Lakeside View Global Vision
CEGEP JOHN ABBOTT COLLEGE

Chemistry of the Environment

Discipline:	Chemistry	Semester:	Fall 2020
Course Code:	202-DDN-05	Instructor:	Ed Hudson
Competency Code:	00UV	e-mail:	edward.hudson@johnabbott.qc.ca
Ponderation:	3-2-3	Tel:	(514) 457-6610 ext. 5684
Credits:	2.67	Office Hours:	Posted on Léa.
Prerequisites:	202-NYB-05 & 202-NYA-05 (Chemistry)		***Note that all office hours will be held via the web (online)***
Lectures:	Monday & Thursday 2:30-4:00 Online (MS Teams)		
Labs:	Friday 12:30-2:20 or 2:30-4:20 Room AME-432 or online, as announced		

Because much of this course will take place online, MIO will be especially important for communication. Please check your MIO regularly.

Please do not use MS Teams messaging to communicate with the instructor outside of class time (please use MIO instead).

John Abbott College is located on unceded Indigenous lands, the traditional territory of both the Kanien'kehá:ka ("Mohawk") and the Omàmiwinini ("Algonquin") peoples.

Note on terminology: Parts of this document are written in the active voice. "I" or "me" refers to the course instructor, Ed Hudson. "You" refers to a student enrolled in the course. "We" or "us" refers to the community of the students and instructor.

B: Introduction

Chemistry of the Environment (for science students) is an option course in the science program. It is specifically designed to partially fulfill the requirements of objective 00UV and is normally taken by science students after they have completed at least two semesters of the program.

Chemistry provides a rich set of tools with which to understand our fascinating living and non-living environment, including the nature and behavior of substances in the atmosphere, natural waters, the solid earth and organisms, and how substances move between these. At the same time, human activities are altering the environment, globally and at unprecedented speed, in ways that often negatively affect human societies and ecosystems. A related concern is the overuse and depletion of finite natural resources. Thus, altered or contaminated environments and the undisturbed environments which preceded them must be studied in tandem.

This course explores selected current issues in environmental studies using the framework and methods of chemistry, and with reference to the chemical compounds and processes involved. Tools or insights from physics, mathematics, biology, earth sciences and economics are also invoked. You will assess the condition of natural or modified environments, and the effect of naturally occurring substances and contaminants on environmental and biological systems. You are encouraged to use these insights to propose and evaluate solutions to environmental problems, and to critically evaluate the environmental impacts of choices which individuals or societies might make.

This course can contribute to the Environmental Studies certificate. For more information, talk to the teacher or contact the certificate coordinator at envirostudies@johnabbott.qc.ca

Comprehensive Assessment and Integration in the Science Program

The Ministry of Education requires every student to pass a program Comprehensive Assessment and a program integrating activity (Exit Profile Competency 14: "to apply what has been learned to new situations" and Ministry objective 00UU: "to apply acquired knowledge to one or more subjects in the sciences"). The Ministry introduced these requirements because it recognized the importance of connecting the various components within each program.

The various competencies to be addressed in the Science Program are outlined in the outcomes and standards of the Science Program Exit Profile and are listed below. They are divided into two groups: those competencies that are taught and assessed in virtually every course in the program, and those that will be the primary focus of the option courses.

The following competencies are taught and assessed in most courses of the program:

3. To apply the scientific method.
4. To apply a systematic approach to problem solving.
5. To use appropriate data processing techniques.
6. To reason with rigour, i.e., with precision.
8. To learn in an autonomous manner.
13. To display attitudes and behavior compatible with the scientific spirit and method.
14. To apply what has been learned to new situations.

The following competencies will be the special focus of the option courses of the program:

7. To communicate effectively.
9. To work as a member of a team.
10. To recognize the links between science, technology and the evolution of society.
11. To develop a personal system of values.
12. To put into context the emergence and development of scientific concepts.

Rather than impose a major exam or paper at the end of the Science Program, or requiring a single course to fulfill these requirements, John Abbott College has integrated the fulfillment of these requirements into the option courses taken late in the program.

Some option courses in the Science program at JAC, including 202-DDN-05, offer the opportunity to complete the Comprehensive Assessment. Passing the Comprehensive Assessment in any one of these courses will fulfill the Comprehensive Assessment requirements for obtaining a Science D. E. C. at JAC.

C: Course Objectives

OBJECTIVES **STANDARDS**

Statement of the Competency:

To explore in a systematic manner a number of current issues in environmental chemistry.(00UV)

General Performance Criteria:

- Appropriate choice of concepts, laws and principles
- Rigorous application of the concepts, laws and principles
- Appropriate use of terminology
- Adequate mathematical or graphical representation
- Coherence, rigour and justification of the problem-solving methods
- Respect for the scientific method and experimental protocol
- Justification of the method
- Critique of the credibility of the results
- Use of an interdisciplinary approach (00UU)

Elements of the Competency:

1. To apply the laws and principles of natural sciences to the study of the air, water and soil environment and their pollution.

2. To apply scientific procedures and methods to the resolution of some environmental problems.

3. To apply experimental techniques of the natural sciences to analyse environmental samples.

4. To undertake an interdisciplinary project that integrates current learning and which demonstrates competence in three specific goals of the exit profile at the advanced level (00UU).

Specific Performance Criteria:

Specific performance criteria for each of the elements of the competency are shown below along with the corresponding **Intermediate Learning Objectives.** *For the items in the list of learning objectives it is understood that each is preceded by:*

'The student is expected to .....'

D: Evaluation Plan

Assessment	*Ponderation**	*Elements of the Competency*
Test 1**(Thursday October 1)	11 %	1, 2
Test 2** (on-site) (Monday November 9)	14%	1, 2
Final Exam**	20%	1, 2, 3
Laboratory work**	20%	3
Comprehensive Assessment Project (Late November)	15 %	4
Quizzes and assignments	20%	1, 2

*Base ponderation. You will be informed ahead of time what each individual laboratory experiment, quiz and assignment is worth.

** *Will take place wholly (tests and exam) or partly (labs) on-site (on the JAC campus)*

- You may drop the lowest of the two test marks, if it is lower than the final exam mark. In that case, the remaining test is worth 14% of the final grade, and the final exam is worth 31% of the final grade. This is not available if you are assigned a grade of zero on a test because of cheating.
- To pass the laboratory portion of the course, a minimum of 60% of the total laboratory grade must be obtained. Failing this, a laboratory grade of zero will be given and a maximum grade of 55% will be allowed for the course.
- If you pass the laboratory portion of the course, a grade of 60% or more on the final exam will guarantee a pass in the course.
- The final evaluation for this course is comprised of the Final Exam (20%), the Laboratories (20%) and the Comprehensive Assessment Project (15%).

E: Required Texts and Course Costs

There is no set textbook for this course. All necessary worksheets and handouts, including the laboratory manual, will be made available on Omnivox (Léa). Other useful resources are listed in Section G (Bibliography)

Other Course Costs

Course costs are mainly associated with the laboratory sessions.

1. *Safety glasses must be worn at all times in the laboratory*. Good quality safety glasses are available from the bookstore or from most hardware stores (approx. $10). You may wear normal prescription glasses.
2. A sturdy cotton lab coat is required (approx. $20).
3. A dedicated laboratory notebook (approx. $1-3) is required. You will receive instructions concerning this notebook during the first two days of the course.
4. For any onsite (at JAC) activities this semester, including our labs and tests, a face mask is required.

Please be especially certain to bring your lab coat and safety glasses to all lab sessions. Due to COVID-19-related health precautions, I will be not be able to lend you any.

F: Course Content

Tentative number of classes for each section is indicated in square brackets. Where indicated (*), this may include sessions scheduled in the lab timeslot.

1. The Global Environment and the Tools of Environmental Chemistry [8*]

1.1 Environmental compartments	1.1.1 Describe and link components (both abiotic and biotic) of the global environment and identify material flows between them.
1.2 Biogeochemical cycles	1.2.1 Explain the environmental and redox cycling of selected elements.
1.3 Sampling & chemical analysis [a]	1.3.1 Identify and distinguish steps, components and limitations of a chemical analysis as these relate to environmental samples. 1.3.2 Calculate basic statistical descriptors of environmental quantities
1.4 Modelling & Fermi estimation	1.4.1 Discuss the role of numerical modelling in environmental studies. 1.4.2 Articulate a strategy, data needs and reasonable simplifications for calculating environmentally relevant quantities.

[a] *Topic will be addressed throughout the course as it arises in the context of each environmental compartment*

2. The atmosphere and climate: composition, processes and anthropogenic changes [10]

2.1 Atmospheric properties and composition	2.1.1 Describe the large-scale structure and chemical composition of the atmosphere. 2.1.2 Appreciate the role of radicals in atmospheric processes and anticipate how they will behave in simple gas-phase reactions.
2.2 Tropospheric chemistry: pollutants resulting from combustion, smog	2.2.1 Describe the sources and health effects of selected urban air pollutants. 2.2.2 Explain the basic chemical reactions involved in photochemical smog formation. 2.2.3 Describe measures to control photochemical and particulate air pollution.
2.3 Stratospheric chemistry: ozone formation and depletion	2.3.1 Describe naturally occurring sources and sinks for stratospheric ozone and its importance to the biosphere. 2.3.2 Identify and describe the compounds and reactions responsible for stratospheric ozone depletion. 2.3.3 Discuss control & replacement of ozone-depleting compounds.
2.4 Acid deposition	2.4.1 Describe the sources, effects and control of acidifying pollutants.
2.5 Climate change	2.5.1 Describe what climate is and what determines climate on a planet-wide scale. 2.5.2 Explain how the greenhouse effect operates. 2.5.3 Describe the sources, relative importance and concentration trends of major greenhouse gases. 2.5.4 Describe lines of experimental evidence for climate change and the components of climate models.

2.5.5 Discuss the evidence that human activity is causing climate change, and what the consequences of climate change will or may be.
2.5.6 Describe and evaluate actions (current and potential) to mitigate or respond to human-induced climate change.

3. The Hydrosphere: natural and modified waters and dissolved substances [9]

3.1 Composition of natural and treated waters	3.1.1 Compare and contrast the composition of different natural waters. 3.1.2 Describe the quality and treatment of drinking water and wastewater. 3.1.3 Identify global changes to the hydrosphere which are currently occurring.
3.2 Redox chemistry of natural waters	3.2.1 Define and describe the oxic status of natural and polluted waters. 3.2.2 Explain and predict how the oxic status of waters influences the oxidation state of elements in the environment. 3.2.3 Identify and describe the chemicals and processes responsible for oxygen depletion in aquatic environments.
3.3 Toxic and redox-active metals and organic pollutants	3.3.1 Explain dose, response and accumulation in the context of (potentially) toxic substances. 3.3.2 Describe the sources, environmental behaviour, and effects of selected metals in aquatic systems. 3.3.3 Recognize the structures of selected organic pollutants and predict some of their properties. 3.3.4 Describe the sources, environmental behaviour and effects of selected organic pollutants, including emerging organic contaminants (PPCPs)

4. Soils- structure, composition and properties [3*]

4.1 Soil structure and properties	4.1.1 Compare and describe the physical nature and chemical composition of selected soils. 4.1.2 Describe and determine selected physical and chemical properties of soils and relate these to soil ecosystem services.

6. Sustainability and Green Chemistry [2]

6.1 Sustainability and Life Cycle Analysis	6.1.1 Define sustainability.[b] 6.1.2 Assess on what grounds a process or activity might be considered sustainable.[b] 6.1.3 Identify and explain the stages in a product's life cycle.
6.2 Green Chemistry	6.2.1 Describe selected principles of green chemistry and apply them in assessing how 'green' a synthetic or manufacturing process is.

[b]*These ideas will also be introduced and reinforced in other parts of the course.*

G: Bibliography

The following books may be helpful. Many are available either in the JAC library or on the web. The three bulleted titles are comprehensive texts on environmental chemistry and are on reserve in the library. Many of the other titles deal with more specific topics.

- Baird, C., Cann, M., *Environmental Chemistry*, 5th ed., WH Freeman, New York, 2012, 776 pp.*
- Spiro, T.G., Purvis-Roberts, K.L., Stigliani, W.M., *Chemistry of the Environment*, 3rd ed, University Science Books, Mill Valley, CA, 2012, 615 pp.*
- VanLoon, G.W., Duffy, S.J., *Environmental Chemistry: a global perspective*, 3rd ed., Oxford University Press, 2011, 545 pp.*

Andrews, J.E., Brimblecombe, P., Jickells, T.D., Liss, P.S., Reid, B., *An Introduction to Environmental Chemistry*, 2nd ed, Blackwell Science, Oxford, 2004, 296 pages. Available on the web: goo.gl/2SV8y7

Eash, N.S., Sauer, T.J., O'Dell, D., Odoi, E., *Soil Science Simplified*, John Wiley, 2015, 260 pp.*

Harte, J., *Consider a Spherical Cow- A course in Environmental Problem Solving*, University Science Books, Mill Valley, CA, 1988, 283 pp.*

Hobbs, P.V., *Introduction to Atmospheric Chemistry*, Cambridge Univ. Press, Cambridge, 2000, 262 pp.

Houghton, J., *Global Warming-The Complete Briefing*, 5th ed., Cambridge University Press, Cambridge, 2015, 380 pp.*

Lancaster, M., *Green chemistry: an introductory text*, RSC Publishing, Cambridge, 2010, 340 pp.*

Libes, S. M., *An Introduction to Marine Biogeochemistry*, John Wiley, New York, 1992, 734 pp.

Weil, R.R., Brady, N.C. *The Nature and Properties of Soils*, Pearson/Prentice Hall, Upper Saddle River, NJ. [Approx. 1000 pp.; any recent edition is worthwhile]

*Available at the JAC Library. Several are available as e-books.

H: Teaching Methods

The course will be 75 hours, nominally divided into classroom and laboratory periods.

There will be two 1.5-hour periods per week, designated 'classroom' periods, where we will meet online. New material will be introduced, and you will have opportunities for practice and problem-solving. *Your participation is expected, and grades may be associated with these activities.* Preparation for upcoming laboratory sessions may also be discussed during this time, and we expect to welcome several guest speakers during the term, to the extent that the online format allows.

There will be one 2-hour laboratory period per week. During the first 9 weeks of the term, you will have an on-site (at JAC) laboratory session every *second* week during weeks 2-9; expect to use the other week independently, for sample collection or for data analysis. Further 'laboratory' sessions (week 10 onwards) will be web-based (online) and may be used for workshops.

On-site experiments will follow the John Abbott College COVID-19 Safety Rules.

I: Departmental Policies

Normal attendance policies (below) notwithstanding, ***please do not come to in-person labs or tests if you are sick or showing any COVID-19 related symptoms.*** *Be assured that we will arrange make up work or some alternative. Our overriding concern this semester is protecting everyone's health. Thank you in advance for your co-operation.*

a) Attendance policy: (*Policy 6*) Students are expected to attend all lecture and laboratory sessions. Students are responsible for all assigned work, lecture material and other course related material announced or assigned during class. Attendance for laboratory periods is mandatory. Missing a lab period without a valid reason will result in a grade of zero being assigned to any work assigned during that period.

b) Policy relating to late submission: (*Policy 7*) All assigned work is to be submitted on time. You may use this course's 'late days' system (see details posted on Léa) to your advantage, although I urge you to do so carefully and responsibly.

c) Cell phones, computers and other electronic devices may only be used during class for pedagogical purposes. (*Policy 13)*

Please Note:

1. This course uses chemicals as part of its normal teaching practices. If you have experienced allergic reactions in the past due to any particular chemical(s), you must inform the instructor. If you experience an allergic reaction at the college, you should report to Campus Security immediately (local 6911, or 514-457-6911).
2. You are expected to behave respectfully towards your classmates and teachers. In case of inappropriate behaviour, you will be asked to leave the class or the lab session. If an assessment is planned for this session, a mark of zero will be given in that case.

   These expectations also apply to online settings, including posts in class chats and forums. Please read, and abide by, the college's document "Online civility & student code of conduct", which is posted on Léa (and in several other places).

J: College Policies

Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. The normal attendance expectations are outlined above and your teacher will inform you of any modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the fall semester.

Please note that course outlines may be modified if health authorities change the access allowed on-site.

In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.

Classes on Teams may be recorded by your teacher and subsequently posted on Teams to help for study purposes only. If you do not wish to be part of the recording, please let your teacher know that you wish to not make use of your camera, microphone or chat during recorded segments. Any material produced as part of this course, including, but not limited to, any pre-recorded or live video is protected by copyright, intellectual property rights and image rights, regardless of the medium used. It is strictly forbidden to copy, redistribute, reproduce, republish, store in any way, retransmit or modify this material. Any contravention of these conditions of use may be subject to sanction(s) by John Abbott College.

Policy No. 7- IPESA, Institutional Policy on the Evaluation of Student Achievement
http://departments.johnabbott.qc.ca/wp-content/uploads/2017/08/Policy-7-IPESA.pdf

a) **Changes to Evaluation Plan in Course Outline** (Article 5.3).
All changes to evaluation plan in the course outline must have documented unanimous consent from the regularly attending students affected by the change(s) before submission.

b) **Evaluation** (Article 6)
Teachers should evaluate and enter grades for a sufficient number of assessments in Gradebook in order that the College may advise DEC students of their progress by mid semester as per the ACADEMIC PROCEDURE: Academic Progress by Mid Semester.

c) **Religious Holidays** (Article 3.2)
Students who wish to miss classes in order to observe religious holidays must inform their teacher of their intent, in writing, within the first two weeks of the semester.

d) **Student Rights and Responsibilities** (Article 3.2 and Article 3.3)
It is the responsibility of students to keep a copy of all assessed material returned to them and/or all digital work submitted to the teacher for at least four (4) weeks past the grade submission deadline (See current Academic Calendar) in the event that they request a Final Grade Review (Refer to Article 8)
Students have the right to receive graded evaluations, for regular day division courses, within two weeks after the due date or exam/test date, except in extenuating circumstances. A maximum of three (3) weeks may apply in certain circumstances (ex. major essays) if approved by the department and stated on the course outline

e) **Cheating and Plagiarism** (Article 9)
Cheating and plagiarism are serious infractions against academic integrity which is highly valued at the College; they are unacceptable at John Abbott College. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.

College definition of cheating:
Cheating means any dishonest or deceptive practice relative to examinations, tests, quizzes, lab assignments, research papers or other forms of evaluation tasks. Cheating includes, but is not restricted to, making use of or being in possession of unauthorized material or devices and/or obtaining or providing unauthorized assistance in writing examinations, papers or any other evaluation task and submitting the same work in more than one course without the teacher's permission. It is incumbent upon the department through the teacher to ensure students are forewarned about unauthorized material, devices or practices that are not permitted.

College definition of plagiarism:
Plagiarism is a form of cheating. It includes copying or paraphrasing (expressing the ideas of someone else in one's own words), of another person's work or the use of another person's work or ideas without acknowledgement of its source. Plagiarism can be from any source including books, magazines, electronic or photographic media or another student's paper or work.

- For PowerPoint on cheating and plagiarism**,** refer to the JAC Portal: My JAC Communities / Academic Council / Curriculum Validation Committee (CVC) / Course Outlines – Reference Documents / Academic Integrity.
- For link to interactive tutorial on how to cite sources correctly: http://citeit.ccdmd.qc.ca

K. Further note on cheating and plagiarism

Cheating and plagiarism are taken ***very*** seriously. Any instance (even a first instance) of cheating or plagiarism ***will*** result in failure on the assessment and ***will*** be reported to the college. "I didn't know" does not constitute a defence or excuse.

You will be provided with tools and examples (including in the laboratory manual, the *JAC Science Style Guide*, and an exercise during class time) for documenting sources and ideas in your work. Please do not be shy about asking me for further advice or guidance.