Diploma Programme subject outline–Group 4: sciences			
School name	**Gymnazium a SOS, Rokycany**	**School code**	**061768**
Name of the DP subject *(indicate language)*	**Biology**		
Level *(indicate with X)*	Higher X	Standard completed in two years	Standard completed in one year *
Name of the teacher who completed this outline	Pavel Vlach, Vladimira Moulisova	**Date of IB training**	19th - 21st May 2021
Date when outline was completed	05/2021	**Name of workshop** *(indicate name of subject and workshop category)*	Biology Cat 1

* All Diploma Programme courses are designed as two-year learning experiences. However, up to two standard level subjects, excluding languages ab initio and pilot subjects, can be completed in one year, according to conditions established in the *Handbook of procedures for the Diploma Programme*.

1. Course outline

– Use the following table to organise the topics to be taught in the course. If you need to include topics that cover other requirements you have to teach (for example, national syllabus), make sure that you do so in an integrated way, but also differentiate them using italics. Add as many rows as you need.

– This document should not be a day-by-day accounting of each unit. It is an outline showing how you will distribute the topics and the time to ensure that students are prepared to comply with the requirements of the subject.

– This outline should show how you will develop the teaching of the subject. It should reflect the individual nature of the course in your classroom and should not just be a "copy and paste" from the subject guide.

– If you will teach both higher and standard level, make sure that this is clearly identified in your outline.

	Topic/unit (as identified in the IB subject guide) *State the topics/units in the order you are planning to teach them.*	Contents	Allocated time One class is 45 minutes In one week there are 3 classes	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	Unit 1: Cell biology	1.1 Introduction to cells 1.2 Ultrastructure of cells 1.3 Membrane structure 1.4 Membrane transport 1.5 The origin of cells 1.6 Cell division	21 classes **15.75 hours** 10 classes in Lab **7.5 hours**	Formative and summative assessment over all the topics: ● single and multiple-choice tests ● short response test ● essays ● DBQs based test ● presentations ● class discussions ● Mock exams Practical internal assessment based on laboratory works (learning skills, results, laboratory protocols)	**Books**: Tosto P., Damon A., Ward W. & McGonegal R., 2014. Standard Level Biology. Pearson Education, 608 pp. Davis A. & Clegg C.J., 2017. Biology for the IB Diploma Study and Revision Guide. Hodder Education, 320 pp. **Online sources:** https://www.hoddereducation.co.uk/ib-extras https://www.bioknowledgy.info/ **Scientific articles in journals** (free access to Elsevier and Springer databases) **Online or open source software tools and databases:** Protein and gene databases, BLAST and alignment tools (https://www.rcsb.org/, https://www.ebi.ac.uk/Tools/msa/clustalo/, https://www.ncbi.nlm.nih.gov/, https://blast.ncbi.nlm.nih.gov/Blast.cgi etc.) **Other sources:**
	Unit 2: Molecular biology	1.1 Molecules to metabolism 1.2 Water 1.3 Carbohydrates and lipids 1.4 Proteins 1.5 Enzymes 1.6 Structure of DNA and RNA 1.7 DNA replication, transcription and translation 1.8 Cell respiration 1.9 Photosynthesis	29 classes **21.75 hours** 12 classes in Lab **9 hours**		
	Unit 7: Nucleic Acid	7.1 DNA structure and replication 7.2 Transcription and gene expression 7.3 Translation	12 classes **9 hours**		
	Unit 8: Metabolism, cell respiration and photosynthesis	8.1 Metabolism 8.2 Cell respiration 8.3 Photosynthesis	19 classes **14.25 hours** 2 classes in Lab **1.5 hours**		

	Unit 3: Genetics	2.1 Genes 2.2 Chromosomes 2.3 Meiosis 2.4 Inheritance 2.5 Genetic modification and biotechnology	22 classes **16 hours** 2 classes in Lab **1.5 hours**		Computers, iPads, calculators, Labs (see below)
	Unit 10: Genetics and evolution	10.1 Meiosis 10.2 Inheritance 10.3 Gene pools and speciation	12 classes **9 hours** 4 classes in Lab **3 hours**		
	Unit 5: Evolution	4.1 Evidence for evolution 4.2 Natural selection 4.3 Classification of biodiversity 4.4 Cladistics	17 classes **12.75 hours**		
	Unit 9: Plant biology	9.1 Transport in the xylem of plants 9.2 Transport in the phloem of plants 9.3 Growth in plants 9.4 Reproduction in plants	18 classes **13.5 hours** 2 classes in Lab **1.5 hours**		
Year 2	Unit 6: Human physiology	5.1 Digestion and absorption 5.2 The blood system 5.3 Defence against infectious disease 5.4 Gas exchange 5.5 Neurons and synapses 5.6 Hormones, homeostasis and reproduction	30 classes **22.5 hours** 4 classes in Lab **3 hours**		
	Unit 11: Animal Physiology	11.1 Antibody production and vaccination 11.2 Movement 11.3 The kidney and osmoregulation 11.4 Sexual reproduction	25 classes **18.75 hours** 4 classes in Lab **3 hours**		

	Unit D: Human physiology	D.1 Human nutrition D.2 Digestion D.3 Functions of the liver D.4 The heart D.5 Hormones and metabolism D.6 Transport of respiratory gases	35 classes **26.25 hours** 4 classes in Lab **3 hours**		
	Unit 4: Ecology	4.1 Species, communities and ecosystems 6.4 Energy flow 6.5 Carbon cycling 6.6 Climate change	23 classes **17.25 hours** 13 classes in Lab **9.75 hours**		

2. The group 4 project

As the IB guides say, "The group 4 project is a collaborative activity where students from different group 4 subjects work together on a scientific or technological topic, allowing for concepts and perceptions from across the disciplines to be shared in line with aim 10—that is, to 'encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.'" Describe how you will organise this activity. Indicate the timeline and subjects involved, if applicable.

As the Group 4 Project should be done collaboratively among Subject Group 4 Science subjects, our students will go through a project concerning at least two of them: Biology and Chemistry, Biology and Physics or Chemistry and Physics. There are five main topics for them available for the period 2022-2024: Biochemistry of plant cells (Bi, Ch), Animal movements (Bi, Physics), Water properties (Ch, Physics), Water pollution (Bi, Ch), Soil pollution (Bi, Ch).
Each student group consisting of 3-4 participants will be asked to choose one of these topics and specify their project while discussing with lecturers.
The groups will spend 2,25 hours planning, 4,5 hours executing, 2 hours finalising their results and 1,75 hours presenting the project to other groups. While working on the projects, our teaching staff will always be available to support the students (discussions on / help with all aspects of the project while encouraging students' independent work).
The Group 4 Project will start in May of the first IB DP year (3.75 hours in Y1) and finish up in October of the second year (6.25 hours in Y2).

3. IB practical work and the internal assessment requirement to be completed during the course

As you know, students should undergo practical work related to the syllabus.

Practical activities (see below):	56 classes (42 hours)
Individual investigation (internal assessment–IA)	10 hours
Group 4 project	10 hours

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
1.1 Introduction to cells	Basics in microscopy, cell observation (2 classes)	No
1.4 Membrane transport	Osmotic phenomena in onion cells (2)	Yes (3)
1.5 The origin of cells	Bacteria cultivation on different substrates (2)	Yes (3)
	Gram staining of bacteria, observation of bacterial cells (2)	No
1.6 Cell division	Identifying phases of mitosis in onion cells (2)	No
2.3 Carbohydrates and lipids 2.4 Proteins	Evidence of proteins and carbohydrates present in different food items (2)	Yes (1, 2, 3, 5)
	Protein separation by electrophoresis (2)	Yes (
2.4 Proteins	Protein homology between species – alignments (2)	Yes (4)
2.6 Structure of DNA and RNA	DNA isolation from banana (2)	No
2.9 Photosynthesis	Chromatography of different plant tissues (2)	No
8.3 Photosynthesis	Measuring of primary production in different condition (2)	Yes (1, 2, 3, 5)
3.2 Chromosomes	Chromosomes observation in locusts' testicles	No

10.1 Meiosis	Identifying phases of meiosis in locusts' testicles (2)	No
10.3 Gene pools and speciation	Working with gene databases (BLAST analysis) (2)	Yes (4)
9.3 Growth in plants	Chromatography of plant pigments (2)	Yes (2)
6.2 The blood system	Comparing vital signs concerning blood system (pulse and blood pressure) after different levels of exercise (2)	Yes (1, 2)
6.4 Gas exchange	Comparing vital signs concerning respiratory systems (respiratory rate, vital lung capacity) (2)	Yes (1, 2)
11.3 The kidney and osmoregulation	Thin cuts of animal tissues	No
11.4 Sexual reproduction	Thin cuts of animal tissues	No
D.2 Digestion	Evidence of essential catabolic reactions (4)	No
4.1 Species, communities and ecosystems	Field survey phytocenosis structure (3)	Yes (5)
4.1 Species, communities and ecosystems	Field survey zooocenosis structure (2)	Yes (5)
4.4 Climate change	Water properties field survey (2)	Yes (1, 2)
	Water Properties Measurement in Lab (2)	Yes (1, 2)
	Isolation of anaerobic bacterial population from environmental water sample (4)	No

IB internal assessment requirement to be completed during the course

Briefly explain how and when you will work on it. Include the date when you will first introduce the internal assessment requirement to your students, the different stages and when the internal assessment requirement will be due.

General information

Internal assessment is an integral part of the course and is compulsory for both SL and HL students. It enables students to demonstrate the application of their skills and knowledge and to pursue their personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment requirements at SL and at HL are the same.
The internal assessment task will be a scientific investigation and should be about 6 to 12 pages long. Investigations exceeding this length will be penalized in the communication criterion as lacking in conciseness.

Scheduling

There is a time of 10 hours (13.5 classes) allocated for working on IA at the school. The precise scheduling depends on a chosen topic for IA; nevertheless, there will be 3.75 hours (5 classes) in Y1 and 6.25 (8 classes) in Y2 engaged for these purposes.
Y1 September (1): class time for the teacher to explain to students the requirements of the internal assessment;
Y1 February (2): class time for choosing the topic;
Y1 March (2): class time for students to work on the internal assessment component and ask questions;
Y2 September (2): time for consultation between the teacher and each student;
Y2 October (2): time for consultation between the teacher and each student;
Y2 November (4): time to review and monitor progress, and to check authenticity;
Y2 December – deadline for IA submission.

Assessment criteria

In assessment the following criteria will be taken into consideration: Personal engagement (8%), Exploration (25%), Analysis (25%), Evaluation (25%), and Communication (17 %).

For more detail see the Biology guide.

4. Laboratory facilities

Describe the laboratory and indicate whether it is presently equipped to facilitate the practical work that you have indicated in the chart above. If it is not, indicate the timeline to achieve this objective and describe the safety measures that are applicable.

Two separate labs are currently used for the subject:
Biology Lab is equipped with:

- All necessary safety equipment according to safety requirements (fire extinguisher, fire blanket, sink and running water)
- 16 optical microscopes (1000× magnification)
- 10 stereoscopic microscopes
- Rotary microtome
- Equipment for microbiology (autoclave, biochemical incubator)
- Electrophoresis
- other small lab equipment
- Vernier LabQuests with various sensors (Blood Pressure sensor, EKG sensor, Hand Dynamometer sensor, Spirometer sensor, SpectroVis, ...)
- The school´s own animal facilities (crickets, mice, fish).

Chemical Lab is equipped with:

- All necessary safety equipment according to safety requirements (safety shower, fire extinguisher, fire blanket, nine sinks and running water, fume hood, eye shower)
- Vernier LabQuests with various sensors (Temperature Sensor, CO2 sensor, 02 sensor, pH sensor, Conductivity sensor, ...)
- The equipment (reagents, various equipment such as spectrometers, pipettes, glass, plastic and metal equipment and consumables) stands above the common standard for a high school chemical lab in the Czech Republic.

5. Other resources

Indicate what other resources the school has to support the implementation of the subject and what plans there are to improve them, if needed.

Laptops are available whenever needed; there are also 16 iPads for simulations in molecular biology and genetics.
The school's classrooms are all equipped with computers, multimedia projectors, touch boards, speakers, and high-speed Wi-Fi. There is a computer lab and a well-equipped library with several multimedia and VR stations accessible to students. The school has purchased teacher resource materials for every subject including textbooks, subject guides and teaching methodology material. There is also a virtual link to the library of Western Bohemia University in Pilsen which enables students and teachers to use a wide variety of resources, magazine articles, fiction and non-fiction literature, etc.
There are also printing and scanning stations available to students and teachers enabling them to work with and create various teaching and learning materials.
Overall, the amount and quality of available resources is sufficient to give effective support to the Biology course.

6. Links to TOK

You are expected to explore links between the topics of your subject and TOK. As an example of how you would do this, choose one topic from your course outline that would allow your students to make links with TOK. Describe how you would plan the lesson.

Topic	Link with TOK (including description of lesson plan)
5.1 Evidence for evolution	There are many life origin theories and its development on the Earth. All these theories include many blank spaces. This lack of evidence is often compensated by speculations rather than providing proofs, and very different opinions are accepted / defended across the world. The generally accepted points of views also vary according to specific culture or history. **How are these points of view verified?** At first, students will be working in four groups and will present each evolution theory to the others. Secondly, students will be asked for their opinion and will discuss the pros and cons of these theories. The main point of this discussion will be the question: **What makes someone choose, support and defend one of these theories even though none of them is unbreakable**?

7. Approaches to learning

Every IB course should contribute to the development of students' approaches to learning skills. As an example of how you would do this, choose one topic from your outline that would allow your students to specifically develop one or more of these skill categories (thinking, communication, social, self-management or research).

Topic	Contribution to the development of students' approaches to learning skills (including one or more skill category)
6.5 Neurons and synapses	Within this topic, various neural diseases will be discussed in a broad context. Firstly, every student will prepare a short presentation concerning a selected neural disease, including symptoms, the prevalence in the population, and treatment; it will be presented to other students (*communication*). Besides, a little tightly scheduled research will be done (*self-management*). A group of students will prepare an anonymous questionnaire for various small groups of people – families, friends, other students (*thinking*). The aim will be to determine the prevalence of these diseases and the level of knowledge and awareness among participants (*social*). The results of each group will be analysed, compared and discussed (*research*, *communication*).

8. International mindedness

Every IB course should contribute to the development of international-mindedness in students. As an example of how you would do this, choose one topic from your outline that would allow your students to analyse it from different cultural perspectives. Briefly explain the reason for your choice and what resources you will use to achieve this goal.

Topic	Contribution to the development of international mindedness (including resources you will use)
4.1 Species, Communities, and Ecosystems	**Humanity inflicted changes in ecosystems** - It is modern and trendy to point at developing countries because of the way they continuously change their landscape by deforestation, destroy the vegetation cover, or do their landscape management in other ways. There will be a comprehensive discussion concerning changes in the landscape connected to primary production, carbon dioxide pollution and global warming. Moreover, the socio-economic aspect of these landscape and ecosystem changes will be pointed out. Students revise European history to consider past medieval landscape changes and deforestation. Based on this historical excursion, they might find out parallels and change their mind. Moreover, they will describe other but present European ecosystems changes connected with renewable fuels, for instance. Used sources: online databases concerning landscape changes, changes in plants in agriculture across the world, online interactive maps (https://climate.nasa.gov/earth-now, for instance).

9. Development of the IB learner profile

Through the course it is also expected that students will develop the attributes of the IB learner profile. As an example of how you would do this, choose one topic from your course outline and explain how the contents and related skills would pursue the development of any attribute(s) of the IB learner profile that you will identify.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
4.1 Species, Communities, and Ecosystems	The discussion concerning ecosystem changes mentioned in the previous paragraph (see International mindedness development) also brings opportunities for the IB learner profile development. One group of students will defend some Indonesian countries' attitude to planting oil palms, spontaneously or artificially (they will be *communicators*). If they defend this attitude spontaneously, they are also *risk-takers*. Some students defending rare or unusual opinions could hesitate to share their opinions in front of the whole class; thus, we will initially have small discussion groups to allow such students to express their thoughts. Students often want to be winners in such discussions. They will be asked to communicate correctly, focusing on the others' understanding (*open-minded*). Moreover, the latest vegetation cover changes in Indonesia and central Europe will be compared; it is quite likely that their thoughts will be reflected in surprising results (*reflective*) and care about the local landscape (*caring)*.