

CHM 311 Green Chemistry and Industrial Processes. Green Chemistry is the design of chemicals and processes while eliminating the use and generation of hazardous substances. Focuses on green chemistry principles and their industrial applications: global perspectives on green chemistry performed in industrial settings with no negative environmental consequences and increased benefits to humans and the earth. Prerequisites: CHM 242 or CHM 247. Three credits.

Lecture: MWF 12:00 - 12:50 pm Mackinac Hall A1184

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Office Hours: **Mo: 2-2:50pm**, PAD 3rd level, White board, **Wed: 1-1:50pm** and **Fr: 9:00-9:50am**, PAD 362
Virtual office hours will be listed on BB, held via either *Wimba Classroom* or the video- conferencing software *ooVoo*. GVSU ooVoo business **plan** is available to download for free at <http://www.gvsu.edu/e-hr/> go to the menu tab **ooVoo on campus**. My ooVoo ID **prof.kovacs**
By appointment: send e-mail for request: **E-mail:** please use CHM 311 in your subject line.

Textbook: *Green Chemistry-An introductory text* by Mike Lancaster ISBN 0-85404-620-8
Green Chemistry: Theory and Practice, by Paul T. Anastas and John C. Warner

Web access: <http://bb.gvsu.edu> **Main dialog** tool meant to facilitate your communication with your professor and with each other. I strongly encourage you to post your question and participate in the group discussions available on this website. Homework may be occasionally completed and *handed-in* via bb website

Recommended Supplementary readings:

Sustainable Industrial Chemistry: Tools and Industrial Examples, Cavani, Centi, Parathoner, Trifiro, (Eds), Wiley-VCH, ISBN 978-3-527-31552-9.

Introduction to Green Chemistry, A. S. Matlack. New York: Marcel Dekker, 2nd Ed. ISBN: 9781420078114, 2010.

Green Engineering: Environmentally Conscious Design of Chemicals, D. Allen, D. Shonnard ISBN 0-13-061908-6.

Introductory Chemistry for the Environmental Sciences, 2nd Ed., R. M. Harrison, S. J. de Mora

Fundamentals of Environmental Chemistry, S. E. Manahan

Environmental Chemistry, 2nd edition, C. Baird

Environmental Toxicology and Chemistry, D. G. Crosby

Real-World Cases in Green Chemistry, M. C. Cann, M. E. Connelly

Introduction to Green Chemistry, M. A. Ryan, M. Tinnesand (Eds); Washington: ACS, 2002.

Handbook of Green Chemistry and Technology, J. H. Clark, D. MacQuarrie. Oxford: Blackwell Science Publishers Ltd., 2002.

Course grades: Your final course grade will be calculated as follows:

45% Exams: 10% Exam 1; 15% Exam 2; 20% Final Exam.

35% Assignments: 5% Knol-of-Science; 5% SS Day Presentation; 5% GC Presidential Award presentation;
 15% Case Study + Homework; 5% Class & Discussion Board participation

20% Final Project: you must complete you final project (with 67% for a C) in order to pass the class.

The course grade will be based on the following scale:

%	100-91	90-89	88-87	86-79	78-77	76-75	74-67	66-65	64-63	62-55	54-0
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F

Objectives:

At the end of the semester you should

- Be able to locate, evaluate and use the available information connected with green chemical processes effectively
- Use the information as a platform to think critically
- Be able to integrate the principles of Green Chemistry into your main area of expertise
- Make sensible use of the variety of data addressing the concerns related with the effect of humans on the environment as well as the effect of environment on the humans
- Be able to articulate expression through effective speaking –Student individual project & presentations (three throughout the semester)
- Be able to articulate expression through effective writing – Student individual projects & presentation-Written final report
- Acquire a better understanding of the important role chemistry plays in our everyday lives

Written Assignments 65%. There will be three written examinations: Exam 1, 2, and the Final. The material on the exams may be taken from your textbooks, lecture notes or handouts, problems worked in class, and/or from student seminar presentations. See time table below. **Please do not create a conflict for yourself!** No make-up exams.

Individual project FINAL REPORT: to be turned in for grading April 20th. The project will be evaluated both by your instructor and by a representative of the beneficiary, the company your project comes for. You must complete your final project (with 67% for a C) in order to pass the class (*Oral presentation April 16-10*)

Graded Assignments 35%:

5% *Knol-of-Science* → due February 3rd

5% SS Day Presentation → 1st draft due March 2nd

5% GC Presidential Award presentation → due week 14, April 16-20th (*Oral presentation*)

10% Case Study → February 20-29th and April 2-9th (*Oral presentation*)

5% Class & Discussion Board participation

5% Assigned Readings and Homework: The purpose of homework is to guide your search for the subject, direct your thinking, and help you learn; homework problems provides feedback as a measure of how you are progressing. Ultimately, you must take responsibility for your own learning. Read ahead. Develop a regular study schedule, and follow it faithfully.

Oral Presentations: Each student will prepare at least three presentations, each followed by a brief question & answer period. The first one will be a case study (10 min + 5 min q&a); the second on a topic chosen by the student from the Presidential Green Chemistry Award (10 min + 5 min q&a); the third one would be the final presentation of the individual project (20 min + 5 min q&a).

Business partnership & Student Individual project: 20 % of the student's final grade will be evaluated by the completion and presentation of a final project involving: (1) data collection, (2) problem(s) identification and (3) consequences evaluation along with (4) foreseen solutions. Original ideas will be highly evaluated. Projects with relevance for West Michigan will be encouraged by pairing you with one of the local businesses willing to work with GVSU students to identify a mutually agreed upon topic concerning aspects of green chemistry. Each student must work independently to complete the project and prepare two oral presentations and a final written report. Excellent work will be encouraged for presentation at the GVSU Student scholarship day, in April. This project should represent your very best creative work! Remember that your future working place will highly praise your knowledge about Green Chemistry and more so, your experience with real-life applications. Use the provided opportunity to your best advantage!

Detailed tentative Schedule

Date		Topic
UNIT 1: Green Chemistry, tools, principles, and practice		
Week 1	Chapters 1-3 Anastas Chapter 1 Lancaster	Principles of Green Chemistry
	Chapter 4-5 Anastas Chapter 2 Lancaster	Principles of Green Chemistry, Evaluating the Effects of Chemistry Waste: Production, Problems & prevention
	Chapter 6-10 Anastas	Evaluating Feedstock, Starting Materials, Reaction Types; Methods to Design Safer Chemicals, and Future Trends
Week 2	Chapter 3 Lancaster	Measuring & Controlling Environmental Performance
	Chapter 4 Lancaster	Catalysis & Green Chemistry
Week 3	Chapter 2 Centi	Sustainable Industrial Chemistry: Catalysis <i>Handouts</i>
	Chapter 5 Lancaster	Organic Solvents: Environmentally Benign Solutions
	Chapter 6 Lancaster	Renewable resources
Week 4	Chapter 7 Lancaster	Emerging Green Technologies & Alternative Energy Sources
Friday February 3rd Exam 1 in class		
UNIT 2: Green process & Case Studies		
Week 5	Chapter 8 Lancaster	Designing Greener Processes
	Chapter 3 Centi	Sustainable Industrial Chemistry: Process Intensification <i>Handouts</i>
Week 6	Chapter 9 Lancaster	Industrial Case Studies
Week 7,8	Real Life applications	25 Cases study in Green Chemistry application <i>Handouts</i>
Friday March 2nd Exam 2 take-home Due March 16 th		
Week 9	March 3-March 11-Spring Break	
UNIT 3: From Green to Sustainable Industrial Chemistry		
Week 10	Chapter 10 Lancaster Chapter 1 Centi	The Future is Green: an Integrated approach to a greener Chemical Industry Sustainable Industrial Chemistry <i>Handouts</i>
	Chapter 5 Centi	Sustainable Industrial Chemistry: Accounting for Chemical Sustainability
Week 11-13	Chapter 6-16	Sustainable Industrial Chemistry, selected cases: Propylene oxide, Adipic acid, bio-diesel, bio-ETBE, Phenol, olefin alkylation, Friedel-Crafts acylation, etc.
Week 14	Final project	Draft Presidential GC award-presentation
Week 15	Final project	Presentation
Week 16 FINAL Exam Wednesday April 25th 2-3:50pm		

Green Chemistry-a growing discipline: Harnessing chemical reactions have greatly enhanced our life but, to-date, unfortunately also been associated with pollution and waste. Green Chemistry or environmentally benign chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. Green chemistry is gaining a strong foothold in the areas of research and development in both industry and academia. Prominent conferences and meetings are held each year with green chemistry/technology as their focus. The [Green Chemistry Institute](#) was created in 1995 and the Presidential Green Chemistry Challenge Awards were established in the same year. The journal [Green Chemistry](#) made it debut in 1999. By enrolling in this course at GVSU you choose to be at the forefront of our discipline. As Green Chemistry emerges and evolves so do the available materials pertaining to the domain. This course relies heavily on up-to-date materials. Many relevant articles are already selected for you and available in the GVSU library. In addition, we will have to work together to search relevant information published mainly on the www and share it on the Green Chemistry webpage where you are required to contribute. See below a small sample for only two of the main subjects to be investigated.

Web search learning tool: <http://www.thelearningsite.net/cyberlibrarian/searching/ismain.html>

Suggested Key words for web search

Sustainability

Population

Warming, greenhouse gases, energy consumption

Fisheries, roads, vehicles

Consumption

Water

Waste

Forests, species extinction

Ecological footprint

Environment/economy

Introduction to Green Chemistry

Environmental disasters in part caused by chemistry

Command and control laws

Pollution Prevention Act of 1990

The beginnings of Green Chemistry at the EPA

The spread of Green Chemistry

The Presidential Green Chemistry Challenge Awards

The Twelve Principles of Green Chemistry

ACS/EPA Green Chemistry partnership

Etc...

For this and many more available links check the *Externals link* section of the course Blackboard site:

USA Environmental protection Agency-Green Chemistry:

<http://www.epa.gov/greenchemistry/index.html>

Green Chemistry Institute

<http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=greenchemistryinstitute\index.html>

Green Chemistry Network

<http://www.chemsoc.org/networks/gcn/>

Sustainability Institute

<http://www.sustainabilityinstitute.org/sitemap.html>

Additional Help: If you have any special needs due to learning, physical, or other disability, please contact the Office of Academic Support @ 331-2490 and me.

Winter 2012 Academic Calendar

Last day to Add, Register or Pay	January 13
100% Tuition Refund Deadline	January 13
75% Tuition Refund Deadline	February 3
Drop Deadline - grade W	March 9
Spring Break	March 4-11
Classes End & Commencement	April 12
Final Examinations	April 23-28