Chemistry Syllabus

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The objectives for the Higher Level Chemistry is based on the International Baccalaureate Chemistry Prospectus (February 2001). To meet these objectives, specific material is covered in each of the two years. In covering the IB objectives, the Ontario Curriculum is also covered in depth.

From the Prospectus

Chemistry is the central science. Chemical principles underpin the physical environment in which we live, and all biological systems. As such the subject of chemistry has two main roles in the curriculum. It is a subject worthy of study in its own right as a preparation for employment or further study. Chemistry is also a prerequisite for many other courses in higher education, such as medicine, and biological and environmental sciences.

Chemistry is an experimental science that combines academic study with the acquisition of practical and investigational skills. The chemistry programme aims to balance the needs of an examination syllabus on one hand with the freedom of teachers to devise courses which meet the needs of their students on the other. The programme reflects, through the variety of options available, the need to ensure that the qualification will meet the needs of students who wish to enter higher education in the sciences and those for whom this will be their final formal study of science.

This is a two year program designed for students who plan to write the Higher IB Chemistry Examination. Students are awarded the SCH3UE credit upon successful completion of the SCH3UE (IB, Higher, Year I) course requirements. Students are awarded the SCH4UE credit upon successful completion of the SCH4UE (IB, Higher, Year II) course requirements.

Students attain the Higher level Chemistry qualification upon successful completion of IB external evaluations and practical work as 24 % of the total mark, with the IB external evaluation making up the remaining 76 %.

Higher Level Chemistry consists of 240 hours, of which at least 60 h is practical work consisting of Internal Assessment.

Philosophy & Program Intent

Chemistry is a natural science based upon "student investigation." Throughout the units there is ample opportunity for student projects (group or individual). The focus is upon both quantitative and qualitative skills development, as required in science investigation. The scientific method is forever being applied in the laboratory experiments of each unit area. Where it is beneficial to do so, more difficult concepts are simplified by use of models or computer simulations.

Another key area of science training and proficiency is the regular use of science terminology, equipment and materials. Safe handling of equipment is incorporated into all student activities, and also the evaluation.

Of further importance in a chemistry program is the emphasis upon "science changing through time" as new applications of knowledge lead to differing technologies. Diversity and continuity in science are exemplified within units also.

A powerful feature of the program is the emphasis upon students to extrapolate beyond the text materials. Questions that engage students in applying successfully some understanding or techniques to a problem, but under "never before seen" conditions is the key. A desired outcome of science is critical thinking, involving science concepts and the ability to visualize the links between science investigation and discovery with other academic disciplines. A continuous theme is the historical approach to scientific thought, and key discoveries in history which contributed to a revolution of thought as within the framework of daily class time, current science news events and historical understanding shall be shared. The social and economical ramifications of science and technology, within the domain of chemistry, shall be a springboard for enriched discussions and shared opinions.

Scope

Chemistry is the first stage of any senior science program of study which leads into pathways within science careers. Chemistry is the science which deals with the properties of matter and interactions (chemical reactions) of matter; it is concerned with the identification, character and transformation of matter. It is also a science concerned with the energy exchanges and interactions of energy systems.

This course, like other science programs, is both a body of knowledge (facts, concepts, models a and theories) and a process for obtaining this knowledge.

The important emphasis upon the microscopic and the macroscopic world is key to the course. The Kinetic Molecular Theory is referred to time and time again, bridging the microscopic and macroscopic. Proficiency with equipment, using measurements, inferring from the gathered data, and making conclusions are all necessary skills developments within the educational process. Although the Chemistry syllabus is broad, there is ample opportunity to link the areas to one another, and of course to the Scientific Method utilized within the lab experiments. Selected lab experiments shall mirror and reinforce the concepts from the regular class periods.

Context of Learning Outcomes

- develop a positive scientific attitude towards the experimental process and the Scientific Method of Analysis
- appreciate the complexity of the microscopic chemical world and its relationship to the visible macroscopic world
- acquire the skills to understand the process of science at work using actual lab data which is student generated
- learn how to extrapolate from data and create hypothetical learning models
- come to better understand the basic concepts and the principles of chemistry
- develop a sensitivity and appreciation for the delicate balance between science and technology, and the environment
- to critically think and ask new questions based upon an on-going examination of the modern-day current events, while looking backwards to historical beliefs and models to interpret the world around us
- develop and carry out various experiments which utilize skills of graphing, dimensional analysis, data manipulation, and use of computing technologies within the program as a tool for working with the data
- develop a responsible attitude towards the learning process and how to communicate findings effectively in science
- develop cooperative communication skills via labs and group projects

Aims

Students should become aware of the way in which scientists work and communicate with each other throughout the world. While, in practice, the scientific method may take on a wide variety of forms, it will generally involve the formation, testing and modification of hypotheses, through observation and measurement, under the controlled conditions of an experiment. It is this approach, along with the falsifiability of scientific hypotheses, that distinguishes science from the other disciplines and characterizes the course of study.

It is in this context that the course shall aim to:

- ✓ provide opportunities for scientific study and creativity within the global contexts which stimulate and challenge students
- ✓ provide a body of knowledge and methods / techniques which characterizes science and technology
- ✓ enable students to apply and use a body of knowledge and methods / techniques which characterize science and technology
- ✓ develop an ability to analyze, evaluate and synthesize scientific information and engender an awareness of the need for, and the value of, effective collaboration.
- ✓ develop experimental and investigative scientific skills
- ✓ raise awareness of the moral / ethical, social, economic and environmental implications of using science and technology
- ✓ develop appreciation for the “possibilities and limitations”associated with science and scientists
- ✓ encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

Brief Statement of Learning Objectives

The assessment objectives reflect those parts of the aims which will be assessed. Whenever appropriate the assessment will draw upon environmental and technological contexts; identify the social and economic effects of the experimental sciences, in the moral considerations of scientific activity. It is the intention of all experimental sciences programs that students should be able to:

- ✏ demonstrate an understanding of
  (a) scientific facts and concepts
  (b) scientific methods / techniques
  (c) scientific terminology
  (d) methods of presenting scientific information

- ✏ apply and use
  (a) scientific facts and concepts
  (b) scientific methods / techniques
  (c) scientific terminology to communicate effectively
  (d) appropriate methods to present scientific information

- ✏ construct, analyze and evaluate
  (a) hypotheses, research questions and predictions
  (b) scientific methods / techniques and procedures
  (c) scientific explanations

- ✏ demonstrate the personal skills of cooperation, perseverance and responsibility appropriate for effective scientific investigation and problem solving

- ✏ demonstrate the manipulative skills necessary to carry out scientific investigation with precision and safety

Unit Design and Sequencing: SCH3UE: IB Year I

(1) Introduction and Orientation

(a) overview of Chemistry – branches
(b) assessment and lab rubric
(c) goals and expectations, lab safety
(d) Lab journal – portfolio
(e) Initial research project

(2) The Nature of Chemistry

(a) matter and classifications
(b) physical vs. Chemical changes
(c) language of chemistry – formulas
(d) dimensional analysis and units
(e) Scientific Method: design lab project
(f) the Periodic Table: overview

(3) Inorganic Naming Chemical Nomenclature

(a) chemical ions and polyatomic
(b) reactions classified; equations
(c) balancing equations
(d) conservation of mass/energy

(4) Fundamental Concepts of Matter

(a) Kinetic Molecular Theory
(b) techniques of separation in labs
(c) properties of substances
(d) atomic mass and number
(e) Collision Theory and reactivity

(5) Stoichiometry

(a) the Mole concept
(b) % composition
(c) Stoichiometry conversions
(d) limiting/excess reagents
(e) molarity
(f) empirical/molecular formulas
(g) theoretical vs. Actual yield

(6) Atomic Theory and Structure

(a) Rutherford – Bohr models
(b) Atomic Spectra – line Spectra
(c) Electron Configurations and Electron Cloud Model
(d) The Modern Bohr model

(7) Gas Laws and Gas Behavior

(a) solids, liquids and gases compared
(b) Real vs. Ideal Gases – the Ideal Gas Law
(c) The Gas Laws and molar volume calculations
(d) Graham's Law and Van der Waals Equation
(e) Kinetic Molecular and Collision Theory – applied to gases

(8) Nuclear Chemistry & Fuels

(a) phenomenon of radioactivity
(b) nuclear stability
(c) nuclear fission and fusion
(d) rate of decay
(e) nuclear reactors

(9) The Nature of Chemical Bonding

(a) electronegativity and atomic structure
(b) bond types related to electronic clouds
(c) bond types predicted – Lewis Diagrams
(d) VSEPR Model – molecular shapes
(e) Enthalpy bondage breakage/formation

(10) Solution Chemistry

(a) water – the universal solvent
(b) nature and types of solutions
(c) solubility rules/precipitate formation
(d) net – Ionic equations
(e) molarity revisited

(11) Chemical Kinetics Equilibrium Theory

(a) rate equation and order
(b) Collision Theory revisited
(c) P. E. Diagrams and mechanisms
(d) Dynamic Equilibrium
(e) Le Chatelier's Principle

(12) Acid – Base Theory

(a) nature of acids/bases; conjugate pairs
(b) Arrhenius & Bronsted-Lowry definitions
(c) titrations and chemical indicators
(d) Strong/weak acids and bases
(e) titration curves/graphical analysis

(13) Oxidation – Reduction Reaction

(a) half – cell balancing method
(b) redox reactions and chemical potential
(c) the battery; half – cells and electrodes

(14) Organic Chemistry

(a) homologous series
(b) IUPAC naming
(c) introduction to functional groups
(d) organic synthesis

Unit Design and Sequencing: SCH4UE: IB Year II

Start - Up and Review
Thermodynamics
Further Kinetics
Applications of Equilibrium: Redox and Acid-Base
Organic Chemistry I
Organic Option: Organic Chemistry II
Option: Fuels and Energy
Group IV Project
Course Consolidation and Exam Review

Course Text

Chemistry Today I, Whitman, Nalepa, and Zinck
Petrucci and Harwood General Chemistry

Help Session

Monday to Friday
12:35 – 13:10 and 15:30 – 16:00

Grading Assessments (Ontario Grading)

Knowledge/Understanding	25%
Thinking/Inquiring	20%
Communication	10%
Making Connections	15%
Summative	30%

Lab Assessment

Planning (a)
Planning (b)
Data Collection
Data Processing and Presentation
Data Evaluation and Conclusion
Manipulative skills
Personal skills (a)
Personal skills (b)
(0 to 3 grading ruberic)

Lab Assessment Criteria: Lab Grade

For the lab Journal – Portfolio in the following eight assessment criteria have been identified which are related to the established objectives for this syllabus.
The assessment criteria for Planning, Data Collection, Data Analysis and Evaluation are worded in such a manner that they can be used both formatively and summatively. Manipulative and Personal skills are expressed only summatively

Criteria:	**Description of Task:**
Planning (a)	Defined problem, / research questions, and formulated hypothesis which are selected as relevant
Planning (b)	Design realistic procedures to include appropriate apparatus, materials, methods for both the control of variables and collection of data.
Data Collection	Observed and recorded raw data with precision and presented them in an organized way.
Data Processing and Presentation	Transformed, manipulated and presented data to provide effective scientific communication.
Data Evaluation and Conclusion	Evaluated the results of an experiment and evaluated the procedures suggesting any modifications to procedures where appropriate
Manipulative Skills [summative only]	Carried out a range of techniques proficiently with due attention to safety; also one follows instructions.
Personal Skills (a) [summative only]	Worked within a team; recognizing the contribution of others and encouraged the contributions of others
Personal Skills (b)	Approached experiments /investigations/ projects and problem solving exercises with self – motivation and perseverance, in an ethical manner; also paying due attention to the environmental impact.

NOTE: The method of assessment used is criterion – referenced, not norm referenced. That is to say, the method of assessing the portfolio lab journal judges students in relation to the identified criteria, not in relation to each other.
For each assessment criterion, four achievements levels, describing achievement levels 0-3 are defined. The lowest level of achievement is represented by 0, while 3 represents the highest level of achievement.
The descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.
The aim is to find, for each criterion, the descriptor which conveys most adequately the achievement levels attained by the candidate's work.

Philosophy on Homework

Homework is an important part of your education. You will be assigned homework everyday you have class. Depending on your ability these assignments should require about one half hour to complete. I suggest you work between 7:00 and 9:00 p.m. on week nights as research seems to indicate that we humans tend to undergo a power surge in that interval. If my subject is one that you struggle with, then I suggest you tackle it sooner rather than later.

I randomly check homework. If the assigned work is not complete then this will be reflected in your overall mark. I do not accept too many excuses for homework not done. Often students will tell me they could not do their homework because they didn't understand it. I can accept that if I see an attempt, but a blank page and an equally blank stare does not do much for me. It will also add luster to your image if you explain to me before class why homework is not done as opposed to trying to explain after I've caught you.

You will often be asked to perform and write up laboratories with other students. I do not mind students working together as long as they do not copy, the written lab report must be your own.

Lab write ups must be in your own words. Any evidence of copying will result in a mark of zero for you and the person you copied from!

Regular and punctual attendance is required. Diligent use of class time is vital for success in Chemistry. If you miss an evaluation you must make prior arrangements to write the evaluation immediately upon returning to school. The make-up evaluation will ideally be written after school rather than during class time. If you do not make up the evaluation in a reasonable period of time you will be assigned a mark of zero! It is up to you to make sure evaluations are made up in a reasonable period of time. After an absence, it is the student's responsibility to find out about missed classroom work, assignments and evaluations.