Diploma Programme subject outline—Group 4: sciences			
School name	Spojená škola Pankúchova 6, Bratislava	**School code**	061749
Name of the DP subject *(indicate language)*	Chemistry		
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	Nechvátalová Ľubica	**Date of IB training**	6/10/2021 - 3/11/2021
Date when outline was completed	April 14, 2022	**Name of workshop** *(indicate name of subject and workshop category)*	Chemistry (Cat.1) (Group 2)

* 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 3 SL / 5 HL classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	UNIT 1 Stoichiometric relationship	1.1 Introduction to particulate nature of matter	13,5 hours = 18 classes	• Test yourself questions of coursebook on each subtopic to be completed • Exam style question of coursebook, and past exam questions on each topic to be completed. • Homework to be monitored via Toddle (Edupage). • All lab work (lab reports) to be assessed according to IA criteria. • As a formative assessment instrument, At the end of each topic, end-of topic quizzes are given • As a summative assessment instrument, each semester students write two mock exams including past IB exam questions • IB exams:	• IBDP Physics course books and revision books published by different publishers, students have one and others are available in school library • • Recomended Textbook: • Ch. Tlbot, R.Harwood, Ch. Coates: **CHEMISTRY (2ndEd)** Hodder education • • Sergey Bulikin: • **CHEMISTRY FOR IB DIPLOMA COURSE PREPARATION**, Oxford University Press Jacqueline PARIS: **Chemistry for the IB Diploma Workbook with CD-ROM**, Cambridge University Press, 2017 • IB DP Online question bank is used for producing quizzes, mock exams and homework. • Simulations (Phet, etc),Data logging, databases, and spreadsheets are in use in class
		1.2 The mole concept			
		1.3 Reacting masses and volume			
		1.4 Gases			
	UNIT 2 Atomic Structure	2.1 The nuclear atom	6 hours = 8 classes		
		2.2 Electron congfiguration			
	UNIT 12 Atomic structure	12.1 Electrons in atoms	1,5 hours = 2 classes		
	UNIT 3 Periodicity	3.1. Periodic table	6 hours = 8 classes		
		3.2 Periodic trends			
	UNIT 13 Periodicity	13.1 First row d-block elements	4,5 hours = 6 classes		
		13.2 Coloured complexes			
	Unit 4 Chemical bonding and structure	4.1 Ionic bonding and structure	12,5 hours = 17 classes		
		4.2 Covalent bonding			
		4.3 Covalent structure			

		4.4 Intermolecular forces		External assessment (80%) o Paper 1 – (20% SL – 20% HL) o Paper 2 – (40%SL – 36% HL) o Paper 3 – (20% SL – 24% HL) Internal assessment (20%) Group 4 – project – Planning stage, Action stage, Evaluating stage ccording to IA criteria.	● Vernier software and hardware are used for experimental work (such as Graphical Analysis Software, pH Sensor, temperature probe, Voltage probe, Spectrometry). Tutorial videos: MSJChem - Tutorial videos for IB Chemistry - Home
		4.5 Metalic bonding			
	Unit 14 Chemical bonding and structure	14.1 Furhter aspects of covalent bonding and structure	7,5 hours = 10 classes		
		14.2 Hybridization			
	UNIT 5 Energetics, Termochemistry	5.1 Measuring energy changes	9 hours = 18 classes		
		5.2 Hess´s Law			
		5.3 Bond enthalpies			
	UNIT 15 Energetics, Termochemistry	15.1 Energy cycle	7 hours = 9 classes		
		15.2 Entropy and spontaneity			
	UNIT 6 Chemical kinetics	6.1 Collision theory and rates of reaction	6 hours = 8 classes		
	Unit 16 Chemical kinetics	16.1 Rate expression and reactrion mechanism	6 hours = 8 classes		
		16.2 Activation energy			
	Unit 7 Equilibrium	7.1 Equilibrium	4,5 hours = 6 classes		
	Unit 17 Equilibrium	17.1 The equilibrium law	4,5 hours = 6 classes		
Year 2	Unit 8 Acids and bases	8.1 Theories of acids and bases	7,5 hours = 10 classes		IBDP Chemistry course books and revision books published by different publishers, students have one and others are available in school library Recomended Textbook:
		8.2 Properties of acids and bases			
		8.3 The pH scale			

		8.4 Strong and weak acids and bases			Ch. Tlbot, R.Harwood, Ch. Coates: **CHEMISTRY (2ndEd)** Hodder education Sergey Bulikin: **CHEMISTRY FOR IB DIPLOMA COURSE PREPARATION**, Oxford University Press Jacqueline PARIS: **Chemistry for the IB Diploma Workbook with CD-ROM**, Cambridge University Press, 2017 ● IB DP Online question bank is used for producing quizzes, mock exams and homework. ● Simulations (Phet, etc),Data logging, databases, and spreadsheets are in use in class ● Vernier software and hardware are used for experimental work (such as Graphical Analysis Software, pH Sensor, temperature probe, Voltage probe, Spectrometry). Tutorial videos: MSJChem - Tutorial videos for IB Chemistry - Home
		8.5 Acid deposition			
	Unit 18 Acids and bases	18.1 Lewis acids and bases	10,5 hours = 14 classes		
		18.2 Calculations involving acids and bases			
		18.3 pH curves			
	Unit 9 Redox processes	9.1 Oxidation and reduction	9 hours = 12 classes		
		9.2 Electrochemical cells			
	UNIT 19 Redox processes	19.1 Electrochemical cells	6 hours = 8 classes		
	Unit 10 Organic chemistry	10.1 Fundamentals of organic chemistry	10,5 hours = 14 classes		
		10.2 Functional group chemistry			
	Unit 20 Organic chemistry	20.1 Types of organic reactions	12 hours = 16 classes		
		20.2 Synthetic routes			
		20.3 Stereoisomerism			
	Unit 11 Measurement and data processing	11.1 Uncertainty and errors in measurement and results	10,5 hours = 14 classes		
		11.2 Graphical techniques			

		11.3 Spectroscopic identification of organic compound			
	UNIT 21 Measurement and data processing	21.1 Spectroscopic identification of organic compounds	1,5 hours = 2 classes		
	Option D Unit 25 Medical chemistry	25.1 Pharmaceutical products and drug action	15 hours = 20 classes		Recommended textbook: Patrick, G. L., & Spencer, J. **An introduction to medicinal chemistry.** Oxford: Oxford University Press (6th ed.), 2009
		25.2 Aspirin			
		25.3 Opiates			
		25.4 pH regulation of the stomach			
		25.5 Anti-viral medications			
		25.6 Enviromental impact of some medications			
		25.7 Taxol – a chiral auxiliary case study	9 hours = 12 classes		
		25.8 Nuclear medicine			
		25.9 Drug detection and analysis			

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.

The Group 4 Project will include students studying Biology and Chemistry.

Timing: The group work is an assignment to be done throughout the end of the first year DP study – May, June, and terminating at the beginning of the second year DP study – September, October.
Timeline: (10 hrs)
(2 hrs): Planning stage – After selecting a focused topic, the activities to be carried out must be clearly defined before moving to action phase
(6 hrs): Action stage – investigation of topic
(2 hrs): Evaluation Stage – Powerpoints, videos, scale models etc. will be presented in class

Topics:
Investigation idea: students will do an experiment where they determine whether seeding clouds with silver iodide increases rainfall.
They will process the gathered data of the amount of rain generated in acre-feet by 52 in-planted clouds (an assignment with the table of data)

Action
Several practical sessions organised during this week.

The group 4 project addresses aim 7 & 8.
For aim 7: Students can explore the mechanism of cloud seeding and make a presentation for other to explain the process.
For aim 8: Students will consider any global problem arisen from using such method and what technologies are needed and consider in a written
http://www.stat.ualberta.ca/statslabs/casestudies/files/cloud14.pdf
Aim 8: “become critically aware, as global citizens, of the ethical implications of using science and technology.”

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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.

- All lab work to be assessed according to IA criteria : Personal engagement, Exploration, Analysis, Evaluation and Communication

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Acids and bases	Titration	Yes
Introductory lab: Basic skills like measurement of volumes of liquids, weight measurement etc., Basic Chemical Terminology and the Scientific Method, Lab Safety, and Data Processing (SL/AHL)	Qualitative and Quantitative Observations	1.Data logging 2.Graph plotting software 3.Spread sheet 4.Database 5. Computer model or simulation
Topic 1: Stoichiometric relationships 1.2 The mole concept	The obtaining and use of experimental data for deriving empirical formulas from reactions involving mass changes: -Determining the formula of magnesium oxide	1. Data logging 2. Graph plotting software
Topic 1: Stoichiometric relationships 1.3 Reacting masses and volumes	Obtaining and the use of experimental values to calculate the molar gas of a gas from the ideal gas equation.	1. Data logging

Topic 1: Stoichiometric relationships 1.3 Reacting masses and volumes	Use of the experimental method of titration to calculate the concentration of a solution by reference to a standard solution: -Percentage of $CaCO_3$ in eggshells -Determination of Vitamin C content in a fruit	1. Data logging 2. Graph plotting software
Topic 5: Energetics/thermochemistry 5.1 Measuring energy changes	A calorimetric experiment for an enthalpy of reaction should be covered and the results evaluated.	1. Data logging 2. Plotting software
Topic 6: Chemical kinetics 6.1 Collision theory and rates of reaction	Investigation of rates of reaction experimentally and evaluation of results: -The decomposition of hydrogen peroxide	2. Plotting software
Topic 16: Chemical kinetics (HL) 16.2 Activation energy (HL)	-Determining Ea for a reaction -Acid-catalyzed iodination of propanone	1. Data logging 2. Plotting software 3. Spread sheet
Topic 8: Acids and bases 8.2 Properties of acids and bases	Experiments of acid-base titrations with different indicators. -use of litmus paper, phenolphthalein, methyl orange,	1. Data logging 3. Spread sheet
Topic 8: Acids and bases 8.3 The pH scale	The use of a pH meter and universal indicator: -A traditional acid-base titration with a pH meter and universal indicator.	1. Data logging 3. Spread sheet
Topic 18: Acids and bases (HL) 18.2 Calculations involving acids and bases (HL)	-Analysis of aspirin tablet	1. Data logging 2. Graph plotting software
Topic 9: Redox processes & **Topic 19: Redox processes (HL)** 9.2 Electrochemical cells 19.1 Electrochemical cells (HL)	Performance of laboratory experiments involving a typical voltaic cell using two metal/metal-ion half-cells: -Using voltaic cells	1. Data logging 2. Graph plotting software
Topic 10: Organic chemistry	Construction of 3D models (real or virtual) of organic molecules.	5. Computer model/simulation
Topic 15: Energetics/thermochemistry 15.1 Energy cycles (HL) **OR** **Topic 19: Redox processes** 19.1 Electrochemical cells (HL)	Perform lab experiments, which could include single replacement reactions in aqueous solutions: -Enthalpy changes (15.1) -Voltaic cells (19.1)	4. Database

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.

Laboratory gives IB DP school students everything they need in order to grow during the years of study. Laboratory facilities are sufficient for experiments identified. Laboratory includes benches established with sinks and necessary equipment. Experiment equipment and materials are sufficient. Our laboratory meet fully to the IB standards as set out in “Science Laboratories-recommended minimum standards.” The lab is equipped with fume hood, electronic balance, eye protection, eye wash station, fire extinguisher and fire alarm and breaker, water bath. The lab is equipped with projection equipment and a smart board to accommodate a variety of presentations. Safety equipment is provided for individual student use. Vernier software and hardware are used for experimental work (such as Graphical Analysis Software, pH Sensor, temperature probe, Voltage probe, Spectrometry).

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.

There are a variety of Chemistry resources available for student use, both in the library and in the Science department, which include online resources such as Turnitin, IB online question bank. The School Library and the Science Department has a varied and very well-stocked range of DP CHemistry and other textbooks, DVDs which include television documentaries on current scientific issues and topic specific educational programs. The school plans to buy subscriptions to a variety of science journals including New Scientist.
Students are encouraged to use a range of course books in the library but an IB Diploma specific course book is purchased – one per student at the start of the course: Chemistry for the IB Diploma by Hodder Education. The School library and the Science Department has a range of additional Chemistry resources suitable for students at this level, and is in the process of reassessing these and extending the collection. These can act as extension material, university preparation and research material suitable for students to prepare their Extended Essays, and IA's. The Science department has a list of websites which will be used to support learning. MSJChem - Tutorial videos for IB Chemistry - Home

IB-Specific Resources:
- C. Brown & M. Ford, Chemistry – developed specifically for the IB Diploma (2009). Pearson Education Limited
- T. Lister & J. Renshaw, Understanding Chemistry for AL (1999). Nelson Thornes
- R. Petrucci & W. Harwood, General Chemistry. Pearson Education
- M. Clugston & R. Flemming, Advanced Chemistry, Oxford University Press
- J. Murray, Fundamentals of Organic Chemistry (1998), Brooks/Cole Publishing Company
- ICT research
- IB Question Bank

Additional Teacher Resources:
www.chemcollective.org
www.oxfordsecondary.co.uk

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)
UNIT 1 STOCHIOMETRIC RELATIONSHIP 1.1 Introduction to the particulate nature of matter abd chemical change	Priestley´s and Lavoisier´s discovery of oxygen overturned the phlogiston theory of combustions and it is example of a **paradigm shift.** **Topic of lesson:** Burning and rusting as a the most common chemical change that occurs History of the various discoveries or theories are leading the humankind to the knowledge. The Flogiston theory proposed by j.Becher and G.Stahl in 17th century was theory of combustion and rusting and main hypothesis was that all materials can burn if they contain substabce known as «phlogiston». The theory has considerable influence upon the progress of chemistry. Although the theory made qualitative sense and helped explain burning and rusting, it suffered from a quantitative defect. The theory was disproved by the work of French chemist Lavoisier and English chemist Priestley. **TOK question:** How does scientic knowledge progress? The students will explore the hostory behind the theory and analyse the work of Lavoisier and Priestley to understand the way of proving the theories wrong.

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)
UNIT 2 ATOMIC STRUCTURE 2.2 Electron configuration	**The lesson topic:** <u>Recognizing the shapes of orbitals</u> Students find infotmation about different shapes of orbitals , sketch the shape of each one and determine the position around the atom´s nucleus. They work in groups and afterwards they make a presentation of their research in the poster. **ATL skills :** - Information literacy skills - Critical thinking skills - Collaboration 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)
Topic 7: Equilibrium (SL)	Students will learn about the Haber process and the production of ammonia. Students will research uses of ammonia and consider global implications for the production of fertiliser and ammunition powder, with a particular focus on implications during World War II. Students discuss why the Nobel Prize was awarded for this discovery, and consider the ethics of this decision from different global perspectives. Students will research Nobel Prize winners in recent years to examine the types of chemistry that have been awarded a prize and the international collaboration that has allowed for the discovery awarded. Through this process, they will consider the value of different perspectives in the discovery of new scientific ideas.

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
Topic 20: Organic Chemistry: reactions of alkanes, alkenes, alcohols, halo alkanes, esters, soaps; reaction pathways.	Studying chemical properties of organic substance is interesting and develops students' natural curiosity and skills of observation. Doing experiments, analysing and generalising, students exercise critical skills and are taught to make reasoned decisions. The students become not only **knowledgeable** but **principled** and **caring**. Collaborating with others they learn to predict the processes.