# Appendix 5
# IB Diploma Programme course outlines

Teachers responsible for each proposed subject must prepare a course outline following the guidelines below. While IB subject guides will be used for this exercise, teachers are expected to adapt the information in these guides to their own school's context. Please be sure to use IBO nomenclature throughout. The name of the teacher(s) who wrote the course outline must be recorded at the top of the outline.

**Name of the teacher who prepared the outline:**

Julie Karjala

**Name of the course:**

For example, English A1, HL.

Chemistry SL

**Course description:**

In two to three paragraphs, describe the course in terms of focus, purpose, aims and objectives, the inclusion of internationalism, the proposed process, and expected assessment. This should be a summary.

In IB Chemistry SL, students will build a foundation of chemical science knowledge and practice its application and be guided through student oriented inquiries. Students will demonstrate, apply, construct and analyze scientific methods, techniques and concepts while reflecting on the social, moral and economic effects of scientific discoveries across the world. Through this learning process, students will be guided through their individual learning routes to develop their knowledge and curiosities in chemistry.

IB Chemistry SL students will be able to apply the mathematical foundations of science and understand how chemistry plays a role in biology, the physical environment, and its important role in history and social existence.

Through inquiry, problem solving and experimentation, students will be provided opportunities to study science and technology and realize the possible risks in the purposeful or serendipitous findings of past and future scientists. During this process, students will demonstrate laboratory skills in order to investigate student driven scientific inquiries.

**Topics:**

In narrative or outline form, list what you will cover in your course to meet the IB syllabus requirements. In addition, if IB courses are going to be combined with Advanced Placement or other curriculums, outlines should address additional non-IB topics to be covered.

**SL Chemistry Topics – Year 1**

I. **Scientific Measurement and Methods (September 7- September 11)**
   a. Safety in the Lab
      Scientific Method
         i. Formulating a hypothesis
         ii. Designing an experiment to test a hypothesis
         iii. Controls and variable
         iv. Collection and recording of data
         v. Evaluation of results
   b. Accuracy, Precision and Significant Figures (2 hours and practiced throughout the year)

**Labs and Assessments**

- Students will design, perform and write up an experiment analyzing the accuracy of their glassware
- Propose a theory for why ice melts more slowly in salt water than distilled water. Design, perform and write up an experiment to test their theory.

II. **Quantitative Chemistry (September 14 – October 2)**
   a. Moles, Molarity and Empirical Formula
   b. Review the Atomic Theory
   c. Mole Concept and Avogadro's constant
   d. Empirical and Molecular formula determination
   e. Solutions, concentration and molarity

**Labs and Assessments**

- Answer questions that distinguish the different isotopes of an element and the relationships between the subatomic particles
- Answer questions related to subatomic particles, atoms, molecules, moles and masses
- In a lab, determine the empirical formula for MgO
- In a lab, determine the empirical formula for the oxide in Potassium Nitrate
- Write an IB format test which involves both multiple choice and short answer critical thinking questions

III. **Atomic Theory and Chemical Bonding (October 5 –October 23 )**
   a. Electron arrangement in atoms
   b. Classes of compounds and their properties
   c. Ionic bond
      i. Prediction of charge
      ii. Prediction of formula
      iii. Nomenclature
   d. Covalent Bond
      i. Electron dot diagrams
      ii. Electronegativity and polar bonds
   e. Ionic bonds involving polyatomic ions
      i. Prediction of charge
      ii. Prediction of formula
      iii. Nomenclature

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**Labs and Assessments**

- In a lab, use spectroscopes to observe and compare the light spectrum of various elements such as hydrogen and neon gas. Interpret this observation as evidence for electron energy levels in the atom.
- In a lab activity, students will compare the melting points, solubility and conductivity of ionic and covalent compounds.
- Write an IB format test which involves multiple choice and short answers on covalent compounds, ionic compounds, ionization energies and electron arrangement.

**IV. Types of Chemical Reactions (October 23-November 11)**

a. Chemical equations to represent reactions
   i. Balancing chemical equations
   ii. Law of conservation of mass
b. Acid/Base reactions
   i. Properties of acids and bases
   ii. Acid + base reaction
   iii. Acid + carbonate reaction
c. Oxidation/reduction reactions
   i. Spontaneous and non spontaneous redox reactions
   ii. Net ionic equations
   iii. Assigning oxidation numbers
d. Precipitation reactions
   i. Net ionic equations
   ii. Solubility rules

**Labs and Assessments**

- Design and conduct an experiment to determine the order of an electrochemical series
- Design and conduct an experiment to determine the factors that affect the corrosion of iron
- Perform test with precipitation reactions to determine the identity of four unknown solutions
- Write an IB format test which involves multiple choice and short answers on but not limited to reactivity, reaction types, and solubility.

**V. Stoichiometry- Mole and Chemical Equations (November 11-November 30)**

a. Mass/mole relationships in chemical reactions
b. Limiting reagent and reagent in excess
c. Experimental vs. theoretical yields
d. Titration

**Labs and Assessments**

- Design and conduct an experiment to produce saltpeter, $KNO_3$, from stoichiometric amounts o K2CO3 and $Ca(NO_3)_2$ and determine theoretical and percent yields.
- Titration of HCl and NaOH to monitor the stoichiometry
- Use redox titration with $KMnO_4$ to determine the amount of iron (II) sulfate in an iron supplement tablet
  - Students will need to standardize the potassium permanganate with oxalic acid as a primary standard and conduct an error analysis with their experimental data and the company's advertised value.
- Write an IB format test which involves short answers on mathematical analysis.

**VI. Physical and Chemical Periodicity (December 1-December 11)**

a. Periodicity of physical and atomic properties
b. Chemical nature of elements in the same group
c. Metallic to non metallic switch within a period

**Labs and Assessments**

- Design and implement a lab to view the characteristic reactions between Silver nitrate and chloride, bromide (might not be obtainable according to state laws) and iodide.
- Write an IB format test which involves short answers on but not limited to chemical periodicity and physical characteristics.

**VII. Heats of Reactions (December 11- December 18)**

a. Exothermic and endothermic reactions
b. Calculation of enthalpy change
c. Hess' law
d. Bond enthalpies

**Labs and Assessments**

- Perform lab activity which involves the reaction of copper (II) chloride and aluminum. Students can investigate the relationship between the amount of limiting reagent and the amount of heat flow.
- Students will design and perform an experiment illustrating Hess' Law.
- Write an IB format test which involves multiple choice, short answers and critical thinking questions on Hess Law, heat flow, system and surroundings.

**VIII. States of Matter (January 4-Janruary 15)**

a. States of matter and kinetic theory of matter
b. Ideal gas law and corresponding equations

**Labs and Assessments**

- Determine the identity of an unknown metal through stoichiometric relations of the amount of gas produced when he metal is reacted with excess acid solution.
- Write an IB format test which involves multiple choice and short answers on but not limited to mathematical interpretations of the gas law, kinetic theory and the three states of matter.

**IX. Molecular Shape, polarity and Intermolecular Forces (January 18-January 29)**

a. Hydrocarbons and Functional groups including haloalkanes and alcohol
    i. Nomenclature
    ii. Homologous series
    iii. Full and condensed structural formulae isomers
    iv. Physical properties
b. Molecular geometry and VSEPR theory
c. Intermolecular forces and relation to physical properties
d. Inter-particle forces and relation to physical properties

**Labs and Assessments**

- Investigate the solubility of iodine in water versus other solvents such as hexane and alcohols.
- Write an IB format test which involves multiple choice and short answers on different bond types, intermolecular forces, and polarity trends.

**X. Kinetics (February 1-February 12)**

a. Measurement of a rate of reaction
b. Collision theory and factors that affect rate of reaction
c. Rate expression
    i. Order of reaction and rate constant
    ii. Reaction half-lives
d. Reaction mechanism rate determining step
    i. Activated complex
e. SL Collision theory
    i. Maxwell-Boltzman energy distribution curve
f. SL Activation Energy
    i. Homogeneous and heterogeneous catalyst

**Labs and Assessments**

- Design and implement to determine the rate law for the iodine clock reaction
- Design and implement an experiment to show the effect of surface area on the rate of reaction between Mg and HCl.
- Design an experiment to determine factors that influence the rate of oxygen gas and the decomposition of hydrogen peroxide
- Write an IB format test which involves multiple choice and short answer questions on reaction time, the affects on the reaction if the concentration in reagents is increased or there is a temperature change
- Write an IB format test which involves short answers on but not limited to the rate of reactions and the effects of catalysts on reactions.

**XI. Equilibrium (February 22-March 5)**

a. Conditions for dynamic equilibrium
b. Factors that affect the position of equilibrium
c. Equilibrium constant calculations
d. Phase equilibrium
e. Vapor Pressure
f. Application of Equilibrium –acid and base chemistry
    i. Bronsted-Lowry acids and bases
    ii. Strong and weak acids and bases
    iii. The pH scale
    iv. Acid and Base calculations and equilibrium constants
    v. Salts as acids and bases
    vi. Buffer solutions – acid-base titrations and the use of indicators

**Labs and Assessments**

- Design and implement a lab to answer the question, can water boil below 100 degrees Celsius
- Write an IB format test which involves short answers on but not limited to balanced acid-base reactions, rate of reactions, and $K_a$

**XII. Energetics and Entropy (March 8- March 19)**

a. Standard enthalphy changes of reaction
b. Entropy, Spontaneity and free energy
c. SL Lattice enthalpy including Born-Haber cycles

**Labs and Assessments**

d. Write an IB format test which involves short answers on but not limited to enthalpy, entropy and Gibbs free energy.

**XIII. SL Organic Chemistry (March 22- April 2)**

a. Properties and reactivity of hydrocarbons
b. Halogenoalkanes
c. Alkanols
d. Alkanals and alkanones
e. Alkanoic acids
f. Polymers
g. Determination of structure based on spectroscopic techniques
h. Separation and purification based on chromatography

**Labs and Assessments**

- Design and implement a lab testing the roles of organics in cosmetics
- Write an IB format test which involves short answers on but not limited to the structure, properties and reactivity of hydrocarbons

**Assessment:**

Knowledge of IBO-required assessments and descriptors should be evident. All parts of IB assessment should be addressed, both internal and external. In addition, examples of non-IB monitoring should be given, if they are part of the course.

All students will be held to the academic honesty policies of Newport Harbor High School and the International Baccalaureate Organization. Internal assessment will include practice exams, short laboratory practicals, project experiences, computer simulations, data gathering exercise, laboratory and field work. Investigations will be problem-solving and inquiry based. In addition, students will record their process through a class blog/ journal.

**Formal External Assessment** for the IB Chemistry SL student will take place in May of the second year of the course, It will include 3 papers:
**Paper 1:** 30 multiple choice questions on the core
**Paper 2:** A data based question and several short answer on the core.
**Paper 3:** Several short-answer questions on each of the two options studied
(Grade weighting will be as follows:
Examination – 76% ( Multiple Choice 20%/ Structured Questions 36%/ Options Questions 20%)
Group 4 Project will be a cross-curricular collaborative effort as described below.

**Resources:**

List the books and other resource materials and software that will be used in the course. Information should include what is currently available as well as what is being ordered.

In addition to the lab materials and equipment now available, we will be moving into our new science building in September of 2009. The new labs will be state of the art, and all necessary resources will be provided.
At this time textbook(s) have not been decided on. We will certainly choose one that in our mind best conforms to IB standards.

**Teaching time:**

List all classroom teaching hours for each HL and SL course. Explain how the hours are calculated.

| HL/SL course | Teaching hours |
|---|---|
| Chemistry SL | 150 |
| | |
| | *(add rows as necessary)* |

***In addition:***

**For group 4 subjects:**

- Have the teachers organized appropriate laboratory exercises and optional topics for study that conform to IBO requirements for the specific science course?
- Does the course provide adequate training in analytical and critical thought?
- Have science teachers collaborated and planned for the group 4 project?
- How do you envision that the methodology and resources with which the sciences are presented will enhance the international perspective of your students?
- Has there been an assessment of the laboratory facilities?
- Is there adequate instructional space for the group 4 courses?
- Are the science laboratories adequately equipped to perform those exercises required by the IB Diploma Programme curriculum?
- Does the school subscribe to appropriate scientific periodicals and journals and maintain balanced, current and adequate stocks in the life and physical sciences?

The chemistry teacher(s) will indeed organize appropriate laboratory exercises and optional topics that conform to IBO standards. As a scientist interested in training future scientists, the chemistry teacher holds as a high priority the development of analytical and critical thought. All exercises will have these as key elements.
In September we move into our new state of the art science building. We have monitored the plans every step of the way, and have made preliminary tours of the construction site. Since science is by nature international, it is hoped that through this course students will achieve a greater understanding of this fact. By studying international scientists and by collaborating (online) with IB schools around the world, student will begin to see the international nature of this discipline. We hope students will also acquire a greater sensitivity to the cultural differences they encounter.

**Group 4 Project:**

IB Chemistry SL students will maintain a portfolio documenting 60 hours of their experiments and field work demonstrating the process of their guided inquiry. The portfolio will contain a copy of the candidate's form 4/PSOW, contents page, instruction sheets, evidence of the candidate's involvement, observations, data tables, graphs, drawings, short write ups, and three to six full write ups of different investigations. The topic will be student generated and must fit and feasible for the students involved.

Students will be required to share their action research online and also be required to communicate ideas and reflections on other students' action research. Each student must address the moral, social, ethical and economic implications of their research. Because they are posting online, we will be able to communicate with other IB programs and draw on others' ideas.

All students will be required to create a model, physical or electronic of their project and allow for extension for future growth and knowledge.

- First week- Groups are created, brainstorming to discuss central topic and share ideas.
- End of September ---Literary Review: Students research other scientists research, complete an outline of research found; Process is blogged online; Potential topics are chosen
- By November 30- Action Research Topic is defined; Blog and reflection on three other groups
- By December 15 – Action Research Plan is drawn- draft model is available
- By February 19- Stage 1 – Initial findings. Experiment should have been performed several times at this stage. Findings will be posted on class blog and students will comment and reflect on each others work.
- By March 15 – Draft Documentation- submitted to teacher
- Evaluation – April 15: Students will exhibit their findings in a symposium. Administration, colleagues and parents will be invited. There will be visual displays, oral presentation and technological presentation must be included.
  Note: Teacher will be making informal evaluations during the entire process.