

Teacher: Ella Hou

Email: ellaxiao3@edu4u.com**Prerequisite:** Chemistry 11, University; **Textbook:** Chemistry 12 (Nelson)**Course Description**

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.

University courses are designed to equip students with the knowledge and skills they need to meet the entrance requirements for university programs.

Science Course Goals

1. To relate science to technology, society, and the environment
2. To develop the skills, strategies, and habits of mind required for scientific inquiry
3. To understand the basic concepts of science

Course Units

The following units of study will be covered:

- Unit 0 – Grade 11 Review
- Unit 1 – Structure and Properties of Matter
- Unit 2 – Energy Changes and Rates of Reaction
- Unit 3 – Chemical Systems and Equilibrium
- Unit 4 – Electrochemistry
- Unit 5 – Organic Chemistry (OPTIONAL)

Evaluation Breakdown

The student will be provided with numerous and varied opportunities to demonstrate the knowledge and skills in all four achievement categories which include *Knowledge/Understanding*, *Thinking/Investigation*, *Communication*, and *Application* as indicated below ($\pm 5\%$):

Term work	70%
Knowledge/Understanding.....	25 %
Thinking/Investigation.....	25 %
Communication.....	25 %
Application.....	25 %
Final Exam	30 %

Knowledge/Understanding

- Recalling scientific facts and terminology and understanding scientific concepts and relationships among concepts
- Primarily assessed from tests and quizzes

Thinking/Investigation

- Design/conduct experiments/activities: recording, analysis, interpretation of experimental data and problem solving
- May be assessed through lab performance, lab reports, assignments, tests, quizzes, presentations, projects and journals

Communication

- Correct use of scientific terminology, symbols, units, and written communication following proper scientific format
- May be assessed through lab performance, lab reports, assignments, tests, quizzes, presentations, projects and journals

Application

- Connecting science, technology, the environment to society and every-day life

- May be assessed using assignments, tests, quizzes, presentations, projects and journals

Culminating Activities

- Assignments or labs which summarize key concepts of the unit, usually assigned near the end of the unit or semester

Exams

- All categories of assessment may be reflected on the final examinations

Ministry Expectations

A: Scientific Investigation Skills and Career Exploration

A1. 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);

A2. identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.

B: Organic Chemistry

B1. 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;

B2. investigate organic compounds and organic chemical reactions, and use various methods to represent the compounds;

B3. demonstrate an understanding of the structure, properties, and chemical behaviour of compounds within each class of organic compounds.

C: Structure and Properties of Matter

C1. 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;

C2. investigate the molecular shapes and physical properties of various types of matter;

C3. 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.

D: Energy Changes and Rates of Reaction

D1. 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;

D2. investigate and analyse energy changes and rates of reaction in physical and chemical processes, and solve related problems;

D3. demonstrate an understanding of energy changes and rates of reaction.

E: Chemical Systems and Equilibrium

E1. analyse chemical equilibrium processes, and assess their impact on biological, biochemical, and technological systems;

E2. investigate the qualitative and quantitative nature of chemical systems at equilibrium, and solve related problems;

E3. demonstrate an understanding of the concept of dynamic equilibrium and the variables that cause shifts in the equilibrium of chemical systems.

F: Electrochemistry

F1. analyse technologies and processes relating to electrochemistry, and their implications for society, health and safety, and the environment;

F2. investigate oxidation-reduction reactions using a galvanic cell, and analyse electrochemical reactions in qualitative and quantitative terms;

F3. demonstrate an understanding of the principles of oxidation-reduction reactions and the many practical applications of electrochemistry

Consideration for Program Planning

Assessment, instructional and environmental **accommodations** are provided to individual students as per their *IEP*. Similarly, **adaptations** for **English Language Learners** are provided based upon the student's level of language development, strengths and needs.

Accommodations for ELL Learners:

- Modification of some or all of the subject expectations so that they are challenging but attainable for the learner at his or her present level of English proficiency, given the necessary support from the teacher;

- Use of a variety of instructional strategies (e.g., extensive use of visual cues, graphic organizers, and scaffolding; previewing of textbooks; pre-teaching of key vocabulary; peer tutoring; strategic use of students' first languages);
- Use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, and materials that reflect cultural diversity);
- Use of assessment accommodations (e.g., granting of extra time; use of oral interviews, demonstrations or visual representations, or tasks requiring completion of graphic organizers or cloze sentences instead of essay questions and other assessment tasks that depend heavily on proficiency in English).

Learning Skills

In addition students will be assessed on their *learning skills* as listed below. They are NOT included in determining the final grade.

Responsibility	Organization	Independent Work	Collaboration	Initiative	Self-Regulation
<ul style="list-style-type: none"> • Complete work with care • Submit assignments on time • Manage classroom behaviour • Prepare for test & quizzes 	<ul style="list-style-type: none"> • Come to class prepared • Notebooks tidy & ordered • Plan ahead & manage time to meet deadlines • Use an organizer to help achieve goals 	<ul style="list-style-type: none"> • Use time effectively during class • Follow instructions with minimum supervision • Make use of notes to complete tasks • Seek assistance after serious effort 	<ul style="list-style-type: none"> • Complete your share of work • Contribute ideas • Cooperate & participate with others • Listen attentively without interrupting 	<ul style="list-style-type: none"> • Make up missed work • Ask for future work before an absence • Complete work without prompting • Demonstrate interest • Participate in discussions • Seek assistance 	<ul style="list-style-type: none"> • Attend class on time • Set goals • Consistent effort to complete work • Correct homework • Persist and do not give up easily on assigned school work

Plagiarism: Plagiarism is the act of taking ownership of written material or ideas belonging to someone else, whether knowingly or unknowingly. At Humberside Collegiate Institute, plagiarism is strictly dealt with. A student caught plagiarizing an assignment in this course will receive an automatic mark of zero. A second chance will not be granted. So please be *extremely* careful – even homework copied from another student (although reworded), lab work paraphrased from your partner or the internet without documentation are ***all*** considered plagiarism. If you are at all concerned or have questions about plagiarism, please ask!

Deadlines: The deadline for assignments and lab reports etc. is at the *beginning* of class. In accordance with the school's policy on assessment and evaluation, any assignment or lab report handed in after the deadline will receive a penalty of 5% per day, up to a maximum of 10%. Lab reports/assignments etc. will not be accepted once they have been handed back. Exceptions for extenuating circumstances may apply at the discretion of the teacher.

Absences

If you know you are going to be absent for a class (appointment, field trip, sports event), then **you must inform the teacher beforehand**. This shows that you are *organized*, conscientious and that you have *initiative*. The sooner you discuss the conflict, the more likely an acceptable alternate arrangement can be made. Failure to do so will jeopardize any consideration.

Missed	Action Student Should Take
Regular Class	Check the website to obtain notes, homework, and/or assignments BEFORE the following class.
Quiz	You must <u>follow-up with the teacher and provide confirmation</u> (parental note or parents call teacher or on an official field trip or team list) that the absence was excused . For most legitimate absences the teacher will offer a make-up quiz at his or her convenience.
Test	MISSING A TEST IS A SERIOUS MATTER. The teacher should be informed as soon as possible and consulted <u>the morning of your return to school</u> . This action, on your part, is very important as it shows initiative and maturity in handling missed work. For a legitimate absence for a test, a parental phone call on the day of your absence explaining why you missed the test must be made. You will then be permitted to write a make-up test at a time arranged by your teacher. An effort will be made to accommodate you but please be aware that tests are time sensitive. Be prepared to write the day you come back.
Lab	You will not receive marks for an experiment that you have NOT performed. In the case of absence, arrangements must be made to make up the experiment as soon as possible. Lab experiments are also time sensitive; as soon as the marked reports are passed back, you can no longer make up the lab and may receive zero for the experiment.

Final Thought:

To do well in chemistry requires time and effort. Unfortunately, we cannot make you learn. So please do not think by just sitting in class and taking notes will make you successful in chemistry. Coming to class prepared can help you to achieve an excellent mark in chemistry. This means before you come to class you are:

- reading relevant sections in the text; and reading them critically
- reading over your notes from the previous class
- writing down questions you can ask to clarify your understanding
- attempting all assigned homework questions or seeking clarification from teacher if a question is difficult
- visiting me in my office or make an appointment to get extra help
- retrieving any missed work from the course website

Most of all take charge of your education, remain engaged, organized and prepared and you will be successful!

Unit 1: Grade 11 review

1. Periodic table
2. Periodic trend
 - a) Radius
 - b) (first and second) Ionization energy (For metal)
 - c) Electronegativity (For non-metal)
3. Naming
 - a) Ionic compound
 - b) Molecular compound (including polyatomic ions)
 - c) Acid (with oxygen & w/o oxygen)
4. Basic Lewis structure (Exception octet rule in Unit 2)
5. Stoichiometry
 - a) Balance chemical reaction
 - b) Type of reactions
 - c) Determine limiting reactant
 - d) Calculation

You will have a quiz on Grade 11 review.

Unit 2: Atomic bonding

1. History of the Atomic Model
TED-ed Video: <https://ed.ted.com/lessons/the-2-400-year-search-for-the-atom-theresa-doud>
 - a) Dalton – billiard ball
 - b) Thomson-Plum pudding, discovered electron
 - c) Rutherford – gold foil experiment, discovered proton
https://www.youtube.com/watch?v=5pZj0u_XMbc
 - d) Bohr – energy level of electrons (quantum)

2. Quantum Mechanical Model
 - a) De Broglie – wave particle duality
 - b) Heisenberg – Uncertainty principle
 - c) Schrodinger – Equation of electron probability (orbitals)

A great explanation of the quantum mechanical model:

<https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms/orbitals-and-electrons/a/the-quantum-mechanical-model-of-the-atom>

3. Quantum numbers
 - a) Principle quantum number – energy level – n (1, 2, 3...)
 - b) Orbital angular momentum quantum number – shape l – s, p, d, f...
 $l = n - 1$
 - c) Magnetic quantum number – orientation $m_l = -l \rightarrow l$
 - d) Electron spin quantum number - m_s
4. Electron configurations
 - a) Energy level diagrams
 - b) Complete electron configurations
 - c) Condensed electron configurations
 - d) Aufbau principle: electrons get added lowest energy level and go up
 - e) Hund's Rule: fill the empty orbital
 - f) Pauli's Exclusion Principle: Opposite spins
 - g) Exceptions - (This is extra, and goes beyond the course)
 - completely full or half full d-sub-level is more stable than a partially filled d sub-level.
 - In reality, energy level of 4s is slightly higher than 3d. This explains how to make positive ions from d-block.

A great explanation of some exceptions:

<http://www.chemguide.co.uk/atoms/properties/3d4sproblem.html>

5. Lewis structure
 - a) Steps:
 - count valence e-

- place electrons in bond (least EN in middle, look for symmetry, H always on end)
 - fill valence shell of outer atoms
 - fill valence shell of central atoms
 - move electrons into double or triple bonds to make octets
- b) Exceptions
- expanded/overfilled octet (3rd period)
 - resonance structure (formal charge)
6. VSEPR
Use the simulation to help understanding:
<https://phet.colorado.edu/en/simulation/molecule-shapes>
7. Types intramolecular force
- a) London dispersion
 - b) Dipole-dipole
 - c) Hydrogen bonding
 - d) ion-dipole
 - e) ion induced dipole
 - f) effect on properties: melting point, boiling point, vapour pressure
8. Crystal types
- a) Ionic crystals
 - b) molecular crystals
 - c) covalent crystals
 - d) metallic crystals
 - e) amorphous solids

Unit 3: Organic chemistry

1. Hydrocarbons
- a) Types: Saturated vs. unsaturated; aliphatic vs. cyclic vs. aromatic; Alkanes vs. alkenes vs. alkynes
 - b) Naming
 - c) Isomers: cis vs. trans
 - d) Properties: boiling point
 - e) Reactivity
 - Alkanes < aromatics < alkenes < alkynes
 - Combustion – complete and incomplete
 - Substitution
 - Addition: hydrogenation, halogenation, hydrohalogenation
 - Markovnikov's rule
 - f) Aromatics
 - Hybridization in benzene, stability
 - Substitution reaction
 - Naming <https://www.youtube.com/watch?v=jMonOaN72wo>
2. Hybridization of carbon
- a) sp³, sp², sp hybridization
 - b) pi and sigma bonds

Video 1:

<https://www.youtube.com/watch?v=JxNpU3Ky7xA>

Video 2:

<https://www.youtube.com/watch?v=hHHJhVRzhP8>

Video 3:

<https://learning.hccs.edu/faculty/komala.krishnaswamy/chem-1411-supplementary-links-videos-websites/valence-bond-theory-ethane-ethylene-acetylene>

Video 4:

<https://www.youtube.com/watch?v=cPDptc0wUYI&feature=youtu.be&t=5m32s>

3. Functional groups
- a) Naming
 - Halo-alkane
 - Alcohol
 - Aldehyde

- Ketones
 - Carboxylic acid
 - Ester
 - Ether
 - Amine
 - Amide
- b) Properties
- Polarity, hydrogen bonds, solubility
 - Melting/boiling point
 - Application: How soap works
- Video 1: https://www.youtube.com/watch?v=NjZDTiV2s_w
- Video 2:
<https://www.youtube.com/watch?v=xHglmUQnrqo>
- c) Reactions:
- Addition
 - Substitution
 - Elimination
 - Oxidation
 - Dehydration
 - Condensation
- d) LAB: Esterification OR Reaction of Alcohols

Online Functional Group Naming QUIZ: <https://orgchem101.com/nom/en/>

4. Polymers

- a) Natural polymers
- b) Addition polymers
- c) Condensation polymers

Unit 4: Energy & Rates in chemical reactions

Unit 5: Acid and bases

1. Characteristic of acid and bases
2. 6 strong acids and strong bases
3. Bronsted Lowry theory: Conjugate acid-base pair
4. Amphoteric substances
5. PH and POH value
6. Ka and Kb constant and involving calculation
7. Titration
8. Salt hydrolysis
9. Acid-base indicators
10. Buffers