Ontario eSecondary School
Course Outline
2024-2025

Ministry of Education Course Title: Chemistry, University Preparation	
Ministry Course Code: SCH4U	
Course Type: University Preparation	
Grade: 12	
Credit Value: 1.0	
Prerequisite(s): SCH3U, Grade 11, University Preparation	
Department: Science	
Course developed by: **Sara McCormick**	**Date: March 6th, 2019**
Length: **One Semester**	**Hours:** **110**

This course has been developed based on the following Ministry documents:

1. *Science, The Ontario Curriculum, Grades 11 and 12*, 2008, (revised)
2. *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools (2010)*
3. *Learning for All (2013)*

COURSE DESCRIPTION/RATIONALE

This course enables students to deepen their understanding of chemistry through the study of organic chemistry, the structure and properties of matter, energy changes and rates of reaction, equilibrium in chemical systems, and electrochemistry. Students will further develop their problem-solving and investigation skills as they investigate chemical processes, and will refine their ability to communicate scientific information. Emphasis will be placed on the importance of chemistry in everyday life and on evaluating the impact of chemical technology on the environment.

OVERALL CURRICULUM EXPECTATIONS

Scientific Investigation Skills and Career Exploration
By the end of the course, students will:

- demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating)

Structure and Properties of Matter
By the end of this course, students will:

- assess the benefits to society and evaluate the environmental impact of products and technologies that apply principles related to the structure and properties of matter
- investigate the molecular shapes and physical properties of various types of matter
- demonstrate an understanding of atomic structure and chemical bonding, and how they relate to the physical properties of ionic, molecular, covalent network, and metallic substances.

Organic Chemistry
By the end of this course, students will:

- assess the social and environmental impact of organic compounds used in everyday life, and propose a course of action to reduce the use of compounds that are harmful to human health and the environment;
- investigate organic compounds and organic chemical reactions, and use various methods to represent the compounds;
- demonstrate an understanding of the structure, properties, and chemical behaviour of compounds within each class of organic compounds.

Energy Changes and Rates of Reaction
By the end of this course, students will:

- analyse technologies and chemical processes that are based on energy changes, and evaluate them in terms of their efficiency and their effects on the environment;
- investigate and analyse energy changes and rates of reaction in physical and chemical processes, and solve related problems;
- demonstrate an understanding of energy changes and rates of reaction.

Chemical Systems and Equilibrium
By the end of this course, students will:

- analyse chemical equilibrium processes, and assess their impact on biological, biochemical, and technological systems;
- investigate the qualitative and quantitative nature of chemical systems at equilibrium, and solve related problems;
- demonstrate an understanding of the concept of dynamic equilibrium and the variables that cause shifts in the equilibrium of chemical systems.

Electrochemistry
By the end of this course, students will:

- analyse technologies and processes relating to electrochemistry, and their implications for society, health and safety, and the environment;
- investigate oxidation-reduction reactions using a galvanic cell, and analyse electrochemical reactions in qualitative and quantitative terms;
- demonstrate an understanding of the principles of oxidation-reduction reactions and the many practical applications of electrochemistry.

COURSE CONTENT

Unit	*Length*
Unit 1: Structure and Properties of Matter	30 hours
Unit 2: Organic Chemistry	21 hours
Unit 3: Energy Changes and Rates of Reaction	21 hours
Unit 4: Chemical Systems and Equilibrium	20 hours
Unit 5: Electrochemistry	14 hours
Culminating and Final Exam	4 hours
Total	**110 hours**

UNIT DESCRIPTIONS

UNIT 1: STRUCTURE AND PROPERTIES OF MATTER

In this unit, students will investigate the molecular shapes and physical properties of various types of matter. Students will also demonstrate an understanding of atomic structure and chemical bonding, and how they relate to the physical properties of ionic, molecular, covalent network, and metallic substances. Lastly, students will assess the benefits to society and evaluate the environmental impact of products and technologies that apply principles related to the structure and properties of matter.

UNIT 2: ORGANIC CHEMISTRY

In this unit, students will investigate organic compounds and organic chemical reactions, and use various methods to represent the compound and will demonstrate an understanding of the structure, properties, and chemical behaviour of compounds within each class of organic compounds. Lastly, students will assess the social and environmental impact of organic compounds used in everyday life, and propose a course of action to reduce the use of compounds that are harmful to human health and the environment.

UNIT 3: ENERGY CHANGES AND RATES OF REACTIONS

In this unit, students will investigate and analyse energy changes and rates of reaction in physical and chemical processes, and solve related problems. Students will also demonstrate an understanding of energy changes and rates of reaction. Lastly, students will analyse technologies and chemical processes that are based on energy changes, and evaluate them in terms of their efficiency and their effects on the environment.

UNIT 4: CHEMICAL SYSTEMS AND EQUILIBRIUM

In this unit, students will investigate the qualitative and quantitative nature of chemical systems at equilibrium, and solve related problems. Students will demonstrate an understanding of the concept of dynamic equilibrium and the variables that cause shifts in the equilibrium of chemical systems. Lastly,

students will analyse chemical equilibrium processes, and assess their impact on biological, biochemical, and technological systems.

UNIT 5: ELECTROCHEMISTRY

In this unit, students will investigate oxidation-reduction reactions using a galvanic cell, and analyse electrochemical reactions in qualitative and quantitative terms. Students will also demonstrate an understanding of the principles of oxidation-reduction reactions and the many practical applications of electrochemistry. Lastly, students will analyse technologies and processes relating to electrochemistry, and their implications for society, health and safety, and the environment.

TEACHING AND LEARNING STRATEGIES

In this course, students will experience the following activities.

Presentations with embedded videos are utilized to outline concepts, explain theory with the use of examples and practice questions, and incorporate multi-media opportunities for students to learn more (e.g. online simulations, quizzes, etc.).

End of unit conversations and Poodlls are opportunities for students to express their ideas, problem solving, and thought processes with a teacher who provides timely feedback.

Reflection is an opportunity for students to look back at concepts and theories with new eyes, to relate theory to practice, and to align learning with their own values and beliefs.

Discussions with the instructor are facilitated through video conferencing, discussing the concepts and skills being studied. This enables two-way communication between the student and the instructor, to share ideas and ask questions in dialogue. This also helps to build a relationship between the student and instructor.

Instructor demonstrations (research skills, etc.) are opportunities for the instructor to lead a student through a concept or skill through video conferencing, videos, or emailing with the student.

Discussion forums are an opportunity for students to summarize and share their ideas and perspectives with their peers, which deepens understanding through expression. It also provides an opportunity for peer-to-peer feedback.

Practical extension and application of knowledge are integrated throughout the course. The goal is to help students make connections between what they learn in the classroom and how they understand and relate to the world around them and their own lives. Learning becomes a dynamic opportunity for students to be more aware that their learning is all around them and enable them to create more meaning in their lives.

Individual activities/assignments assessments are completed individually at a student's own pace and are intended to expand and consolidate the learning in each lesson. Individual activities allow the teacher to accommodate interests and needs and to assess the progress of individual students. For this reason, students are encouraged to discuss IEPs (Individual Education Plans) with their teacher and to ask to modify assessments if they have a unique interest that they feel could be pursued in the assessment. The teacher plays an important role in supporting these activities by providing ongoing feedback to students, both orally and in writing.

Research is an opportunity to apply inquiry skills to a practical problem or question. Students perform research to gather information, evaluate quality sources, analyze findings, evaluate their analysis, and synthesize their findings into conclusions. Throughout, students apply both creative thinking and critical thinking. New questions are also developed to further learning.

Writing as a learning tool helps students to think critically about course material while grasping, organizing, and integrating prior knowledge with new concepts. Good communication skills are important both in and out of the classroom.

Virtual simulations are interactive websites that provide students with an opportunity to ask questions, explore hypotheses, relate variables, examine relationships, and make connections between theory and application in a safe environment that promotes intellectual risk taking and curiosity.

Virtual labs are interactive websites that provide students with an opportunity to follow a procedure to test hypotheses using scientific apparatus, gather and record observations, analyze observations using formula and relevant theory/concepts, and then formulate conclusions that relate hypotheses to analysis.

Diagrams are visual representations of scientific ideas and concepts. They provide another perspective to organize ideas. Visuals are thought to promote cognitive plasticity - meaning, they can help us change our minds or help us to remember an idea.

Graphics/images are visual representations of ideas/concepts. Visuals are thought to promote cognitive plasticity - meaning, they can help us change our minds or help us to remember an idea.

Charts are visual representations of scientific ideas and concepts using math that support analysis. For example, you can have a pie chart that shows Canada's energy sources.

Tables involve organizing information in terms of categories (rows and columns). This helps us to understand the relationships between ideas and data, as well as highlight trends.

Drawings and schematics are scientific and engineering ideas explained visually. For example, an electric circuit can be explained using symbols, which makes it possible to communicate ideas universally, clearly, and succinctly.

Articles are examples of concepts and theories being discussed in the public realm and with respect to current events. They are snapshots not only of why scientific theories/concepts/applications are relevant but also provide a window into the broader context of scientific knowledge and understanding. Students learn through reading and analysis that science is deeply related to, and intertwined with, society and the diverse perspectives of lived experience.

Practice problems provide students with a scenario/problem to solve by applying concepts and skills learned in a context. This helps students to understand the relevance of their learning.

ASSESSMENT, EVALUATION, AND REPORTING

Assessment: The process of gathering information that accurately reflects how well a student is achieving the identified curriculum expectations. Teachers provide students with descriptive feedback that guides their efforts towards improved performance.

Evaluation: Assessment of Learning focuses on Evaluation which is the process of making a judgement about the quality of student work on the basis of established criteria over a limited, reasonable period of time.

Reporting: Involves communicating student achievement of the curriculum expectations and Learning Skills and Work Habits in the form of marks and comments as determined by the teacher's use of professional judgement.

STRATEGIES FOR ASSESSMENT

Assessment practices can nurture students' sense of progress and competency and information instruction. Many diagnostic tools, e.g. checklists and inventories, are used at regular intervals throughout the units to encourage students' understanding of their current status as learners and to provide frequent and timely reviews of their progress.

Units conclude with unit tests and performance tasks (student designed inquiry projects and lab reports). Teachers are encouraged to share goals with students early in the course and to connect Unit learning experiences frequently and explicitly with big ideas, overall expectations, and performance tasks. The

teacher could also involve students in the discussion, modification, or creation of rubrics, and teach students to use rubrics as a learning tool that can support the writing process and practice.

ASSESSMENT ACTIVITIES

- ❑ You Try! Self-check problems
- ❑ Homework assignments
- ❑ Individual conference meetings
- ❑ Diagnostic quizzes
- ❑ Oral presentations (conferences)
- ❑ Research projects (STSE focused)
- ❑ Inquiry Projects
- ❑ Tests & Exam

EVALUATION

The final grade will be determined as follows:

- ❑ Seventy per cent of the grade will be based on evaluation conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- ❑ Thirty per cent of the grade will be based on a final evaluation administered at or towards the end of the course. This evaluation will be based on evidence from one or a combination of the following: an examination, a performance, an essay, and/or another method of evaluation suitable to the course content. The final evaluation allows the student an opportunity to demonstrate comprehensive achievement of the overall expectations for the course.

  (*Growing Success: Assessment, Evaluation and Reporting in Ontario Schools*. Ontario Ministry of Education Publication, 2010 p.41)

Weightings	
Course Work	**70**
Knowledge/Understanding (K)	21
Thinking/Inquiry (T)	17.5
Communication (C)	10.5
Application (A)	21
Final	**30**
Performance Task (0K, 5T, 5C, 0A)	10
Final Exam (20K)	20

TERM WORK EVALUATIONS (70%)

Evaluation Item	Description	Category	Weight
Unit 1 STSE Project	Research-based projects for each unit based on applications of learned concept/law to real life problems	T,C	14
Unit 1 Lab Investigation	Labs are used to evaluate students' thinking and communication skills in relation to the scientific process	T, C	

Unit 1 Test	Tests evaluate unit concepts in a timed and proctored environment.	K,A	
Unit 2 STSE Project	Research-based projects for each unit based on applications of learned concept/law to real life problems	T,C	14
Unit 2 Lab Investigation	Labs are used to evaluate students' thinking and communication skills in relation to the scientific process	T, C	
Unit 2 Test	Tests evaluate unit concepts in a timed and proctored environment.	K,A	
Unit 2 End of Unit Conference (Units 1 and 2)	Live interviews are used to evaluate students through observation and conversation.	K, T, C, A	
Unit 3 STSE Project	Research-based projects for each unit based on applications of learned concept/law to real life problems	T,C	14
Unit 3 Reaction Rate Assignment	Problem sets supplement lessons and are used to assess whether or not students are meeting criteria for success	K, T, C, A	
Unit 3 Lab Investigation	Labs are used to evaluate students' thinking and communication skills in relation to the scientific process	T, C	
Unit 3 Test	Tests evaluate unit concepts in a timed and proctored environment.	K,A	
Unit 4 STSE Project	Research-based projects for each unit based on applications of learned concept/law to real life problems	T,C	14
Unit 4 Lab Investigation	Labs are used to evaluate students' thinking and communication skills in relation to the scientific process	T, C	
Unit 4 Test	Tests evaluate unit concepts in a timed and proctored environment.	K,A	
Unit 5 STSE Project	Research-based projects for each unit based on applications of learned concept/law to real life problems	T,C	14
Unit 5 Lab Investigation	Labs are used to evaluate students' thinking and communication skills in relation to the scientific process	T, C	
Unit 5 Test	Tests evaluate unit concepts in a timed and proctored environment.	K,A	
End of Unit Response (Units 3-5)	Live interviews are used to evaluate students through observation and conversation.	K, T, C, A	

FINAL EVALUATIONS (30%)

Evaluation Item	Description	Category	Weight
Final Project	A comprehensive project, covering all overall curriculum expectations for the course.	K, T, C, A	10
Final Exam	A final, written examination, covering all curriculum expectations for the course.	K, T, C, A	20

AAL/AFL/AOL TRACKING SHEET

Unit 1 Structure and Properties of Matter

AAL	**AFL**	**AOL**
Energy Level Diagrams and Electron Configuration Problem Set	Atomic Theory Timeline	Unit 1 STSE Project
Light as a Wave Problem Set	Gizmos Activity – Photoelectric Effect	Unit 1 Lab Investigation
Schrodinger's Cat Analogy	Periodic Table Reflection	Unit 1 Test
Matter Waves Problem Set	Atomic Theory Quiz	
Quantum Numbers Problem Set	Intermolecular Forces Assessment	
Atomic Theory Practice Quiz	Experimental Design Practice Lab Report	
Lewis Structures Problem Set	Types of Solids Dry Lab	
VSEPR Theory Problem Set		
Molecular Polarity Problem Set		
Bonds, Forces and Properties Problem Set		
Unit 1 Review		

Unit 2 Organic Chemistry

AAL	**AFL**	**AOL**
Naming Alkanes Worksheet	Benzene and Cancer Recording	Unit 2 STSE Project
Alkene Alkyne Problem Set	Famous Aldehydes/Ketones	Unit 2 Lab Investigation
Cyclic HC and Aromatics Problem Set	Organic Compounds – Comparing Properties & Dry Lab	Unit 2 Test
Alcohol and Ethers Problem Set	Gizmos – Dehydration and Hydrolysis Assessment	
Aldehydes and Ketones Problem Set		
Carboxylic Acids and Esters Problem Set		
Amines and Amides Problem Set		
Organic Nomenclature Quiz		
Organic Reactions Problem Set		
Unit 2 Review		

Unit 3 Energy Changes and Rates of Reaction

AAL	**AFL**	**AOL**
Calorimetry Problem Set	Potential Energy Diagram Assessment	Reaction Rate Assignment
Hess' Law Problem Set		Unit 3 STSE Project

Standard Enthalpy of Formation Problem Set		Unit 3 Lab Investigation
Thermochemistry Practice Quiz		Unit 3 Test
Rate Law Problem Set		
Unit 3 Review		

Unit 4 Chemical Systems and Equilibrium

AAL	**AFL**	**AOL**
Equilibrium Problem Set	Real World Equilibrium Example	Unit 4 STSE Project
Reaction Quotient Problem Set	LeChatelier's Principle	Unit 4 Lab Investigation
Weak Acids & Bases Problem Set	Haber Process Assessment	Unit 4 Test
Acid-Base Titration Problem Set	Relevance of Solubility in the Human Body Assessment	
Unit 4 Review		

Unit 5 Electrochemistry

AAL	**AFL**	**AOL**
Introduction to Redox Reactions Problem Set	Real World Electrochemistry Examples	Unit 5 STSE Project
Half Reaction Method Problem Set	Metallurgist for a Day	Unit 5 Lab Investigation
Galvanic Cell Problem Set		Unit 5 Test
Unit 5 Review		

Cumulative Assessments

AAL	**AFL**	**AOL**
		Final Project
		Final Exam

CONSIDERATION FOR PROGRAM PLANNING

PLANNING SCIENCE PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education teachers, where appropriate, to achieve this goal. Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs in all disciplines. Those beliefs are as follows: All students can succeed. Universal design and differentiated instruction are effective and interconnected means of meeting the learning or productivity needs of any group of students. Successful instructional practices are founded on evidence-based research, tempered by experience.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 per cent of the students in Ontario's English language schools is a language other than English. Ontario's linguistic heritage includes several Aboriginal languages; many African, Asian, and European languages; and some varieties of English, such as Jamaican Creole. Many English language

learners were born in Canada and raised in families and communities in which languages other than English were spoken, or in which the variety of English spoken differed significantly from the English of Ontario classrooms. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited. When they start school in Ontario, many of these students are entering a new linguistic and cultural environment.

THE ROLE OF TECHNOLOGY IN THE SCIENCE PROGRAM

Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' language learning. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these can help students to collect, organize, and sort the data they gather and to write, edit, and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning.

ACCOMMODATIONS

Accommodations will be based on meeting with parent, teachers, administration and external educational assessment report. The following three types of accommodations may be provided:

- ***Instructional accommodations:*** such as changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.
- ***Environmental accommodations:*** such as preferential seating or special lighting.
- ***Assessment accommodations:*** such as allowing additional time to complete tests or assignments or permitting oral responses to test questions.

Other examples of modifications and aids, which may be used in this course, are:

- Provide step-by-step instructions.
- Help students create organizers for planning tasks.
- Allow students to report verbally using a voice or video recording.
- Permit students a range of options for reporting tasks.
- Provide opportunities for enrichment.