	
3.3, 7.1 DNA structure	2
3.4, 7.2 replication	2

3.5, 7.3, 7.4	transcription, translation, mutation	6
3.6, 7.5	proteins	2
<i>Topic 5 (Option Topic D) Evolution</i>		
D.2, 5.4	origin of evolutionary thinking/evidence Darwin and natural selection	10
D.2	speciation	2
D.3	human evolution	2
5.5	classification and biodiversity	5
D.5	population genetics	4
D.4	Hardy-Weinberg Principle	3
<i>Topic 5 Ecology</i>		
5.3	populations	3
5.1	communities	1
5.1	ecosystems	4
	energy flow	
	chemical cycles	
	ecological succession	
5.2	human impact	4
<i>Topic 6 (Topic 11 AHL, Optional Topic H) Human Physiology</i>		
	basic body plan	
11.2	support and movement	4
6.1, H.2, H.3, H.4	nutrition	12
6.2, H.5	transport	8
6.4, H.6	gas exchange	7
6.5, 12.1, 12.2	excretion	7
6.5, H.1	chemical control	5
6.5, 11.2	nervous control 1	4
6.3, 11.1	immunology	6
6.6, 11.4	reproduction	10
Total 180 hrs.		

Assessment:

External Assessment (76% of Final Assessment)

Paper 1 (60 minutes) – Paper 1 is made up of multiple-choice questions covering core and AHL material. Involves Objective 1 (define, draw, list, measure and state) and Objective 2 (annotate, apply, calculate, compare, describe, distinguish, estimate, identify, and outline) action verbs. No calculators are permitted.

Paper 2 (135 minutes) - Divided into two sections (A and B) and covers the core as well as the AHL material. Involves Objective 1, Objective 2 and Objective 3 (analyze, construct, deduce, derive, design, determine, discuss, evaluate, explain, predict, solve, and suggest) action verbs. Calculators are permitted.

Section A – One databased question and several short-answer questions.

Section B – One extended response question on the core (from a choice of three).

Paper 3 (75 minutes) – Several short-answer questions on the two options studied (*Evolution and Further Human Physiology*). Calculators are permitted.

The Internal Assessment (24% of Final Assessment)

The internal assessment for higher-level biology consists of the group 4 project and both short-term and long-term investigations and comprises 24 % of the final assessment. The internal assessments are assessed by the teacher and monitored by IBO. The internal assessment allows students to become skilled at engaging in scientific investigations and practical applications of science. The assessment criteria for evaluating practical work include: design, data collection/processing, conclusion and evaluation, manipulative skills, and personal skills. For each of these criteria, an IB candidate must be assessed a minimum of two times.

Assessment of the group 4 project is up to the discretion of the school. Options for assessment of the group 4 project include: assessment based on the school's local or national standards, or assessment based on IB internal assessment criteria.

Teachers of the group 4 classes agree that the students will develop the evaluation of the project during the design stages of the project itself. The group 4 project does not contribute a fixed percentage to the 24% required for internal assessment. The traditional school grading system will be used to assign class grades based on the scored assignments completed throughout each quarter.

The Final Assessments is graded on a 7 point scale according to the grade descriptors below (the following is taken from the I.B. Diploma Grade Descriptors, February 1999 on April 10, 2007 from <http://occ.ibo.org/ibis/documents/dp/gr4/d4gen4dgrd99021e.pdf>)

Grade 7 Excellent performance

Displays comprehensive knowledge of factual information in the syllabus and a thorough command of concepts and principles. Selects and applies relevant information, concepts and principles in a wide variety of contexts. Analyses and evaluates quantitative and/or qualitative data thoroughly. Constructs detailed explanations of complex phenomena and makes appropriate predictions. Solves most quantitative and/or qualitative problems proficiently. Communicates logically and concisely using appropriate terminology and conventions. Shows insight or originality. Demonstrates personal skills, perseverance and responsibility in a wide variety of investigative activities in a very consistent manner.

Works very well within a team and approaches investigations in an ethical manner, paying full attention to environmental impact. Displays competence in a wide range of investigative techniques, paying considerable attention to safety, and is fully capable of working independently.

Grade 6 Very good performance

Displays very broad knowledge of factual information in the syllabus and a thorough understanding of concepts and principles. Selects and applies relevant information, concepts and principles in most contexts. Analyses and evaluates quantitative and/or qualitative data with a high level of competence. Constructs explanations of complex phenomena and makes appropriate predictions. Solves basic or familiar problems and most new or difficult quantitative and/or qualitative problems. Communicates effectively using appropriate terminology and conventions. Shows occasional insight or originality. Demonstrates personal skills, perseverance and responsibility in a wide variety of investigative activities in a very consistent manner. Works well within a team and approaches investigations in an ethical manner, paying due attention to environmental impact. Displays competence in a wide range of investigative techniques, paying due attention to safety, and is generally capable of working independently.

Grade 5 Good performance

Displays broad knowledge of factual information in the syllabus. Shows sound understanding of most concepts and principles and applies them in some contexts. Analyses and evaluates quantitative and/or qualitative data competently. Constructs explanations of simple phenomena. Solves most basic or familiar problems and some new or difficult quantitative and/or qualitative problems. Communicates clearly with little or no irrelevant material. Demonstrates personal skills, perseverance and responsibility in a variety of investigative activities in a fairly consistent manner. Generally works well within a team and approaches investigations in an ethical manner, paying attention to environmental impact. Displays competence in a range of investigative techniques, paying attention to safety, and is sometimes capable of working independently.

Grade 4 Satisfactory performance

Displays reasonable knowledge of factual information in the syllabus, though possibly with some gaps. Shows adequate comprehension of most basic concepts and principles but with limited ability to apply them. Demonstrates some analysis or evaluation of quantitative or qualitative data. Solves some basic or routine problems but shows limited ability to deal with new or difficult situations. Communicates adequately although responses may lack clarity and include some repetitive or irrelevant material. Demonstrates personal skills, perseverance and responsibility in a variety of investigative activities, although displays some inconsistency. Works within a team and generally approaches investigations in an ethical manner, with some attention to environmental impact. Displays competence in a range of investigative techniques, paying some attention to safety, although requiring some close supervision.

Grade 3 Mediocre performance

Displays limited knowledge of factual information in the syllabus. Shows a partial comprehension of basic concepts and principles and weak ability to apply them. Shows some ability to manipulate data and solve basic or routine problems. Communicates with a possible lack of clarity and some repetitive or irrelevant material. Demonstrates personal skills, perseverance and responsibility in some investigative activities in an inconsistent manner. Works within a team and sometimes approaches investigations in an ethical manner, with some attention to environmental impact. Displays competence in some

investigative techniques, occasionally paying attention to safety, and requires close supervision.

Grade 2 Poor performance

Displays little recall of factual information in the syllabus. Shows weak comprehension of basic concepts and principles and little evidence of application. Exhibits minimal ability to manipulate data and little or no ability to solve problems. Offers responses that are often incomplete or irrelevant. Rarely demonstrates personal skills, perseverance or responsibility in investigative activities. Works within a team occasionally but makes little or no contribution. Occasionally approaches investigations in an ethical manner, but shows very little awareness of the environmental impact. Displays competence in a very limited range of investigative techniques, showing little awareness of safety factors and needing continual and close supervision.

Grade 1 Very poor performance

Recalls fragments of factual information in the syllabus and shows very little understanding of any concepts or principles. Rarely demonstrates personal skills, perseverance or responsibility in investigative activities. Does not work within a team. Rarely approaches investigations in an ethical manner, or shows an awareness of the environmental impact. Displays very little competence in investigative techniques, generally pays no attention to safety, and requires constant supervision.

Internal Assessments will be evaluated according to the following scale (as taken from the I.B. Biology Guide on April 10, 2007 from http://occ.ibo.org/ibis/documents/dp/gr4/biology/d_4_biolo_gui_0903_1_e.pdf)

Design

Levels/marks	Aspect 1	Aspect 2	Aspect 3
	Defining the problem and selecting variables	Controlling variables	Developing a method for collection of data
Complete/2	Formulates a focused problem/research question and identifies the relevant variables.	Designs a method for the effective control of the variables.	Develops a method that allows for the collection of sufficient relevant data.
Partial/1	Formulates a problem/research question that is incomplete or identifies only some relevant variables.	Designs a method that makes some attempt to control the variables.	Develops a method that allows for the collection of insufficient relevant data.
Not at all/0	Does not identify a problem/research question and does not identify any relevant variables.	Designs a method that does not control the variables.	Develops a method that does not allow for any relevant data to be collected.

Data collection and processing

Levels/marks	Aspect 1	Aspect 2	Aspect 3
	Recording raw data	Processing raw data	Presenting processed data
Complete/2	Records appropriate quantitative and associated qualitative raw data, including units and uncertainties where relevant.	Processes the quantitative raw data correctly.	Presents processed data appropriately and, where relevant, includes errors and uncertainties.
Partial/1	Records appropriate quantitative and associated qualitative raw data, but with some mistakes or omissions.	Processes quantitative raw data, but with some mistakes and/or omissions.	Presents processed data appropriately, but with some mistakes and/or omissions.
Not at all/0	Does not record any appropriate quantitative raw data or raw data is incomprehensible.	No processing of quantitative raw data is carried out or major mistakes are made in processing.	Presents processed data inappropriately or incomprehensibly.

Conclusion and evaluation

Levels/marks	Aspect 1	Aspect 2	Aspect 3
	Concluding	Evaluating procedure(s)	Improving the investigation
Complete/2	States a conclusion, with justification, based on a reasonable interpretation of the data.	Evaluates weaknesses and limitations.	Suggests realistic improvements in respect of identified weaknesses and limitations.
Partial/1	States a conclusion based on a reasonable interpretation of the data.	Identifies some weaknesses and limitations, but the evaluation is weak or missing.	Suggests only superficial improvements.
Not at all/0	States no conclusion or the conclusion is based on an unreasonable interpretation of the data.	Identifies irrelevant weaknesses and limitations.	Suggests unrealistic improvements.

Manipulative skills (assessed summatively)

This criterion addresses objective 5.

Levels/marks	Aspect 1	Aspect 2	Aspect 3
	Following instructions*	Carrying out techniques	Working safely
Complete/2	Follows instructions accurately, adapting to new circumstances (seeking assistance when required).	Competent and methodical in the use of a range of techniques and equipment.	Pays attention to safety issues.
Partial/1	Follows instructions but requires assistance.	Usually competent and methodical in the use of a range of techniques and equipment.	Usually pays attention to safety issues.
Not at all/0	Rarely follows instructions or requires constant supervision.	Rarely competent and methodical in the use of a range of techniques and equipment.	Rarely pays attention to safety issues.

*Instructions may be in a variety of forms: oral, written worksheets, diagrams, photographs, videos, flow charts, audio tapes, models, computer programs, and so on, and need not originate from the teacher.

The Group 4 Project

The project, designed to be collaborative with the other Group 4 disciplines, is an extended investigation focusing on the scientific process rather than the product of the investigation. The students determine the focus of the project. It will take place near the middle of the first semester. The 10-15 hours allocated is divided into four stages.

Design (2-4 hours) – Introduction, brainstorming, and selection of the topic. Students will also establish evaluation criteria during this design stage.

Definition of Activities – Possible strategies

Data collection/processing- (6-8 hours) – Investigation from the perspective of the individual science discipline and sharing of information

Conclusions and Evaluation (2-4 hours) – Presentation of information, both successes and failures, using a formal or informal method

Assessments, which are not included in the formal IB evaluation, will include classroom tests, lab practicals and evaluation of laboratory reports and written exercises. The traditional school grading system will be used to assign class grades based on the scored assignments completed throughout each quarter.

International Perspectives

Many world-wide current events in science involving moral, ethical, social, economic and environmental implications, will be investigated, discussed, researched, and shared. As the class develops into a learning community, students will adjust to the need to understand other perspectives whether they agree with these perspectives or not. One of the best ways of doing this is by engaging with people from other cultural backgrounds, and trying to see from their perspective. As Richard vande Lagemaat states in *The Zone of Tolerance* (I.B. World, November 2002): “An internationally educated person should be able to understand and empathize with people from other cultural backgrounds, as well as make sensitive and discriminating judgments about the world.” This will be one of the main goals of this course.

Below is a list of labs intended for use in I.B. Biology (HL)

Topic/Opt.	Unit	Lab Description	Time
1	Process skills of science	Using Excel-learning to let Excel help you	2
1	Process skills of science	Creating professional data charts	2
3	<i>Biochemistry</i>	Lab-enzymes-students investigate variables affecting enzyme activity	2
3	<i>Biochemistry</i>	Testing food samples for organic molecules	1
3	<i>Biochemistry</i>	Chromotography of plant pigments	1
D	<i>How did life begin?</i>	Essay-Origin of Life	3
2	<i>Cell types</i>	Lab-cell types-students investigate cell types and relative sizes	1
2	<i>Transport in cells</i>	Lab-potato size changes-students investigate solute concentrations in potatoes	2
2	<i>Transport in cells</i>	Lab-Students investigate variables effecting membrane transport using dialysis tubing	2
3	<i>Photosynthesis</i>	Lab-students investigate factors affecting rate of photosynthesis using spinach leaf discs	2
3	<i>Cellular Respiration</i>	Lab-students investigate cellular respiration in yeast cells	2
2	<i>Cell division</i>	Lab-Students investigate factors affecting cell division using surface area to volume ratios	2
2	<i>Mitosis</i>	Mitosis lab-students identify stages of mitosis from prepared slides	1
2	<i>Cell division</i>	Students investigate relative time spent in each phase of Mitosis	1
2,4,10	<i>Cell Division</i>	Students compare and contrast processes of Meiosis and Mitosis	1
4	<i>Basic genetics</i>	Human Karyotypes-students investigate nondisjunction through human karyotypes	1
4,10	<i>Basic genetics</i>	Problem sets-Mendelian genetics using genetic corn	1
4	<i>Inheritance Patterns</i>	Students investigate inheritance patterns in <i>Fast plants</i>	3
4	<i>Inheritance patterns</i>	Students investigate Chi-Square analysis of <i>Fast plant</i> inheritance	1
10	<i>Non-Mendelian Genetics</i>	Problem sets-Non-Mendelian genetics	1
4,10	<i>Pedigrees</i>	Case study analysis of a human pedigree	1
3,7	<i>Transcription</i>	Computer simulations-The process of transcription	1
3,7	<i>Translation</i>	Computer simulations-The process of translation	1
4	<i>Genetic Engineering</i>	Research-students research genetic engineering topic	3
4	<i>Genetic Engineering</i>	Students investigate plasmids impact on bacterial cells	2
5,D	<i>Evolution/Natural Selection</i>	Peppered Moth Computer Simulation	1
5	<i>Classification/Biodiversity</i>	Students develop classification scheme	1
D	<i>Population Genetics</i>	Changes in Allele Frequency lab	1
D	<i>Hardy Weinberg</i>	Data analysis-students simulate factors effecting Hardy-Weinberg Equilibrium	1
D	<i>Hominid Evolution</i>	Students compare hominid skulls	1
5	<i>Population Sampling</i>	Students determine school population using population sampling techniques	1
5	<i>Human Survivorship</i>	Students investigate human survivorship curves	2
5	<i>Human Impact on Ecosystems</i>	Research-students research impact of humans on biodiversity	2
6,H	<i>Transport</i>	Lab-Cardiovascular analysis relative to variables	2
6,H	<i>Blood</i>	Students investigate simulated blood typing and blood composition	1
6,H	<i>Nutrition</i>	Data analysis-Students investigate caloric intake versus usage	2
6,H	<i>Respiration</i>	Goldfish ventilation-design lab, students investigate temp effect on breathing in goldfish	2
6,H	<i>Respiration</i>	Lab-Students correlate respiration and lung capacity to body type variables	2
6,H	<i>Chemical control</i>	Design project-students design teaching tool for endocrine system	3
6,11	<i>Nervous system</i>	Reaction time-students investigate factors effecting reaction time	2
6,11	<i>Immune system</i>	Students relate immune system to human situations	2
6,11,H	<i>Human Physiology</i>	Fetal Pig dissection	2
	<i>Group 4-Design</i>		1
	<i>Group 4-Design</i>		1
	<i>Group 4-data collection</i>		2
	<i>Group 4 data processing</i>		2
	<i>Group 4 Conclusion</i>		2
	<i>Group 4 Presentation</i>		2
	<i>Evaluation</i>		
		Total Hours	78

