Diploma Programme subject outline–Group 4: sciences			
School name	**Gymnazium a SOS Rokycany**	**School code**	**061768**
Name of the DP subject *(indicate language)*	Chemistry		
Level *(indicate with X)*	Higher [x] Standard completed in two years [ ] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Daniel Kohout, Vladimira Moulisova, Kravec Petr	**Date of IB training**	March 3rd – April 7th 2021
Date when outline was completed	05/2021	**Name of workshop** *(indicate name of subject and workshop category)*	Chemistry (Cat1) online

* 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 organize 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 5 classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	**Topic 1: Stoichiometric relationships**	1.1 Introduction to the particulate nature of matter and chemical change	3 classes **2,25 hours**	Written and online unit tests (mock tests) with summative and formative assessment and peer-review Smaller test in e.g. Moodle, G-forms, Socrative, Plickers Rubric-based assessment of some practical lessons Assessment with some of IA criteria for some practical lessons Assessment of Group work participation, homework, activity during lessons Formative assessment oral and by using online tools Socrative, Plickers, Mentimeter Mock exam March Year 2	Chemistry Guide 2014 International Baccalaureate Organization CHEMISTRY 2014 – Course companion, B. Murphy et al., Oxford University Press IB Study Guide: Chemistry 2014 Edition, Oxford University Press Organic Chemistry, J. McMurry 2010, Brooks/Cole IB Chemistry Revision Notes High level, V. Keat, Independently published IB Chemistry Revision Notes Standard level, V. Keat, Independently published Chemistry for the IB Diploma STANDARD LEVEL, C. Brown, M. Ford, Pearson Education Limited
	Topic 11: Measurement and data processing	11.1 Uncertainties and errors in measurement and results 11.2 Graphical techniques	5 classes **4 hours**		
	B: Biochemistry	B.8 Nucleic acids B.9 Biological pigments B.10 Stereochemistry in biomolecules	9 lessons **10,5 hours** 3 classes in Lab **2 hours**		
	Topic 2(12): Atomic structure	2.1 The nuclear atom 2.2 Electron configuration 12.1 Electrons in atoms	12 classes **9 hours** 3 classes in Lab **2 hours**		
	Topic 3: Periodicity	3.1 Periodic table 3.2 Periodic trends	8 classes **6 hours**		
	Topic 13: The periodic table—the transition metals	13.1 First-row d-block elements 13.2 Coloured complexes	8 classes **6 hours** 5,3 classes in Lab **4 hours**		

	Topic 4(14): Chemical bonding and structure	4.1 Ionic bonding and structure 4.2 Covalent bonding 4.3 Covalent structures 4.4 Intermolecular forces 4.5 Metallic bonding 14.1 Covalent bonding and electron domain and molecular geometries 14.2 Hybridization	30 classes **22,5 hours**		Chemistry for the IB Diploma HIGHER LEVEL, C. Brown, M. Ford, Pearson Education Limited Chemistry An Introduction to General, Organic and Biological Chemistry, K. Timberlake, Pearson Education Limited Anorganická chemie, C.E.Housecroft, A.G. Sharpe, Vysoká škola chemicko-technologická Different educational online sources (For example: YouTube – e.g. TeDeD, My IB communities, PhET interactive simulations, khanacademy.org) Online or open source software tools and databases (protein databases such as https://www.rcsb.org/)
	Topic 1: Stoichiometric relationships	1.2 The mole concept 1.3 Reacting masses and volumes	16 classes **12,25 hours** 8 classes in Lab **6 hours**		
	Topic 5(15): Energetics/ thermochemistry	5.1 Measuring energy changes 5.2 Hess's Law 5.3 Bond enthalpies 15.1 Energy cycles 15.2 Entropy and spontaneity	27 classes **19,5 hours** 5,3 classes in Lab **4 hours**		
	Topic 6(16): Chemical kinetics	6.1 Collision theory and rates of reaction 16.1 Rate expression and reaction mechanism 16.2 Activation energy	20 classes **15 hours** 5,3 classes in Lab **4 hours**		
	Group 4 project		7 lessons **5 hours**		
	Internal assessment		9 lessons **6,75 hours**		
Year 2	**Internal assessment**	September, October	5 classes **3,75 hours**		
	Group 4 project	October	7 lessons **5 hours**		

	Topic 7: Equilibrium	7.1 Equilibrium 17.1 The equilibrium law	14 classes **10,5 hours** 3 classes in Lab **2 hours**		
	Topic 8: Acids and bases	8.1 Theories of acids and bases 8.2 Properties of acids and bases 8.3 The pH scale 8.4 Strong and weak acids and bases 8.5 Acid deposition 18.1 Lewis acids and bases 18.2 Calculations involving acids and bases 18.3 pH curves	25 classes **18,75 hours** 8 classes in Lab **6 hours**		
	Topic 9: Redox processes	9.1 Oxidation and reduction 9.2 Electrochemical cells 19.1 Electrochemical cells	21 classes **15,75 hours** 8 classes in Lab **6 hours**		
	Topic 10(20): Organic chemistry	10.1 Fundamentals of organic chemistry 10.2 Functional group chemistry 20.1 Types of organic reactions 20.2 Synthetic routes 20.3 Stereoisomerism	29 classes **21,75 hours** 3 classes in Lab **2 hours**		
	Topic 11(21): Measurement and data processing	11.3 Spectroscopic identification of organic compounds	8 classes **6 hours**		
	Topic 21: Measurement and analysis	21.1 Spectroscopic identification of organic compounds	4 lessons **3 hours**		

	B: Biochemistry	B.1 Introduction to biochemistry B.2 B.7 Proteins and enzymes B.3 Lipids B.4 Carbohydrates B.5 Vitamins B.6 Biochemistry and the environment	24 classes **18 hours** 3 classes in Lab **2 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 organize 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 be always 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

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
1.2 The mole concept	The determination of a chemical formula	No
1.3 Reacting masses and volumes	Permanganometry	Spreadsheet, Graph plotting – MS Office

1.3 Reacting masses and volumes	The molar volume of a Gas – determining the molar mass	No
2.1 The nuclear atom	Radioactive radiation and Rutherford scattering	Computer modelling and simulations- PhET
5.1 Measuring energy changes	Determining the enthalpy of a chemical reaction	Graph plotting
6.1 Collision theory and rates of reaction	Rate of chemical reactions, dependence of reaction rate on concentration of substances	Data logging, Spreadsheet, Graph plotting – MS Office
8.2 Properties of acids and bases	Acid-base titration	Data logging, spreadsheet, Graph plotting – MS Office
8.3 The pH scale	Measurement of pH - pH meter, universal indicator, natural indicator from red cabbage	Spreadsheet
9.2 Electrochemical cells	Water electrolysis	No
10.1 Fundamentals of organic chemistry	Constructions of 3D models a) real – Orbit molecular building system b) virtual – ChemSketch, online simulations c) Searching complex molecules	Computer modelling and simulations, Databases,
13.1 First-row d-block elements	Separation and qualitative analysis of cations	No
13.2 Coloured complexes	Determining the concentration of a solution: Beer's law	Graph plotting – MS Office
15.1 Energy cycles	Heat of fusion of Ice	Data logging, Graph plotting – MS Office
16.2 Activation energy	Rate determination and activation energy	No
17.1 The Equilibrium law	Determination of equilibrium constant	Spreadsheet, Graph plotting – MS Office
18.3 pH curves	Titration curves of Strong and Weak acids and bases	Data logging, Spreadsheet, Graph plotting – MS Office
19.1 Electrochemical cells	Electroplating	No

19.1 Electrochemical cells	Electrochemistry – voltaic cells	No
B.7 Proteins and enzymes	Modelling protein structure in 3D	Databases, Computer modelling
B.9 Biological pigments	Chromatography of plant pigments	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.

Scheduling and time allocation
Total time allocated is 14 lessons (**10,5 hours**).

- Teacher explains to students the requirements of the internal assessment (2 lessons in September Year 1)
- Students are scaffolded by the teacher during labs in PSOW and think about the best topic for them (October-February Year 1)
- Students discuss and decide their topics (1 lessons in February Year 1)
- Students read samples of IA, mark them and discuss them together. Students get feedback from the teacher (2 lessons March Year 1)
- Students work on their IA component, ask questions and consult it with the teacher (7 lessons April – June Year 1)
- Students hand out their draft (beginning of September Year 2)
- Teacher gives feedback to the drafts (2 lessons at the end of September Year 2)
- Students hand out the final version at the end of October Year 2.
- Time allocation to each stage may differ according to the students' needs.

Assessment criteria
During the process of evaluation, Personal engagement (8%), Exploration (25%), Analysis (25%), Evaluation (25%), and Communication (17 %) will be considered.
For more detail see the Chemistry 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.

The chemistry laboratory was renovated a few years ago, and it fulfils all the national safety standards. There are 8 lab benches and a fume cupboard. Every lab bench offers a gas burner, an electric socket and a small sink. There are 4 large sinks for washing the laboratory glassware. Standard laboratory equipment such as glassware is available at every bench. There is also a range of different sensors (pH, temperature, O2, etc.).

We have a broad range of different chemicals and reagents, most of which are stored in a separate locked room. Some chemicals are stored in the laboratory in locked cabinets. Flammable and corrosive chemicals are placed separately in cabinets designed for this purpose.

Personal protective equipment is always available for both students and staff (lab coats, goggles, gloves etc.), and is used whenever needed (using chemicals, working with strong acids and bases etc.). Students are familiarized with safety rules at the beginning of each year. The safety rules list is also placed on the laboratory doors.

Safety equipment includes a fire extinguisher, a fire blanket, an emergency shower, an eyewash station and a first aid kit. All of them are available in the laboratory.

In general, the lab is very well equipped for standard high school labs (range of chemicals, standard apparatuses, chemical utensils). Recently we have had a safety shower installed, and we have bought Vernier's lab sets that will be available for IB DP students. Our laboratory fulfils all IB safety standards and complies with EU legislation.

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.

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 Chemistry 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)
1.1 Stoichiometric relationships	The language of chemistry is universal for all chemists around the world. The symbols for elements, compounds are used all around the world, although most of the countries use different names for elements, compounds, etc. Group discussion: What are possible advantages and disadvantages of universal vs. national chemical language? Group work and presentations: The students will be divided into groups representing scientists, teachers, students and non-professional users of the chemical language. In these groups they will discuss concrete benefits/drawbacks of using universal or/and national language from the point of view of the respective interest groups, supporting their chosen position with legitimate evidence, logical reasoning and examples. At the end of the class the groups will give presentations of their conclusions.

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)
8.3 pH scale	A practical lesson - Measurement of pH can serve as an example. Students will develop their *communication*, *social* and *self-management* skills because they will work in pairs during this lesson. They will need to discuss everything with their partner, plan the work, divide it and finish it in the time given. Students will use three different methods to measure pH of different solutions. After finishing their practical work, students will develop their *critical thinking* by evaluating the accuracy of each method and considering reasons for differences among them. In the end, students should decide which method (equipment) would be suitable for home use considering its accuracy, price and simplicity of the use (*research skills*). They will need to search for some necessary facts. Students can discuss ideas with other pairs and reflect on them (peer review) (*social skills*).

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)
10 Organic chemistry	CFCs (chlorofluorocarbons) damaging the ozone layer have been a major ecological topic for many years. Students divided into groups of 3-6 explore and think about measures taken to reduce use of CFCs in different parts of the world: • why are they still used in some countries and what other chemicals substitute or might substitute them in the future? • what are the advantages and disadvantages of these substitutes? • how is the use of CFCs influenced by the country's economic situation? • which countries are the most heavily influenced by the CFCs? Groups work separately using the Internet, present and discuss their ideas with others.

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
8.3 pH scale	A practical lesson - Measurement of pH can be again a good example, this time for developing the IB learner profile attributes. According to the description in point 7 - Approaches to learning, this activity develops these attributes: **Communicators, open-minded** – collaborative work with the partner, dealing with his/her ideas and needs, sharing ideas among other groups **Principled** – dividing, planning and finishing the activity in time **Knowledgeable** – raising knowledge about different methods of pH measurements **Thinkers** – critically thinking about the accuracy of the methods used and reasons for it, thinking about ideas and opinions of other pairs **Reflective, thinkers** – considering different aspects for home use based on gained experience