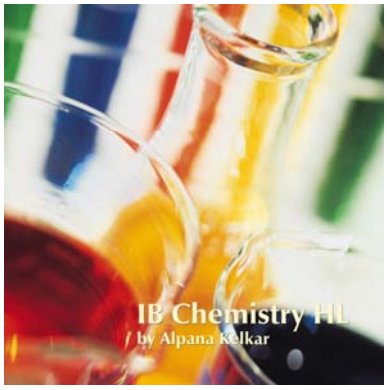

IB Chemistry HL-Syllabus

About IB Chemistry HL

Past experience shows that students will be able to study Chemistry at SL successfully with no background in, or previous knowledge of, science. Their approach to study, characterized by the specific IB learner profile attributes—inquirers, thinkers and communicators—will play a significant role.

However, for students considering the study of Chemistry at HL, some previous exposure to the specific group 4 subjects would be necessary. Having said this, there is no intention to restrict access to Chemistry.

Specific topic details are not specified but students who have undertaken the IB Middle Years Programme (MYP) or studied an international GCSE science subject would be well prepared. Other national science qualifications or a school-based science course would also be suitable preparation for study of Chemistry at HL.

Group 4 students at standard level (SL) and higher level (HL) undertake a common core syllabus, a common internal assessment (IA) scheme and have some overlapping elements in the options studied.

While the skills and activities of group 4 science subjects are common to students at both SL and HL, students at HL are required to study

- some topics in greater depth,
- additional topics and
- extension material of a more demanding nature in the common options.

The distinction between SL and HL is one of breadth and depth.
The study of Chemistry in the IB programme is built around questions such as:

- Why do atoms bond in certain combinations?
- Why do reactions take place?
- What makes water an exceptional molecule?
- What makes a reaction go faster?
- Do reactions move at the same speed throughout the process?

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These are just some of the questions that lead students to explore the concepts and ideas that chemists use in understanding the world of chemistry. As the pathways unfold the learner becomes increasingly adept at acquiring the skills necessary to conduct inquiry and research.

The learner soon grows into a Diploma student, and the concepts and ideas met along the way become increasingly challenging.

Outside of the test tube, over the horizon, the **curious** witness a debate on the future the Earth.
The increasingly **knowledgeable** explorer begins to grasp that understanding is not subject contained but demands a range of disciplines. The study of the Options is an attempt in this direction.
The **reflective** will consider the ethical issues involved in developing drugs and the thoughtful will think about how life was lived with and without antibiotics and antiviral medication.
The **principled** and **caring** will reflect on the inequality in the distribution of water.
The **courageous** will realize that a personal commitment to service and a willingness to collaborate with others can make a difference to the lives of the less fortunate. The aspect of collaboration is encouraged and assessed in the execution of the Group 4 project.

AIMS from the IB Chemistry syllabus
Through studying any of the group 4 subjects, students should become aware of how scientists work and communicate with each other. While the "scientific method" may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that distinguishes the group 4 subjects from other disciplines and characterizes each of the subjects within group 4.

IB Chemistry HL-Syllabus

It is in this context that all the Diploma Programme experimental science courses should aim to:

1. Provide opportunities for scientific study and creativity within a global context that will stimulate and challenge students
2. Provide a body of knowledge, methods and techniques that characterize science and technology
3. Enable students to apply and use a body of knowledge, methods and techniques that characterize science and technology
4. Develop an ability to analyse, evaluate and synthesize scientific information
5. Engender an awareness of the need for, and the value of, effective collaboration and communication during scientific activities
6. Develop experimental and investigative scientific skills
7. Develop and apply the students' information and communication technology skills in the study of science
8. Raise awareness of the moral, ethical, social, economic and environmental implications of using science and technology
9. Develop an appreciation of the possibilities and limitations associated with science and scientists
10. Encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

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IB Learners strive to be

- **Inquirers**

They develop their natural curiosity. They acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives.

- **Thinkers**

They exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions.

- **Communicators**

They understand and express ideas and information confidently and creatively in more than one language and in a variety of modes of communication. They work effectively and willingly in collaboration with others.

- **Knowledgeable**

They explore concepts, ideas and issues that have local and global significance. In so doing, they acquire in-depth knowledge and develop understanding across a broad and balanced range of disciplines.

- **Principled**

They act with integrity and honesty, with a strong sense of fairness, justice and respect for the dignity of the individual, groups and communities.
They take responsibility for their own actions and the consequences that accompany them.

- **Open-minded**

They understand and appreciate their own cultures and personal histories, and are open to the perspectives, values and traditions of other individuals and communities. They are accustomed to seeking and evaluating a range of points of view, and are willing to grow from the experience.

- **Caring**

They show empathy, compassion and respect towards the needs and feelings of others. They have a personal commitment to service, and act to make a positive difference to the lives of others and to the environment.

- **Risk-takers**

They approach unfamiliar situations and uncertainty with courage and forethought, and have the independence of spirit to explore new roles, ideas and strategies. They are brave and articulate in defending their beliefs.

- **Balanced**

They understand the importance of intellectual, physical and emotional balance to achieve personal well-being for themselves and others.

- **Reflective**

They give thoughtful consideration to their own learning and experience.

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The teaching approach
When any topic in science, technology and mathematics is taught only in a single lesson is unlikely to leave a trace by the end of schooling. To take hold and mature, concepts must not just be presented to students from time to time but must also be offered to them periodically in different contexts and at increasing levels of sophistication. Treating Chemistry as a subject that does not stand by itself but is intricately linked to all other areas of study is an important consideration when delivering the syllabus.

Repeated practice
An idea or concept met on a single occasion is unlikely to have a lasting effect on a high school student. Students should be encouraged to practice the ideas they are introduced to throughout their course.

Mastering any skill or ability takes time and practice
This includes the frequent encounter of intuitive ideas used to account for chemical phenomena. Relating composition, structure and change to the behavior of atoms, ions and molecules is not common to everyday experience. Atoms, ions and molecules behave very differently to the objects we see, feel and handle every day. The use of theories and models are constructed to make sense of their behavior.

Developing and integrating concepts in a range of situations
Chemistry underpins the study of environmental systems, biochemistry, industry and physiology, among others. Through the various activities and suggested reading links the text aims to present a broad canvas for students to explore and use the ideas they encounter. Students are encouraged to understand that there is no one scientific method, in the strict Popperian sense, of gaining knowledge and of finding explanations for the behaviour of the natural world. Science works through a variety of approaches to produce these explanations, but they all rely on data from observations and experiments and have a common underpinning rigor, whether using inductive or deductive reasoning

Recurring concepts, models and themes are the threads which integrate the text.
Kinetics, initially introduced as collision theory to rationalize experimental data, is the thread that runs through reaction mechanisms and the role of enzymes.
Energetics threads through the text in contexts ranging from respiration and photosynthesis to nuclear power plants and batteries, on to predictions based on the entropy, Gibbs free energy and enthalpy changes.

IB Chemistry HL-Syllabus

Chemistry and Theory of Knowledge
In looking at the ways of knowing described in the *Theory of knowledge guide* (March 2006), scientists could legitimately claim that science encompasses all these. Driven by emotion, using sense perception, enhanced by technology and combined with reason, Chemistry communicates through language, principally the universal language of mathematics.

The explanation of chemical phenomena may be in the form of a theory, sometimes requiring a model that contains elements not directly observable. Formulating a theory and then creating a model to support this theory often requires an imaginative, creative leap which could be supported by reason.

Prior knowledge could be the inspiration for this method. Where such a predictive theoretical model is not possible, the explanation may consist of identifying a correlation between a factor and an outcome. This correlation may then give rise to a causal mechanism that can be experimentally tested, leading to an improved explanation. This cyclical process is reinforced in the study of IB Chemistry.

Syllabus Details

The order in which the syllabus content is presented is not intended to represent the order in which it should be taught. A syllabus only lists the topics to be covered it is not an outline of a program of study. This book also follows the same line of thought. Along the way the teachers are encouraged to incorporate the practical investigations, but not limited to, into their teaching schedule.
Units are numbered (e.g. Unit 11: Measurement and Data Processing)
Sub topics
Sub-topics are numbered (e.g. 5.4. Bond Enthalpies).
Options are indicated by a letter (e.g. Option D: Medicines and Drugs)

Assessment Statements
Assessment statements, numbered as sub topics, are expressed in terms of the outcomes that are expected of students at the end of the course (e.g. 1.1.1 **Apply** the mole concept to substances.). These statements are intended to help the teacher and student alike understand what can be assessed by means of the written examinations.

The assessment statements accompanied by objective 1, 2 or 3, according to the action verb(s) used. The objective levels are relevant for the examinations and for balance within the syllabus, while the action verbs indicate the depth of treatment required for a given assessment statement. It is important that students are made aware of the meanings of the action verbs since these will be used in examination questions.

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Command Terms

These command terms indicate the depth of treatment required for a given assessment statement. These command terms will be used in examination questions, so it is important that students are familiar with the following definitions. The details of these terms can be found in the syllabus guide published by IB.

Objective 1	Objective 2	Objective 3
Define	**Annotate**	**Analyse**
Draw	**Apply**	**Comment**
Label	**Calculate**	**Compare**
List	**Describe**	**Construct**.
Measure	**Distinguish**	**Deduce**
State	**Estimate**	**Derive**
	Identify	**Design**
	Outline	**Determine**
		Discuss
		Evaluate
		Explain
		Predict
		Show
		Solve
		Suggest

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IB Chemistry HL
Syllabus Overview

Core

Unit 1:	Quantitative Chemistry
Unit 2:	Atomic Theory
Unit 3:	Periodicity
Unit 4:	Bonding
Unit 5:	Energetics
Unit 6:	Kinetics
Unit 7:	Equilibrium
Unit 8:	Acids and Bases
Unit 9:	Oxidation and Reduction
Unit 10:	Organic Chemistry
Unit 11:	Measurement and Data Processing

Additional higher level

Unit 12:	Atomic Theory
Unit 13:	Periodicity
Unit 14:	Bonding
Unit 15:	Energetics
Unit 16:	Kinetics
Unit 17:	Equilibrium
Unit 18:	Acids and Bases
Unit 19:	Oxidation and Reduction
Unit 20:	Organic Chemistry

OPTIONS STANDARD LEVEL AND HIGHER LEVEL

Option A:	Modern analytical chemistry
Option B:	Human biochemistry
Option C:	Chemistry in industry and technology
Option D:	Medicines and drugs
Option E:	Environmental chemistry
Option F:	Food chemistry
Option G:	Further organic chemistry