

## **Environmental Sciences: The Energy Dilemma**

### **JOHN ABBOTT COLLEGE**

Discipline:	Chemistry	Semester:	Winter 2015
Course Code:	202 – ENV-AB	Instructor:	
Objectives:	00UV	Office:	
Ponderation:	3-2-3	Tel:	
Credits:	2.67	Office Hours	
Pre-requisite:	202-NYB-05 & 202-NYA-05 (Chemistry)	Instructor:	
	203-NYA-05 & 203-NYB-05 (Physics)	Office :	
Not allowed with:	202-DDN-05 or 203-ENV-AB	Tel:	
		Office Hours:	

### **B: Introduction**

Environmental Sciences: The Energy Dilemma is an Option Course in the Science Program, specifically designed to partially fulfill the requirements of objective **00UV**. As such it is normally taken by science students after they have completed at least two semesters of the program.

This course is about energy, the methods we use to extract and convert it, and the adverse environmental affects these practices have on our planet. As the material wealth of modern western society is largely a result of our heavy use of fossil fuels since the beginning of the industrial revolution, we will study how we find, process and distribute these limited fuels. The repercussions of our heavy dependence on fossil fuels will be studied through the environmental impact of toxins in our air and water. We will analyze global warming and its consequences both on ecosystems and on human societies. The green economy will be examined through alternative energy sources. From wind farms to fuel cells, the benefits and limitations of proven and emerging technologies will be discussed and debated.

## **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 course (See exceptions below) in the Science program at JAC offers the opportunity to complete the Comprehensive Assessment. Passing the Comprehensive Assessment in any one of these courses will fulfill the CA requirements for obtaining a Science D. E. C. at JAC.

There are three exceptions: Organic Chemistry I (202-DCP-05), Organic Chemistry II (202-DDB-05) and General Biology II (101-DCN-05). Passing the Comprehensive Assessment component in one of these courses will be insufficient for obtaining a D. E. C.; the student will also need to pass the Comprehensive Assessment in any other option Science course, including the other two already listed. For example passing the Comprehensive Assessment in both Organic Chemistry I and General Biology II will be sufficient; so will completing it in Organic Chemistry I and Physics for Engineers.

C: Course Objectives**OBJECTIVES****STANDARDS****Statement of the Competency:**

To explore the relationship between our dependency on fossil fuels as our energy sources and the resulting environmental consequences .(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 energy issues of our modern society.
2. To apply scientific principles in assessing ways of securing our society's energetic future.
3. To apply experimental techniques of the natural sciences to analyse environmental samples and build energy-generating devices.
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: Course Content****1.0 Energy and Fossil Fuels**

- 1.1 The Need for Energy
  - 1.1.1 Explain the energy requirements for all living organisms.
  - 1.1.2 Discuss the evolution of energy sources from peat bog to nuclear reactor.
  - 1.1.3 Compare the stored chemical energy in fossil fuels.
  - 1.1.4 Identify Nature's potential energy in wind, solar, geothermal and tidal power.
- 1.2 Energy Demands
  - 1.2.1 Summarize pre-industrial revolution energy needs.
  - 1.2.2 Explain the evolution of electricity for the masses.
  - 1.2.3 Summarize the energy demand explosion in the last decades.
- 1.3 Fossil fuels
  - 1.3.1 Describe the formation of fossil fuels.
  - 1.3.2 Discuss the prospecting for fossil fuels.
  - 1.3.3 Identify extraction processes of fossil fuels.
  - 1.3.4 Study the transportation economics of fossil fuel.
- 1.4 Energy production from fossil fuels
  - 1.4.1 Explain the inner workings of a coal plant.
  - 1.4.2 List the various fractions of oil and their uses for different energy needs.
  - 1.4.3 Discuss the role of natural gas in industry
- 1.5 Fossil fuels in the near future
  - 1.5.1 Discuss peak oil and its consequences
  - 1.5.2 Summarize global coal and natural gas reserves
  - 1.5.3 Discuss how the tar sands make Canada a major player on the world oil stage

## 2. Environmental Consequences

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|---------------------|---|
| 2.1 Toxic pollution | 2.1.1 Describe acid rain's formation, effects and control.<br>2.1.2 Discuss smog formation and its consequences.<br>2.1.3 Explain how power generation leads to the dispersal of heavy metals in the environment and what are the consequences.   |
| 2.2 Global Warming  | 2.2.1 Describe what climate is and its parameters.<br>2.2.2 Explain what the greenhouse effect is.<br>2.2.3 Discuss how human activity is causing climate change and what will be the consequences both on ecosystems and on human societies.<br>2.2.4 Describe what carbon sequestration is and how it may or may not help minimizing climate change.<br>2.2.5 Explain what geo-engineering is and how it might either minimize climate change or actually make matters worse. |

## 3. Alternative Energy Sources

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|--------------------------------|---|
| 3.1 Hydroelectricity           | 3.1.1 Appreciate the world's hydroelectric development potential.<br>3.1.2 Describe how a dam produces electricity<br>3.1.3 Explain why hydroelectric power is not a perfectly 'green' energy source.   |
| 3.2 Renewable Energy           | 3.2.1 Examine the advantages and limitations of wind energy.<br>3.2.2 Explain solar energy as an emerging solution to micro energy demands.<br>3.2.3 Examine the role of tides and ocean currents in coastal applications.<br>3.2.4 Examine the economic benefits of residential and commercial geothermal applications.<br>3.2.5 Analyze the ethanol debate. |
| 3.3 Hydrogen and the Fuel Cell | 3.3.1 Explain the principles of hydrogen as a fuel.<br>3.3.2 Examine the role of fuel cells in the automotive industry.<br>3.3.3 Discuss the feasibility of a hydrogen economy.   |
| 3.4 The Nuclear Debate         | 3.4.1 Examine a nuclear reactor.<br>3.4.2 Explain how nuclear waste is stored.<br>3.4.3 Analyze the future of nuclear energy.<br>3.4.4 Analyse the aftermath of major nuclear accidents.  |

### E: Required Texts

There is no formal text book for this course, however, course notes and worksheets will either be handed out in class or made available on Omnivox Lea CMS. A laboratory manual has been prepared and is available on Omnivox Lea CMS. The student will be responsible for the printing of course materials (class and laboratory).

### F: Bibliography

Broecker, Wallace, and Kunzig, Robert, *Fixing Climate—What Past Climates Reveal About the Current Threat—and How to Counter It*, Hill and Wang, New York, 2008, 253 pages.\*  
Fagan, Brian, *The Long Summer—How Climate Changed Civilization*, Basic Books, New York, 2004, 284 pages\*  
Flannery, Tim, *The Weather Makers*, Harper Collins Canada, 2006, 384 pages.  
Goodell, J., *Big Coal; The Dirty Secret Behind America's Energy Future*, First Mariner Books, New York, 2006. 322 pages.  
Houghton, John, *Global Warming—The Complete Briefing*, 4<sup>th</sup> ed., Cambridge University Press, Cambridge, 2009, 438 pages.\*\*  
Nikiforuk, A. *Tar Sands; Dirty Oil and the Future of a Continent*. Greystone Books, Vancouver, 2008, 214 pages.\*  
White, Rodney, *Climate Change in Canada*. Oxford University Press, 2010, 174 pages.\*  
\*Available at the JAC Library.      \*\*3<sup>rd</sup> edition available at the JAC library

### G: Teaching Methods

The course will be 75 hours, divided into lecture and laboratory periods. There will be two 1.5-hour periods per week, consisting of the introduction of new material and revision of previously learned material. In addition, preparation for upcoming laboratory sessions may be discussed during lecture time. Lectures will be given with the help of an overhead projector, multimedia projector and the front blackboard. There will be one lab per week, a two-hour session. Laboratory sessions may be used for workshops that will help the student cope with the course material.

The use of cell phones in class is not allowed. Laptop computers may be used for pedagogical purpose during lectures and labs.

A special note concerning the use of chemicals: This course uses chemicals as part of its normal teaching practices. If any student has experienced allergic reactions in the past to any particular chemical or chemicals, he/she must inform the teacher. In the event that a student experiences an allergic reaction at the college, he/she should report to Campus Security immediately (local 7777, 9-514-398-7777).

### H: Departmental Attendance Policy

Attendance is compulsory. If lectures are missed, it is the responsibility of the student to cover the material missed and be aware of any announcements made concerning assignments, tests or changes to the laboratory schedule. Students must attend the laboratory session in which they are officially registered. There may be workshops held during the laboratory period. Attendance at these workshops is required.

There will be no make-up tests, quizzes or laboratory periods. If a test or a deadline is missed due to illness, the instructor must be notified as soon as possible. A valid medical note is required to prove absence for a medical reason.

I: Evaluation Plan

Evaluation	Tentative date	Weight	Elements of the Competency (p. 3)
Unit I test	February 20	10%	1, 2
Unit II test	March 31	10%	1, 2
Unit III test	May 5	10%	1, 2
Laboratory work	Almost weekly	15%	3
Comprehensive Assessment Project	First half of April	15%	4
Quizzes and assignments	Roughly biweekly	15%	1, 2
Final exam	In exam period, TBA	25%	1, 2

Please Note:

- If the final exam mark is greater than one or more of the unit test marks, the final exam mark will replace the LOWEST of the unit test marks in the calculation of the course grade.
- If a student fails to write one of the term tests (with valid reason), then the student must write the final exam worth 35% (10% for missed test and 25% for final).
- 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.
- A student may lose 5% on a test or quiz if his cell phone rings during the testing period; if the student answers the call, he automatically receives a 0 for this assessment.
- Late work will be marked as a zero unless otherwise specified in the assessment instructions.

J: Course Costs In Addition to Text

*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). Normal prescription glasses may be worn, but *for safety reasons, the use of contact lenses is not permitted*. A sturdy cotton lab coat is required (approx. \$20).*

College Policies:

*Policy No. 7- IPESA, Institutional Policy on the Evaluation of Student Achievement*

**a) Changes to Evaluation Plan in Course Outline** (Article 4.3 in IPESA)

Changes to the evaluation plan, during the semester, require unanimous consent.

**b) Mid-Semester Assessment MSA** (Article 3.3)

All students will receive an MSA in accordance with College procedures.

**c) Religious Holidays** (Article 3.2)

Students who wish to observe religious holidays must inform their teacher in writing within the first two weeks of the semester of their intent.

**d) Student Rights and Responsibilities** (Article 3.2)

It is the responsibility of students to keep all assessed material returned to them for at least one month in the event of a grade review.

**e) Cheating and Plagiarism** (Article 8.1 & 8.2)

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.