JOHN ABBOTT COLLEGE COURSE OUTLINE

A. GENERAL INFORMATION:

1. Program name:	Science
2. Course title:	**Chemistry of the Environment**
3. Course and section number(s):	202-DDN-05
4. Ponderation (weekly class – lab/fieldwork – homework hours):	3-2-3
5. Credits:	$2^2/_3$
6. Competency statement and code:	To explore in a systematic manner a number of current issues in environmental chemistry (00UV)
7. Prerequisite:	202-NYB-05 and 202-NYA-05 (Chemistry)
8. Semester:	Fall 2022
9. Teacher name and pronouns:	
10. Office number, phone extension, e-mail:	
11. Teacher's availability:	

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:

Land Acknowledgement: *At John Abbott College we acknowledge that we are on unceded Indigenous lands of the traditional territory of both the Kanien'kehá:ka, "Mohawk," and the Anishinabeg, "Algonquin," peoples.*

We are grateful for the opportunity to gather here and we thank the many generations of people who have taken care of this land and these waters. Tiohtiá:ke, Montreal, is historically known as a gathering place for diverse First Nations; thus, we recognize and deeply appreciate the historic and ongoing Indigenous connections to and presence on these lands and waters. We also recognize the contributions Métis, Inuit, and other Indigenous peoples have made in shaping and strengthening our communities.*

Together, as a diverse college community, we commit to building a sincere relationship with Indigenous peoples based on respect, dignity, trust, and cooperation, in the process of advancing truth and reconciliation.

Course summary: Chemistry of the Environment (for science students) is an option course in the science program. It is specifically designed to fulfill the requirements of objective 00UV.

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 (including humans), and how substances move between these. At the same time, human activities are altering the environment depleting finite natural resources, globally and at unprecedented speed, leading to a climate and ecological emergency. It is therefore important to study, in tandem, both altered or contaminated environments and the undisturbed environments which preceded them.

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 both naturally occurring substances and contaminants on environmental and biological systems. You are encouraged to use these insights to propose and evaluate solutions to facets of the climate and ecological emergency, and to critically evaluate the environmental impacts of choices which individuals, institutions 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

Role and place of the course: A science DEC requires three (3) science option courses, normally taken in your second year, building on the core science courses, and with a deeper focus on an area of interest. 202-DDN-05 is one such course.

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 that are taught and assessed in virtually every course in the program, and those that are 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 are the special focus of the option courses of the program, including this course (202-DDN-05):

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 such courses, including 202-DDN-05, offer the opportunity to complete the Comprehensive Assessment. Passing the Comprehensive Assessment in this course therefore fulfills the Comprehensive Assessment requirements for obtaining a Science D. E. C. at JAC.

C. COURSE OBJECTIVES:

Objectives: To explore in a systematic manner a number of current issues in environmental chemistry.
1. Apply the laws and principles of natural sciences to the study of the air, water and soil environment and their pollution.
2. Apply scientific procedures and methods to the resolution of some environmental problems.
3. Apply experimental techniques of the natural sciences to analyse environmental samples.
4. 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) (see section B, under “Comprehensive Assessment”).
Upon successful completion of this course, students will be able to: • Make appropriate use of concepts, laws and principles. • Rigorous apply the concepts, laws and principles • Use terminology appropriately • Adequately use mathematical or graphical representation • Demonstrate coherence and rigour, and justify problem-solving methods • Respect the scientific method and experimental protocol • Justify the method used • Critique of the credibility of the results • Use an interdisciplinary approach (00UU)

D. EVALUATION PLAN:

Evaluation type:	%	Tentative date(s):	Link to competencies/objectives/ competency elements:	√ if part of final evaluation
Three (3) tests (all equal weight)	25	Sept 28, Nov 2, Dec 5	1,2	
Final exam	23	Mid-December	1, 2, 3	√
Laboratory work	20	Almost weekly	3	√
Quizzes and assignments	17	At instructor's discretion	1,2	
Comprehensive Assessment Project	15	December 2	4	√
Total value:	100			
Value of final evaluation:	58			

- You may drop the lowest of the three test marks, if it is lower than the final exam mark, so that the remaining tests are worth 16% of the final grade, and the final exam is worth 32% 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, you must obtain a minimum of 60% of the total laboratory grade. 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.

E. COURSE CONTENT:

Topics:	Additional Info:
1. The Global Environment and the Tools of Environmental Chemistry	
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	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.

(continues on pages 5 & 6)

2. The atmosphere and climate: composition, processes and anthropogenic changes	
2.1 Atmospheric properties and composition	2.1.1 Describe the large-scale structure, chemical composition and evolution 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 (see also 2.1.1). 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. 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 are and will/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	
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 and explain 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.

4. Soils: nature and significance	
4.1 Soil structure, composition and properties	4.1.1 Describe, determine and compare selected physical and chemical properties of soils. 4.1.2 Relate soil properties to soil ecosystem services.
5. Sustainability and Green Chemistry	
5.1 Sustainability and Life Cycle Analysis	5.1.1 Define sustainability. 5.1.2 Assess on what grounds a process or activity might be considered sustainable. 5.1.3 Identify and explain the stages in a product's life cycle.
5.2 Green Chemistry	5.2.1 Describe selected principles of green chemistry and apply them in assessing how 'green' a synthetic or manufacturing process is.

F. REQUIRED TEXTBOOKS/MATERIALS AND COURSE COSTS:

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

Item:	Estimated cost ($):
Safety glasses (available from the JAC bookstore or from most hardware stores). Normal prescription glasses may be worn.	$10
Cotton lab coat	$25
Dedicated laboratory notebook (no removable pages). 32 pages are probably enough.	$1-3

G. BIBLIOGRAPHY

Suggested books, articles, videos, websites, podcasts that can supplement the course material:

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. Many of the other titles deal with more specific topics. The three bulleted titles are in the library, and I have an additional copy of each; I encourage you to borrow and use them.

Starred (*) titles are available at or via the JAC Library (several as e-books).

- 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.*

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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.

Mann, M. E. *The New Climate War*. Public Affairs, New York, 2021, 351 pages.*

UN Intergovernmental Panel on Climate Change (IPCC), https://www.ipcc.ch/. All the IPCC's reports can be found at that address.

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]

I will post web resources and journal articles relevant to our course on Léa on an ongoing basis. I encourage you to also share any you might find.

H. INSTRUCTIONAL METHODS:

Methods used in teaching the course:
The course will be 75 hours, nominally divided into classroom and laboratory periods. **Classroom sessions:** 45 hours 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. **Laboratory Sessions:** 30 hours Laboratory sessions may also be used for workshops or field work. Several sessions involve going outside- please prepare/dress accordingly.

I. PROGRAM, DEPARTMENTAL/DISIPLINE, AND COURSE/SECTION POLICIES:

Policy:	Description:
Department 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. *However, **please do not come to campus if you are showing any COVID-19-related symptoms unless you have tested negative.** Be assured that I will arrange make up work or some alternative.*
Policy to ensure that issues relating to late submission, or resubmission, of work to be dealt with in an equitable manner (Policy 7).	All assigned work is to be submitted on time. Late submission may be accepted, with or without penalty, at the discretion of individual instructors.
Policy dealing with the expectations of classroom behaviour, including use of cell phones, laptops and other technology (Policy 13).	Use of personal electronic devices is permitted in the classroom or laboratory with teacher's permission.
Other expectations.	1. If you miss an evaluation session or deadline due to illness or other valid reason, you must notify your instructor as soon as possible. If a test is missed for a valid reason, then the final exam mark can be used as a basis for a substitute for the missed test mark. 2. A special note concerning the use of chemicals: this course uses chemicals as part of its normal teaching practices. If a student has experienced allergic reactions in the past due to any particular chemical or chemicals, he or she must inform the instructor. In the event that an allergic reaction is experienced at the college, the student should report to Campus Security immediately (local 6911, or 9-514-457-6911). 3. Students are expected to behave respectfully towards their classmates and teachers. In case of inappropriate behaviour a student 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.

J. COLLEGE POLICIES:

Topic:	Resource:
Student rights and responsibilities (articles 3.2 and 3.3)	Policy 7:IPESA - Institutional Policy on the Evaluation of Student Achievement (version: June 12, 2019)
Changes to evaluation plan in the course outline (article 5.3)	
Religious holidays (articles 3.2.13 and 4.1)	
Cheating and plagiarism (articles 9.1 and 9.2)	
Cheating and plagiarism academic procedure and other resources	Academic Integrity: Cheating and Plagiarism Procedure (version: October 22, 2021) • **You need to log into Omnivox to access the above document** • **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
Code of conduct	Policy 13: Policy on Student Conduct and Discipline Procedures (version: September 21, 2021)

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.

L. PROVISO:

- Attendance: Due to the ongoing pandemic health issues, attendance policies may need to be adjusted by your teacher. The normal attendance expectations are outlined above (Section I) 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 semester.
- Please note that course outlines may be modified if health authorities change the access allowed on-site. This includes the possibility of changing between in-person and online formats.