Diploma Programme subject outline—Sciences

School name	Gymnázium Šrobárova 1, Košice, Slovakia	**School code**	061626
Name of the DP subject *(indicate language)*	Chemistry, EN		
Level *(indicate with X)*	Higher [X] Standard completed in two years [X] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Lucia Hucková	**Date of IB training**	2.8.2023- 29.8.2023
Date when outline was completed	27.8.2023	**Name of workshop** *(indicate name of subject and workshop category)*	Chemistry (Cat.1) (Group 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 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 4 SL 2 HL classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	*Safety at work*	*Safety rules in chemistry labs, basic laboratory aids and working with them*	*45 min = 1 class*	- Students will test themselves on questions from the coursebook on each subtopic. - After each topic, exam style questionnaire. - Lab reports after each lab.	IB Diploma books Slovak chemistry books Online tools: https://www.grandstudio.sk/kvalitan/sk/ https://phet.colorado.edu/sk/ https://tuul.sk https://learn.concord.org https://teachchemistry.org/classroom-resources/simulations Models: http://www.molymod.com/index.html
	STRUCTURE 1 Models of the particulate nature of matter	S1.1- Introduction to the particulate of matter S1.4- Counting particles by mass : The mole R2.1.2 - The mole ratio of an equation S1.2 – The nuclear atom S1.2.3- Mass spectra (HL) S1.3- Electron configuration S1.3.6 – Emission spectrum (HL) S1.5- Ideal gases	SL 25 classes HL 31 classes		

	STRUCTURE 3 Classification of matter	S3.1- The periodic table Periodic trends S1.3.7- Successive ionisation energy (HL) S3.1.7- Discontinuities in trends (HL) S3.1.8- Transition elements (HL)	SL 8 classes HL 13 classes		Lab experiment using Vernier sensors (pH, acid, base) https://www.vernier.com/chemistry/
	STRUCTURE 2 Models of bonding and structure	S2.1- The ionic model S2.2- The covalent model S2.2.1- Resonance structures (HL) S2.2.3- Octet of electrons (HL) S2.2.5- Sigma and Pi bonds (HL) S2.1.6- Hybridization (HL) S2.3 - The metallic model S2.3.1 - Delocalized d-electrons of transition elements (HL)	SL 20 classes HL 33 classes		
	STRUCTURE 3 Classification of matter	S3.1-The periodic table: The classification of elements S2.4-From model to materials S2.4.5-Polymeres, macromolecules (HL)	SL 8 classes HL 10 classes		
	REACTIVITY 1 What drives chemical reactions? Thermochemistry	R1.1- Measuring enthalpy changes R1.2- Energy cycles in reactions R1.2.4- Hess's law (HL) R1.2.5- Born-Haber cycle (HL) R1.4- Entropy and spontaneity (HL)	SL 11 classes HL 18 classes		
	REACTIVITY 2 How much, how fast and how far? Chemical kinetics	R2.1—How much? The amount of chemical change R2.2—How fast? The rate of chemical change R2.3- How far? The extent of chemical change	SL 25 classes HL 38 classes		

Year 2	STRUCTURE 3 Classification of matter Organic chemistry	S3.2-Functional groups: Classification of organic compounds S3.2.7- Stereoisomers (HL) S3.2.8 -Mass spectrometry (HL) S3.2.9-IR (HL) S3.2.10 H NMR (HL) S3.2.11 Structural analysis (HL)	SL 12 classes HL 27 classes		
	REACTIVITY 3 What are the mechanisms of chemical change?	R3.1- Proton transfer reactions R3.1.9-The pOH scale (HL) R3.1.10- Weak acids and bases (HL) R3.2- Electron transfer reactions	SL 24 classes HL 43 classes		
	REACTIVITY 1 What drives chemical reactions?	R1.3 Energy from fuels	SL 5 classes HL 5 classes		
	REACTIVITY 3 What are the mechanisms of chemical change	R3.3- Electron sharing reactions R3.4- Electron-pair sharing reactions	SL 8 classes HL 17 classes		

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.

Context

- The global food industry faces a significant challenge in reducing plastic usage due to its harmful environmental impact. This project aims to investigate the feasibility of using plant-based and artificial starch as substitutes for plastic in various food packaging applications.
- The audience for this project will be food manufacturers and consumers who are interested/concerned in learning about the use of artificial starch in creating plastic, biodegradable materials.

Description

Planning

The project will involve research, experimentation, and analysis over a span of several weeks.
Two weeks before:

- Introducing the CSP ("on timetable") and assigning students into groups of 3-4.
- Presenting the guiding question "Will potatoes save the oceans?"

Next two days: action and reflection stage ("off timetable")

Action

Day 1-2: Research Phase • Conduct a comprehensive literature review on the environmental impact of plastic in the food industry and health risks. • Conduct literature on the biodegradability of plastic and starch substitute. • Explore the properties of plant-based and artificial starch as a potential substitutes. • Identify current food packaging applications that heavily rely on plastic. • Produce a report with all their findings.	Day 3-5: Experimental Phase • Follow experiment *Making plastic from potato starch*: https://edu.rsc.org/experiments/making-plastic-from-potato-starch/1741.article • Test mechanical, barrier and thermal properties of these starch materials and compare them with mechanical, barrier and thermal properties of plastic. • Assess compatibility of plastic created from starch with various types of products. • Write a report about the experiment

Reflection

- Staff mentors meet with their respective teams and provide constructive feedback.
- Students reflect on their CSP experience focusing on:
  - challenges and successes in collaboration
  - challenges and successes in communication
- Students write research-based reports about data analysis collected during the experimentation phase and reflect on the viability of using plant-based and artificial starch in the food industry. Consider factors such as sustainability, cost-effectiveness, practicality and health benefits.
- To link to CAS students could be asked to propose a “manifesto” (video, intervention, magazine etc.) calling attention to the problem and showing a viable solution to population, to population, politicians, food industry etc.

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.

- Physics, chemistry and biology: 40 hours (at standard level) or 60 hours (at higher level)
- Computer science: 40 hours (at standard level) or 40 hours (at higher level)
- Design technology: 60 hours (at standard level) or 96 hours (at higher level)
- Sport, exercise and health science: 40 hours (at standard level) or 60 hours (at higher level)

Use the table below to indicate the name of the experiment you would propose for the different topics in the syllabus.

An example is given. Add as many rows as necessary.

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Acids and bases	Titration	Yes
Introductory lab: Lab safety, basic chemical terminology, weight measuring, measuring of liquids	Qualitative/Quantitative experiments	Data recording (data logging)
Separation methods	Using filtration (coffee filters), sedimentation, chromatography etc.	Data logging
Basic chemical laws and properties of substances	The law of conservation of mass and energy in chemical reactions. Dissolution – Solubility of substances in polar and non-polar solvents.	Data logging, spreadsheets
The influence of factors on the rate of a chemical reaction	Effect of temperature on the rate of chemical reactions - Reaction of nitric acid with copper. Reaction of potassium permanganate with oxalic acid. Decomposition of hydrogen peroxide depending on temperature. The influence of the concentration of reactants on	Data logging, spreadsheets

	the rate of chemical reactions - Oxidation of potassium iodide with hydrogen peroxide. The effect of the size of the surface of the solid reactant on the rate of chemical reactions - Reaction of calcium carbonate with hydrochloric acid. Reaction of aluminium with oxygen. The effect of catalysts on the rate of chemical reactions - The effect of an inhibitor (urea) on the rate of reaction of hydrochloric acid with zinc	
Endothermic and exothermic reactions	Computer-supported experiment on Exothermic and endothermic reactions (reaction of citric acid and baking soda, reaction of hydrochloric acid with magnesium) (temperature sensor). Computer-supported experiments on the topic Factors influencing the rate of chemical reactions: Effect of temperature on the rate of decomposition of hydrogen peroxide (temperature sensor), Effect of catalysts on the rate of decomposition of hydrogen peroxide (gas pressure sensor).	Computer data logging, graph plotting software (Vernier supported), Vernier sensors
Acids and bases	Red cabbage extract as an indicator. Titration of hydrochloric acid with NaOH solution, Determination of acetic acid in food vinegar (pH sensor).	Computer data logging, graph plotting software (Vernier supported), Vernier sensors
Periodic table	Experiments of some substances from periodic table: Preparation of oxygen by catalytic decomposition of hydrogen peroxide and its	Spreadsheets

	proof. Preparation of hydrogen by reaction of metal and water and its proof. Preparation of modifications of sulphur, etc.	
Redox processes	Electrolysis of $CuCl_2$, NaCl, galvanic cell (Daniell cell)	Electrolysis kit, data logging
Organic chemistry	Proof reactions of carbon, preparation of alkanes, alkenes and alkynes, aromatic hydrocarbons and their derivatives	Data logging, spreadsheets

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.

Teachers are fully qualified to follow all safety procedures when undertaking practical work and safety rules are prominently displayed on laboratory walls. Students are required to wear protective clothing which includes protective gloves, splash resistant spectacles or protective shields. Appropriate fire extinguisher is accessible in the laboratory as well as fire blankets, first aid kit and emergency shower and eyewash station too. We do not use bottled gas supply; we use main gas and an independent switch for gas that shuts off all supplies is available at the teacher´s desk and an independent switch for electricity that shuts off all supplies is available at the corridor right next to the lab in the fuse box. We have a separate room for our laboratory supplies. All chemicals and other dangerous equipment are stored in a lockable, ventilated room where students are not allowed without teacher´s presence. All chemical containers are labelled with the name of the chemical and with the hazard warning. The school (chemistry department) maintain an inventory of all the laboratory chemicals. In this extra room glass materials, devices to be used in experiments, and safety materials are available too. We have bought a fume hood in the laboratory. This massive change of equipment of the laboratory must be approved by The Monuments Board of The Slovak Republic because of the specific character of our school building. All chemicals are properly disposed of according to local legal requirements and consideration for the environment.

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.

Library with chemistry books

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)
Chemical bonding	Students can explore how scientists arrive at conclusions about the invisible world of atoms and bonds, the role of evidence, and the limits of our understanding. This unit can lead to discussions about how different cultures might have historically perceived and explained chemical interactions, emphasising the role of perspective in shaping scientific knowledge.

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)
Molecular structures	Thinking Skills: Analysing how molecular shapes influence properties and behaviours, connecting structure to function using models.

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)
Chemical bonding	Studying chemical bonding and structure can foster international mindedness by highlighting the universal principles that govern how elements interact and combine, regardless of geographical or cultural boundaries. The understanding that the same chemical rules apply everywhere encourages students to see the world as interconnected and governed by shared scientific principles.

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
Periodicity	Studying chemical properties of inorganic substances and their properties is interesting and develops students' natural curiosity. They will develop the skill of observation while trying to prove created substances. By doing experiments, looking closely at things, and finding patterns, students get better at making smart decisions and developing critical skills. The students become not only knowledgeable but principled and caring. Collaborating with others they learn to communicate and manage their teamwork.