



**AYAZAĞA IŞIK LİSESİ**

“ Önce İyi İnsan Yetiştirir ”

**2019-2020 IB DIPLOMA PROGRAMME**

**BIOLOGY HL / SL**

**Course Booklet**



Accredited by CIS



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**6 hours of lecture per week**

## INTRODUCTION

*Biology is the study of life.*

The first organisms appeared on the planet over 3 billion years ago and, through **reproduction** and **natural selection**, have given rise to the 8 million or so different species alive today. Estimates vary, but over the course of **evolution** 4 billion species could have been produced. Most of these flourished for a period of time and then became **extinct** as new, better **adapted** species took their place. There have been at least five periods when very large numbers of species became **extinct** and biologists are concerned that another mass extinction is under way, caused this time by human activity. Nonetheless, there are more species alive on Earth today than ever before. This diversity makes biology both an endless source of fascination and a considerable challenge.

Biologists attempt to understand the living world at all levels using many different approaches and techniques. At one end of the scale is the **cell**, its **molecular construction** and **complex metabolic reactions**. At the other end of the scale biologists investigate the interactions that make whole ecosystems function.

There are a variety of approaches to the teaching of biology in the Diploma Programme. By its very nature, biology lends itself to an **experimental approach**, and it is expected that this will be reflected throughout the course.

Group 4 students at standard level (SL) and higher level (HL) undertake a common core syllabus, a common internal assessment (IA) scheme and have some overlapping elements in the option studied. They are presented with a syllabus that encourages the development of certain skills, attributes and attitudes, as described in the “Assessment objectives” section of the guide.

## BIOLOGY and NATURE OF SCIENCE (NOS)

The Nature of Science (NOS) is an overarching theme in the biology, chemistry and physics courses. Below mentioned how one or more of the NOS themes can be exemplified through the understandings, applications and skills in that particular topic. You should be familiar with NOS statements which will be mentioned in textbooks.

Topic 2 : Molecular biology	NOS Statement
2.1 Molecules to metabolism	Falsification of theories—the artificial synthesis of urea helped to falsify vitalism. ( 1.9)

*1.9. This evidence is used to develop theories, generalize from data to form laws and propose hypotheses. These theories and hypotheses are used to make predictions that can be tested. In this way theories can be supported or opposed and can be modified or replaced by new theories.*

## **BIOLOGY and THEORY OF KNOWLEDGE (TOK)**

TOK lessons support students in their study of science, just as the study of science supports students in their TOK course. An example for TOK statement in biology course is below.

<b>Topic 2 : Molecular biology</b>	<b>TOK Statement</b>
2.2 Water	Claims about the “memory of water” have been categorized as <b>pseudoscientific</b> . What are the criteria that can be used to distinguish scientific claims from pseudoscientific claims?

## **BIOLOGY and INTERNATIONAL MINDEDNES (IM)**

Science itself is an international endeavor-the exchange of information and ideas across national boundaries has been essential to the progress of science. An example for IM in biology course is below.

<b>Topic 2 : Molecular biology</b>	<b>IM Statement</b>
2.2 Water	There are challenges for the increasing human population in sharing water resources equitably for drinking and irrigation, electricity generation and a range of industrial and domestic processes.

## THE IB LEARNER PROFILE

The biology course is closely linked to the IB learner profile. By following the course, students will have engaged with the attributes of the IB learner profile. For example, the requirements of the internal assessment provide opportunities for students to develop every aspect of the profile. For each attribute of the learner profile, a number of references from the Group 4 courses are given below.

<b>Learner profile attribute</b>	<b>Biology, Chemistry and Physics</b>
<b>Inquirers</b> Arařtırmacı	Aims 2 and 6 Practical work and internal assessment
<b>Knowledgeable</b> Bilgili	Aims 1 and 10, international-mindedness links Practical work and internal assessment
<b>Thinkers</b> Düşünen	Aims 3 and 4, theory of knowledge links Practical work and internal assessment
<b>Communicators</b> İletişim kurabilen	Aims 5 and 7, external assessment Practical work and internal assessment
<b>Principled</b> İlke sahibi	Aims 8 and 9 Practical work and internal assessment. Ethical behaviour/practice ( <i>Ethical practice in the Diploma Programme poster, IB animal experimentation policy</i> ), academic honesty
<b>Open-minded</b> Açık fikirli	Aims 8 and 9, international-mindedness links Practical work and internal assessment, the group 4 project
<b>Caring</b> Duyarlı	Aims 8 and 9 Practical work and internal assessment, the group 4 project, ethical behaviour/ practice ( <i>Ethical practice in the Diploma Programme poster, IB animal experimentation policy</i> )
<b>Risk-takers</b> Risk alan	Aims 1 and 6 Practical work and internal assessment, the group 4 project
<b>Balanced</b> Dengeli	Aims 8 and 10 Practical work and internal assessment, the group 4 project and field work
<b>Reflective</b> Dönüşümlü düşünen	Aims 5 and 9 Practical work and internal assessment, the group 4 project

## GROUP 4 AIMS

Through studying biology, chemistry or physics, students should become aware of how scientists work and communicate with each other. While the scientific method may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that characterizes these subjects.

The aims enable students, through the overarching theme of the Nature of science, to:

1. **appreciate** scientific study and creativity within a global context through stimulating and challenging opportunities
2. **acquire** a body of knowledge, methods and techniques that characterize science and technology
3. **apply** and **use** a body of knowledge, methods and techniques that characterize science and technology
4. **develop** an ability to analyse, evaluate and synthesize scientific information
5. **develop** a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities
6. **develop** experimental and investigative scientific skills including the use of current technologies
7. **develop** and apply 21st century communication skills in the study of science
8. **become** critically aware, as global citizens, of the ethical implications of using science and technology
9. **develop** an appreciation of the possibilities and limitations of science and technology
10. **develop** an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge.

## IB BIOLOGY SYLLABUS OUTLINE

Syllabus component	Teaching hours	
	SL	HL
<b>Core</b>	<b>95</b>	
1. Cell biology	15	
2. Molecular biology	21	
3. Genetics	15	
4. Ecology	12	
5. Evolution and biodiversity	12	
6. Human physiology	20	
<b>Additional higher level (AHL)</b>	<b>60</b>	
7. Nucleic acids	9	
8. Metabolism, cell respiration and photosynthesis	14	
9. Plant biology	13	
10. Genetics and evolution	8	
11. Animal physiology	16	
<b>Option</b>	<b>15</b>	<b>25</b>
A. Neurobiology and behaviour	15	25
B. Biotechnology and bioinformatics	15	25
C. Ecology and conservation	15	25
D. Human physiology	15	25
<b>Practical scheme of work (PSOW)</b>	<b>40</b>	<b>60</b>
Practical activities	20	40
Individual investigation (internal assessment–IA)	10	10
Group 4 project	10	10
<b>Total teaching hours</b>	<b>150</b>	<b>240</b>

## SEQUENCE OF TOPICS (HL / SL)

Year 1 (11 <sup>th</sup> Grade)	
	Topic
Semester - 1	<p><b>Topic 2: Molecular biology</b>  <i>Some of the topics 7, 8 and 9 integrated</i></p> <p>Group 4 Topic Choice</p> <p>EE Subject Choices</p> <p><b>Topic 1: Cell biology</b>  <i>Topics 11.3 and 9.1 integrated</i></p>
	<p><b>Topic 3: Genetics</b>  <i>Some of the topics 9 and 10 integrated</i></p> <p>EE Research Question</p> <p>EE Outline Writing Camp</p> <p>Group 4 Project Presentations</p> <p><b>Topic 6: Humans</b>  <i>Topics 11 and Opt A integrated</i></p> <p>IA 1st Draft</p> <p>Writing the EE</p>

Year 2 (12 <sup>th</sup> Grade)	
	Topic
Semester - 1	<p>EE 1st draft submitted</p> <p><b>Topic 4: Ecology</b></p> <p><b>Topic 5: Evolution and biodiversity</b>  <i>Topic 10.3 integrated</i></p> <p>IA 2nd draft</p> <p>EE Interim with the supervisor</p> <p>IA Final copy submitted</p> <p>EE final Copy submitted</p>
	<p>REVISION / MOCK EXAMS</p> <p>MAY 2021 - EXAMS</p>



## MATHEMATICAL REQUIREMENTS

All Diploma Programme biology students should be able to:

- perform the basic arithmetic functions: addition, subtraction, multiplication and division
- carry out calculations involving means, decimals, fractions, percentages and ratios
- represent and interpret frequency data in the form of bar charts, graphs and histograms, including direct and inverse proportion
- plot graphs (with suitable scales and axes) involving two variables that show linear or non-linear relationships
- plot and interpret scatter-graphs to identify a correlation between two variables, and appreciate that the existence of a correlation does not establish a causal relationship
- determine the mode and median of a set of data, calculate and analyse standard deviation
- select statistical tests appropriate for the analysis of particular data and interpret the results.

## THE ASSESSMENT OBJECTIVES

The assessment objectives for biology, chemistry and physics reflect those parts of the aims that will be formally assessed either internally or externally. These assessments will centre upon the nature of science. It is the intention of these courses that students are able to fulfill the following assessment objectives:

- 1. Demonstrate knowledge and understanding of:**
  - a. facts, concepts and terminology
  - b. methodologies and techniques
  - c. communicating scientific information.
- 2. Apply:**
  - a. facts, concepts and terminology
  - b. methodologies and techniques
  - c. methods of communicating scientific information.
- 3. Formulate, analyse and evaluate:**
  - a. hypotheses, research questions and predictions
  - b. methodologies and techniques
  - c. primary and secondary data
  - d. scientific explanations.
- 4. Demonstrate** the appropriate research, experimental, and personal skills necessary to carry out insightful and ethical investigations.

## ASSESSMENT OUTLINE—SL

Component	Overall weighting (%)	Approximate weighting of objectives (%)		Duration (hours)
		1+2	3	
Paper 1	20	10	10	$\frac{3}{4}$
Paper 2	40	20	20	$1\frac{1}{4}$
Paper 3	20	10	10	1
Internal assessment	20	Covers objectives 1, 2, 3 and 4		10

## EXTERNAL ASSESSMENT DETAILS—SL

### Paper 1

Duration: 45min, Weighting: 20%

Marks: 30

- 30 multiple-choice questions on core material, about 15 of which are common with HL.
- The questions on paper 1 test assessment objectives 1, 2 and 3.
- **The use of calculators is not permitted.**
- **No marks are deducted for incorrect answers.**

### Paper 2

Duration: 75min, Weighting: 40%

Marks: 50

- Data-based question.
- Short-answer and extended-response questions on core material.
- One out of two extended response questions to be attempted by candidates.
- The questions on paper 2 test assessment objectives 1, 2 and 3.
- **The use of calculators is permitted.**

### Paper 3

Duration: 1 hour, Weighting: 20%, Marks: 35

- This paper will have questions on core and SL option material.
- Section A: candidates answer all questions, two to three short-answer questions based on **experimental skills and techniques, analysis and evaluation**, using unseen data linked to the core material.
- Section B: short-answer and extended-response questions from **one option**.
- The questions on paper 3 test assessment objectives 1, 2 and 3.
- **The use of calculators is permitted.**

## ASSESSMENT OUTLINE—HL

Component	Overall weighting (%)	Approximate weighting of objectives (%)		Duration (hours)
		1+2	3	
Paper 1	20	10	10	1
Paper 2	36	18	18	2¼
Paper 3	24	12	12	1¼
Internal assessment	20	Covers objectives 1, 2, 3 and 4		10

## EXTERNAL ASSESSMENT DETAILS—HL

### Paper 1

Duration: 1 hour, Weighting: 20%

Marks: 40

- 40 multiple-choice questions on core and AHL material, about 15 of which are common with SL.
- The questions on paper 1 test assessment objectives 1, 2 and 3.
- **The use of calculators is not permitted.**
- **No marks are deducted for incorrect answers.**

### Paper 2

Duration: 2¼ hours, Weighting: 36%

Marks: 72

- Data-based question.
- Short-answer and extended-response questions on core and AHL material.
- Two out of three extended response questions to be attempted by candidates.
- The questions on paper 2 test assessment objectives 1, 2 and 3.
- **The use of calculators is permitted.**

### Paper 3

Duration: 1¼ hours, Weighting: 24%, Marks: 45

- Section A: candidates answer all questions, two to three short-answer questions based on **experimental skills and techniques, analysis and evaluation**, using unseen data linked to the core and AHL material.
- Section B: short-answer and extended-response questions from **one option**.
- The questions on paper 3 test assessment objectives 1, 2 and 3.
- **The use of calculators is permitted.**

## Biology HL/SL Grade Boundaries (Nov 2018 Subject Report)

Higher level overall							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 15	16 - 26	27 - 39	40 - 53	54 - 66	67 - 80	81 - 100
Standard level overall							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 14	15 - 25	26 - 38	39 - 50	51 - 61	62 - 74	75 - 100
Higher level internal assessment							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 3	4 - 6	7 - 10	11 - 13	14 - 16	17 - 19	20 - 24
Standard level internal assessment							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 3	4 - 6	7 - 10	11 - 13	14 - 16	17 - 19	20 - 24
Higher level paper one							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 10	11 - 13	14 - 16	17 - 22	23 - 28	29 - 34	35 - 40
Standard level paper one							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 10	11 - 13	14 - 17	18 - 21	22 - 25	26 - 30
Higher level paper two							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 15	16 - 24	25 - 34	35 - 44	45 - 54	55 - 72
Standard level paper two							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 12	13 - 18	19 - 24	25 - 29	30 - 35	36 - 50
Higher level paper three							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 14	15 - 20	21 - 26	27 - 32	33 - 38	39 - 45
Standard level paper three							
Grade:	1	2	3	4	5	6	7
Mark range:	0 - 3	4 - 7	8 - 11	12 - 15	16 - 19	20 - 23	24 - 35

## INTERNAL ASSESSMENT (BOTH SL/HL)

Internal assessment enables you to demonstrate the application of your skills and knowledge, and to pursue your personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment should, as far as possible, be woven into normal classroom teaching and not be a separate activity conducted after a course has been taught.

- Student work is internally assessed by the teacher and externally moderated by the IB.
- Compulsory for both SL and HL students.
- Requirements at SL and at HL are the same.
- Contributing 20% to the final assessment.
- Must be the student's own work.
- **Decide upon a title or topic without any further support from the teacher.**
- Teachers and students must discuss the internally assessed work.
- Teachers should read and give advice to students on one draft of the work.
- **The teacher should provide oral or written advice on how the work could be improved, but not edit the draft.**
- The next version handed to the teacher must be the final version for submission.
- Academic honesty, authenticity and intellectual property!
- The internally assessed work must be entirely their own (students).
- **Collaboration between students is permitted.**
- Once a student has officially submitted the final version of the work it cannot be retracted.
- **The content of the work:**
  - the student's initial proposal
  - the first draft of the written work
  - the references cited
  - the style of writing compared with work known to be that of the student
  - the analysis of the work by a web-based plagiarism detection service such as <http://www.turnitin.com>.

## IA TIME ALLOCATION

A total of approximately 10 hours of teaching time for both SL and HL.

This should include:

- time for the teacher to explain to students the requirements of the internal assessment
- class time for students to work on the internal assessment component and ask questions
- time for consultation between the teacher and each student
- time to review and monitor progress, and to check authenticity.

40 suggestions for a safer lab!



## Practical work and internal assessment

- Total mark: 24
- Worth 20% of the final assessment
- Consists of one scientific (individual) investigation
- 10 hours
- About 6 to 12 pages long
- Syllabus content

### Possible tasks

- a hands-on laboratory investigation
- using a spreadsheet for analysis and modeling
- extracting data from a database and analyzing it graphically
- producing a hybrid of spreadsheet/database work with a traditional hands-on investigation
- using a simulation provided it is interactive and open-ended.

Some tasks may consist of relevant and appropriate qualitative work combined with quantitative work.

Personal engagement	Exploration	Analysis	Evaluation	Communication	Total
2 (8%)	6 (25%)	6 (25%)	6 (25%)	4 (17%)	24 (100%)

## The Seven Prescribed (Required) Laboratory Investigations for IB Biology HL / SL

### Practical 1 *Cells unit*

Use of a light microscope to investigate the structure and ultrastructure of cells and tissues, with drawing of cells and calculation of the magnification of drawings and the actual sizes of structures shown in drawings or micrographs

### Practical 2 *Cells unit*

Estimation of osmolarity in tissues by bathing samples in hypotonic and hypertonic solutions

### Practical 3 *Molecules of Life unit*

Experimental investigation of a factor affecting enzyme activity

### Practical 4 *Metabolism unit*

Separation of photosynthetic pigments by chromatography

### Practical 5 *Ecology unit*

Setting up sealed mesocosms to try to establish sustainability

### Practical 6 *Human physiology*

Monitoring of ventilation in humans at rest and after mild and vigorous exercise

### Practical 7 *Plants unit*

Measurement of transpiration rates using potometers

## THE GROUP 4 PROJECT

The group 4 project is an interdisciplinary activity in which all Diploma Programme science students must participate. The intention is that students from the different group 4 subjects analyse a common topic or problem. The exercise should be a collaborative experience where the emphasis is on the processes involved in, rather than the products of, such an activity. In most cases students in a school would be involved in the investigation of the same topic. Where there are large numbers of students, it is possible to divide them into several smaller groups containing representatives from each of the science subjects. Each group may investigate the same topic or different topics—that is, there may be several group 4 projects in the same school. Students studying environmental systems and societies are not required to undertake the group 4 project.

The group 4 project allows students to appreciate the environmental, social and ethical implications of science and technology. It may also allow them to understand the limitations of scientific study, for example, the shortage of appropriate data and/or the lack of resources. The emphasis is on interdisciplinary cooperation and the processes involved in scientific investigation, rather than the products of such investigation. The choice of scientific or technological topic is open but the project should clearly address aims 7, 8 and 10 of the group 4 subject guides. Ideally, the project should involve students collaborating with those from other group 4 subjects at all stages. To this end, it is not necessary for the topic chosen to have clearly identifiable separate subject components. However, for logistical reasons, some schools may prefer a separate subject “action” phase

## SCHOOL BASED ASSESSMENTS

The oral grades (2nd) for MEB reports will be given by using the following criteria.

FIRST YEAR (Grade 11)			SECOND YEAR (Grade 12)		
	1st term	2nd term		1st term	2nd term
Practicals	20%	20%	Practicals	20%	-
Quizzes	30%	20%	Quizzes	20%	-
Homeworks	30%	20%	Homeworks	20%	-
Participation	20%	20%	Participation	20%	40%
Mock Exams	-	20%	Mock Exams	20%	60%
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>TOTAL</b>	<b>100</b>	<b>100</b>

- Leading a practice will be counted as 1st year 1st term’s first oral grade (performance)
- **Group 4 project** will be counted as 1st year 2nd term’s first oral grade (performance)
- **Internal Assessment** will be counted as 2nd year 1st term’s first oral grade (performance)
- **One of the mock exam** will be counted as 2nd year 2nd term’s first oral grade (performance)

## COMMAND TERMS FOR BIOLOGY

Students should be familiar with the following key terms and phrases used in examination questions. Although these terms will be used frequently in examination questions, other terms may be used to direct students to present an argument in a specific way.

These command terms indicate the depth of treatment required.

### Assessment objective 1

<b>Define</b>	Give the precise meaning of a word, phrase, concept or physical quantity.
<b>Draw</b>	Represent by means of a labelled, accurate diagram or graph, using a pencil. A ruler (straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted (if appropriate) and joined in a straight line or smooth curve.
<b>Label</b>	Add labels to a diagram.
<b>List</b>	Give a sequence of brief answers with no explanation.
<b>Measure</b>	Obtain a value for a quantity.
<b>State</b>	Give a specific name, value or other brief answer without explanation or calculation.

### Assessment objective 2

<b>Annotate</b>	Add brief notes to a diagram or graph.
<b>Calculate</b>	Obtain a numerical answer showing the relevant stages in the working (unless instructed not to do so).
<b>Describe</b>	Give a detailed account.
<b>Distinguish</b>	Make clear the differences between two or more concepts or items.
<b>Estimate</b>	Obtain an approximate value.
<b>Identify</b>	Provide an answer from a number of possibilities.
<b>Outline</b>	Give a brief account or summary.



### Assessment objective 3

<b>Analyse</b>	Break down in order to bring out the essential elements or structure.
<b>Comment</b>	Give a judgment based on a given statement or result of a calculation.
<b>Compare</b>	Give an account of the similarities between two (or more) items or situations, referring to both (all) of them throughout.
<b>Compare and contrast</b>	Give an account of similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.
<b>Construct</b>	Display information in a diagrammatic or logical form.
<b>Deduce</b>	Reach a conclusion from the information given.
<b>Design</b>	Produce a plan, simulation or model.
<b>Determine</b>	Obtain the only possible answer.
<b>Discuss</b>	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
<b>Evaluate</b>	Make an appraisal by weighing up the strengths and limitations.
<b>Explain</b>	Give a detailed account including reasons or causes.
<b>Predict</b>	Give an expected result.
<b>Sketch</b>	Represent by means of a diagram or graph (labelled as appropriate). The sketch should give a general idea of the required shape or relationship, and should include relevant features.
<b>Suggest</b>	Propose a solution, hypothesis or other possible answer.

## LESSON MATERIALS

The student should bring textbooks, laptop, folder (for IB biology only), pens/pencils, ruler and to class every day.

## COURSE BOOK:

- Oxford IB Diploma Programme: Biology Course Companion, Andrew Allott and Author David Mindorff. Oxford University Press 2014

ISBN: 978-0-19-839211-8

- Oxford IB Study Guides: Biology for the IB Diploma, Andrew Allott, Oxford University Press 2014

ISBN: 978-0-19-839351-1

## WEB LINKS

<https://studyib.net/biology>

<https://fmvisik.managebac.com/>

<https://phet.colorado.edu/tr/>

[http://www.mhhe.com/biosci/genbio/virtual\\_labs\\_2K8/](http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/)

<https://ghr.nlm.nih.gov/>

<https://evolution.berkeley.edu/evolibrary/home.php>

<https://pals.sri.com/>

<https://iearn.org/>

[https://www.golabz.eu/labs?subject\\_domain=185](https://www.golabz.eu/labs?subject_domain=185)

<http://www.sciencetimeline.net/>

<https://opentextbc.ca/anatomyandphysiology/front-matter/about-this-book/>

<http://www.primate-sg.org/>

<https://www.sciencemusicvideos.com/>

<https://www.bioknowledgey.info/>

## APPENDIX

Ask for 4/ICCS form which will be completed by the student