Diploma Programme subject outline–Group 4: sciences			
School name	Gymnázium a SOŠ, Rokycany, Mládežníků 1115	**School code**	
Name of the DP subject *(indicate language)*	Science – Biology SL		
Level *(indicate with X)*	Higher [ ] Standard completed in two years [X] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Pavel Vlach, Vladimíra Moulisová	**Date of IB training**	
Date when outline was completed	1. 9. 2023	**Name of workshop** *(indicate name of subject and workshop category)*	

* 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)	**Contents**	**Allocated time** One class is 45 minutes; In one week 3 classes	**Assessment to be used**	**Resources** *List the main resources to be used, including information technology if applicable.*
Year 1	A Unity and Diversity	A1.1 Water A1.2 Nucleic acids A2.1 Origins of cells A2.2 Cell structure A2.3 Viruses [HL only] A3.1 Diversity of organisms A3.2 Classification and cladistics [HL only] A4.1 Evolution and speciation A4.2 Conservation of biodiversity	62 classes **46 hours** 14 classes in Lab **10,5 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**: Allott, A., & Mindorff, D. (2023). *Oxford Resources for IB DP Biology Course Book* (1st ed., 816 pages). Oxford University Press. **Online sources:** https://www.hoddereducation.co.uk/ib-extras https://www.bioknowledgy.i https://sites.google.com/view/ibbioson/home https://www.cambridge.org/go/resources Scientific articles in journals (free access to Elsevier and Springer databases) **Online or open source software tools and databases:** Protein
	B Form and function	B1.1 Carbohydrates and lipids B1.2 Proteins B2.1 Membranes and membrane transport B2.2 Organelles and compartmentalization B2.3 Cell specialization B3.1 Gas exchange B3.2 Transport B3.3 Muscle and motility [HL only] B4.1 Adaptation to environment B4.2 Ecological niches	76 classes **56 hours** 14 classes in Lab **10,5 hours**		

	C Interaction and interdependence	C1.1 Enzymes and metabolism C1.2 Cell respiration	18 classes **13.5 hours** 4 classes in Lab **3 hour**		databases, alignment tools (https://www.rcsb.org/, https://www.ebi.ac.uk/Tools/msa/clustalo/ etc.) **Other sources:** Computers, iPads, calculators, Labs (see below)
Year 2	C Interaction and interdependence	C2.1 Chemical signalling [HL only] C2.2 Neural signalling C3.1 Integration of body systems C3.2 Defence against disease C4.1 Populations and communities C4.2 Transfers of energy and matter	54 classes **40,5 hours** 13 classes in Lab **9,75 hours**		
	D Continuity and change	D1.1 DNA replication D1.2 Protein synthesis D1.3 Mutations and gene editing D2.1 Cell and nuclear division D2.2 Gene expression [HL only] D2.3 Water potential D3.1 Reproduction D3.2 Inheritance D3.3 Homeostasis D4.1 Natural selection D4.2 Stability and change D4.3 Climate change	82 classes **61,5 hours** 13 classes in Lab **9,755 hours**		

2. The Collaborative Science Project

As outlined by the IB, the Collaborative Science Project is a cross-disciplinary activity designed to promote collaboration among students studying different Group 4 science subjects. This project aligns with aim 10 of the IB DP sciences, which encourages students to develop an understanding of the interconnectedness of scientific disciplines and the overarching nature of the scientific method. The project provides students with an opportunity to explore scientific and technological issues through a collaborative and investigative approach.

At our institution, the Collaborative Science Project will involve students working in interdisciplinary groups combining at least two sciences, such as Biology and Chemistry, Biology and Physics, or Chemistry and Physics. For the current cycle, we have identified five key project themes for students to choose from:

1. Biochemistry of plant cells (Biology, Chemistry)
2. Mechanics of animal movement (Biology, Physics)
3. Properties of water (Chemistry, Physics)
4. Water pollution and its impacts (Biology, Chemistry)
5. Soil contamination and remediation (Biology, Chemistry)

Each group, consisting of 3–4 students, will select a topic and develop a detailed project plan in consultation with their teachers. The general project timeline is as follows:

- **Introduction and Teacher Presentation**: Students will be introduced to the project, including its purpose, structure, and expectations.
- **Subject/Topic Selection**: Groups will form and decide on their specific project topic.
- **Project Sessions**: Students will spend focused time working on their projects, including planning, conducting experiments, collecting data, and finalizing their results.

The overall time allocation for the project will include:

- **Planning Phase**: Approximately 2.5 hours for brainstorming, developing hypotheses, and designing experiments.
- **Execution Phase**: Approximately 5 hours for conducting experiments and collecting data.
- **Analysis and Presentation Phase**: Approximately 4 hours for analyzing results, preparing conclusions, and presenting findings.

The Collaborative Science Project will start with initial activities in the first year of the DP and continue into the second year, culminating in a presentation of results. Exact dates for each stage may vary slightly depending on scheduling and the needs of the cohort, allowing flexibility to accommodate student progress and collaboration.

Throughout the project, faculty members will act as mentors, providing guidance on experimental design, data analysis, and reporting, while encouraging independence and creativity in the students' work.

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): 36 classes (27 hours)

Name of the topic	Experiment	Any ICT used?
A1.2 Nucleic acids	DNA isolation from banana	No
A2.1 Origins of cells	Bacteria cultivation on different substrates (save strains)	No
A2.2 Cell structure	Basics in microscopy, cell observation (Calculation of magnification of drawings, actual size of structures from drawings or micrographs) LAB	No
A3.1 Diversity of organisms	Gram staining of bacteria, observation of bacterial cells (safe strains)	No
A3.1 Diversity of organisms	Cut and Paste Karyotyping	No
A3.1 Diversity of organisms	Creation of Dichotomous Key	No
A3.2 Classification and cladistics [HL only]	Working with NCBI - analyse of cytochrome	Yes
A4.2 Conservation of biodiversity	Working with EDGE of Existence programme	Yes
B1.1 Carbohydrates and lipids	Evidence of carbohydrates presence in different drinks	No
B1.1 Carbohydrates and lipids	Evidence of fat presence in different milk beverages LAB	No
B1.2 Proteins	Denaturation of proteins	No
B1.2 Proteins	Protein separation by electrophoresis LAB	No
B3.1 Gas exchange	Stomata density in different plant species	No
B3.2 Transport	Ruffier Fitness Test – Pulse Measurement	Yes
B3.3 Muscle and motility [HL only]	Poultry wing dissection	No
C1.1 Enzymes and metabolism	Catalase activity measurement	No
C1.2 Cell respiration	Using of respirometer - respirations rate	Yes
C1.3 Photosynthesis	Investigation of Factors Affecting Photosynthesis in Pondweed	No
C1.3 Photosynthesis	Separation of photosynthetic pigments	No
C2.2 Neural signalling	Two Point Discrimination Test	No
C3.1 Integration of body systems	Comparing vital signs concerning respiratory systems (respiratory rate, vital lung capacity)	Yes
C3.2 Defence against disease	Working with COVID-16 database - statistics	Yes
C4.1 Populations and communities	Methods in ecology - random quadrat sampling and capture-recapture sampling	No
C4.1 Populations and communities	Modelling predator - prey relationship	No

C4.2 Transfers of energy and matter	Attempting to create a sealed mesocosm	No
D1.2 Protein synthesis	Protein synthesis simulation - Lab X change	Yes
D1.3 Mutations and gene editing	Protein synthesis simulation - mutations - Lab X change	Yes
D2.1 Cell and nuclear division	Identifying phases of Mitosis in Onion Cells	No
D2.1 Cell and nuclear division	Identifying phases of Meiosis in locusts testicle	No
D2.2 Gene expression [HL only]	Working with gene databases (BLAST analysis)	Yes
D2.3 Water potential	Osmotic phenomena in onion cells (estimation of osmolarity in tissues)	No
D3.2 Inheritance	Modelling inheritance in different situations	Yes
D4.2 Stability and change	Water properties field & lab survey	

4. 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 should, as far as possible, be woven into normal classroom teaching and not be a separate activity conducted after a course has been taught. The internal assessment requirements at SL and at HL are the same.

Scheduling
Internal assessment is an integral part of the biology course, contributing 20% to the final assessment in the SL and the HL courses. This weighting should be reflected in the time that is allocated to teaching the knowledge, skills and understanding required to undertake the work, as well as the total time allocated to carry out the work.
It is recommended that a total of approximately 10 hours (SL and HL) of teaching time should be allocated to the work.
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.

More details are shown in the Internal Calendar for a particular school year.

Assessment criteria
During the process of evaluation, Research design (25%), Data analysisn (25%), Conclusion (25%), and Evaluation (25 %) will be evaluated.
For more detail see the Biology guide.

5. 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 used for Biology 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, ...)
Moreover, the school has got its 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 spectrometer, pipettes, glass, plastic and metal equipment and consumables) stands above the common standard for a high school chemical lab in the Czech Republic.

6. 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. Our 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.

7. 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 theories of life origin 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 a 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**?

8. 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	During this topic, various neural diseases will be discussed in 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, mates, 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*).

9. 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	Human changes in ecosystems - It is modern and trendy to point at developing countries how they continuously change their landscape by deforestation, change 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 and carbon dioxide pollution, and global warming. Moreover, the social-economical aspect of these landscape and ecosystems changes will be pointed out. Students should come back to European history to consider past landscape medieval 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 plant in agriculture across the world, online interactive maps (https://climate.nasa.gov/earth-now, for instance).

10. 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 IB learner profile development. One group of students will defend some Indonesian countries' attitude to planting oil palms, spontaneously or artifitially (they will be *communicators*). If they will be defending 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)*.