Chemistry Syllabus

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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 new 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 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 reinforced 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 should 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:

✏ and 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

(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) Grahams 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

(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

Course Text

Petrucci and Harwood General Chemistry

Help Session

Monday to Friday
12:35 – 13:10 and 15:20 – 16:00

Grading Assessments

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.