The University Of Toledo

NEW COURSE PROPOSAL

* denotes required fields

1. College:
   Engineering
   Department:
   Civil Engineering

2. Contact Person:
   Define Apul
   Phone: 530-8132
   Email: define.apul@utoledo.edu

3. Alpha/Numeric Code (Subject area - number):
   CIVE  6670
   If this is a numbering, please request an electronic copy of the old course
   approval through the Register's Office at x4865, and attach it to #15 in
   this form. Remember to delete the old course ID in #13.

4. Proposed title:
   Life Cycle Engineering
   Proposed effective term:
   Fall 2012
   Planned enrollment per section:
   10

5. Is the course cross-listed with another academic unit?
   Yes No
   Is the course offered at more than one level?
   Yes No
   If yes to either question, please list additional Alpha/Numeric codes,
   and submit a separate New Course form or Course Modification form for
   the course(s) referenced below.
   a. CIVE  6670
   b. 
   c. 

6. Approval of other academic unit (signature)
   Name and title
   If course is to be offered at more than one level, attach an explanation of
   the different requirements that students must meet for each level. If the
   requirements are the same for each level, justification must be provided.

7. Credit hours:
   Fixed: 3 or Variable:  to

8. Delivery Mode:
   Primary*  Secondary  Tertiary
   a. Activity Type
      - Lecture
   b. Minimum Credit Hours
      3
   Maximum Credit Hours
      3
   c. Weekly Contact Hours
      3

9. Terms offered:
   Fall  Spring  Summer
   Years offered:
   Every Year  Alternate Years

10. Are students permitted to register for more than one section during a term?
    Yes No
    May the courses be repeated for credit?
    No  Yes
    Maximum Hours

11. Grading System:
    Undergraduate
    Normal Grading (A-F,PS/NC,PR, I)
    Passing Grade/No Credit (A-C, NC)
    Credit/No Credit
    Grade Only (A-F, PR, I)
    Graduate
    Normal Grading (A-F,PS/NC,PR, I)
    Grade Only (A-F)
    Satisfactory/Unsatisfactory (G only)
    Audit only
12. Prerequisites (must be taken before):
   a. 
   b. 
   c. 
   
   Co-requisites (must be taken together):
   a. 
   b. 
   c. 

13. If course is to replace an existing course(s) will be deleted, and when should that deletion occur?
   Course to be removed from inventory: 
   Final Term to be offered (YYYYT, i.e. use 20064 for Fall'06): 
   a. 
   b. 
   c. 
   d. 

14. Catalog description* (30 words Maximum)
   This course discusses the life cycle concept for engineered systems. Course content includes the greenhouse gas protocol, life cycle assessment methodology, life cycle impact assessment, and matrix calculations for life cycle analysis.

15. Attach an electronic copy of a complete outline of the major topics covered.
   Syllabus: 
   Additional Attachment 1: 
   Additional Attachment 2: 

16. Where does this course fit in the University/College/Department curriculum? (Be specific by course level, if applicable). Indicate prospective demand.
   This course will be offered for any graduate student.

17. If the proposed course is similar to another course in the College or University, please describe the difference and provide a rationale for the duplication. (If this course duplicates material covered in another course within your department or college or in another college, attach a letter of endorsement from that area's dean and department chairperson indicating their support. Clarify the manner in which this course will differ).
   NA

18. If the course is intended to meet a University Undergraduate Core requirement, complete the following and submit a course syllabus using the template.
   Please explain how this course fulfills the general education guidelines. (Guidelines are available in Faculty Senate Website)

   Course Approval:
   Department Curriculum Authority: 
   Department Chairperson: 

   Date: Oct 25/2011
After college approval, submit the original signed form to the Faculty Senate (UH 3320) for undergraduate-level courses; for graduate-level courses submit the original signed form to the Graduate School (UH3340). For undergraduate/graduate dual-level courses, submit the proposals to each office.

Faculty Senate Undergrad. Curriculum Comm.:  
Faculty Senate Core Curriculum Comm.:  
Graduate Council:  
Office of the Provost:  
Registrar's Office:  

Submit New Course Proposal

You will see a confirmation page after you press the "Submit" button. If you do not see the confirmation page, please call x 4320 or send an email to ProvostWebMaster.utoledo.edu. Thanks.

Leone April  
Oct 24, 2011
Explanation of Extra Work that Students Taking CIVE 8670 will do compared to students signed up for CIVE 6670

PhD students taking the CIVE 8670 level course will be required to complete all work that MS students would be doing in the CIVE 6670 course. In addition, PhD students will be asked to complete an additional assignment that they would then present to class in a half hour lecture or activity. The nature and details of the assignment will be mutually agreed upon between the instructor and the student.
Detailed Syllabus for CIVE 6670/670 Life Cycle Engineering

Facilitator, Dr. Debra Aupi, The University of Toledo, Department of Civil Engineering

Table of Contents of This Syllabus
1. Typical components of a syllabus and Fink's taxonomy of significant learning (pages 2 and 3)
2. Tentative schedule. Use this to tentative schedule to plan your time (page 4)
3. First meeting's activities (page 5)
4. Assessments (pages 6-14). These are deliverables that you will be graded on. You need to submit the assessments by the due date to be evaluated out of full points. Assessments are deliverables. You NEED to do this work.
5. Preps (page 15). This is what you should do but you will receive no grade for your work. However, if you don't do the work, you may not follow the conversation or may not be able to answer in-class questions. Doing the prep will be very helpful for your learning and for your ultimate project report. If you cannot do all the prep, you can use these references in the future as you further advance your life cycle engineering skills beyond this course.

This course has no exam. Grading scheme is based on assessments summarized on page 4. While this course has no exam, it will require much time and you will need to submit many assessments and do many preps to be able to succeed in class. Plan accordingly. About 9 hrs per week commitment is required to be successful in this class. Note that this course involves a real-life semester long project (page 9).

The University of Toledo
Department of Civil Engineering
CIVE 6670/670 Life Cycle Engineering
3 Credits, Offered in Fall Semesters

Professor: Debra Aupi, N1030, Debra.Aupi@utoledo.edu, (419) 330 8132

Meeting times: First meeting will be on August 22, 2011, M, 5:30-8:00pm, Palmer Hall 3050. After this first meeting, the regular class meeting time will be changed to another time based on availability of students.

Textbook: There is no single textbook for this course. I will share handouts and resources with you for each topic we discuss.

Course format: This course is developed based on Fink's taxonomy of significant learning (Fink, 2003). As discussed in Fink's book I believe that good courses are courses that:
- challenge students to significant kinds of learning
- use active forms of learning
- have teachers who care – about the subject, their students, and about teaching and learning
- have teachers who interact well with students
- have a good system of feedback, assessment, and grading.

Fink's ideas on six critical aspects of learning are summarized in the table below. To achieve these learning aspects, students in the class will be reading and discussing literature, working on some quantitative assignments, and a semester long project. The project for this semester is the development of life cycle based design guidelines for rainwater harvesting systems.

<table>
<thead>
<tr>
<th>Type of Significance</th>
<th>Key Component of Learning</th>
<th>Special Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning how to learn</td>
<td>Learning</td>
<td>Provides capability for long-term continuation of learning</td>
</tr>
<tr>
<td>Motivation</td>
<td>Caring</td>
<td>Provides the energy (short term or long term) for learning; without this, nothing is significant</td>
</tr>
<tr>
<td>Human Dimension</td>
<td>Self, Others</td>
<td>Connects one's self to oneself and to others; gives human significance to the learning</td>
</tr>
<tr>
<td>Integration</td>
<td>Connecting</td>
<td>Adds power by connecting different ideas, disciplinary perspectives, and/or realms of life</td>
</tr>
<tr>
<td>Application</td>
<td>Thinking, Acting</td>
<td>Allows other learning to become useful</td>
</tr>
<tr>
<td>Foundation</td>
<td>Knowing</td>
<td>Provides necessary information for other kinds of learning</td>
</tr>
</tbody>
</table>


Late assignments: 10% will be deducted for every day the assignment is late. Assignments should be submitted before class starts.

Academic Dishonesty: You are encouraged to work together on homework so you can discuss the problems and learn more than you would if you worked on your own. While working with others, don't forget about academic dishonesty. The idea is to learn together not copy from someone or let someone else do the thinking for you. You should read UT's policy on academic dishonesty available at: http://www.utoledo.edu/thescholastcenter/policy.html
Planned Schedule (Tentative: might change depending on student interest and class progress)

<table>
<thead>
<tr>
<th>Date</th>
<th>In-Class Activity</th>
<th>Assessment and Prep Due That Day</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1, August 22</td>
<td>Intro to sustainability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2, August 29</td>
<td>Intro to sustainability</td>
<td>Assessment 1: Milestone, Brundtland, Bill Gates</td>
<td>20</td>
</tr>
<tr>
<td>Week 3, September 5</td>
<td>Discussion of assessment 1, Dr. Apul presents on GHG accounting including methods and UT, Toledo, and Lucas County results</td>
<td>Assessment 2: GHG questions</td>
<td>20</td>
</tr>
<tr>
<td>Week 4, September 12</td>
<td>Discussion of assessment 2, Dr. Apul presents on LCA presentation by Dr. Apul, hands on EOLCA exercises</td>
<td>Assessment 3: Carbon calculator</td>
<td>20</td>
</tr>
<tr>
<td>Week 5, September 19</td>
<td>LCA Introduction to LCA</td>
<td>Prep 1: Browse through LCA links</td>
<td></td>
</tr>
<tr>
<td>Week 6, September 26</td>
<td>LCA Application to sustainability</td>
<td>Prep 2: Browse through Asad and Apul Link</td>
<td></td>
</tr>
<tr>
<td>Week 7, October 3</td>
<td>Emission calculations for environmental services</td>
<td>Prep 3: Read through solid waste, wastewater calculations</td>
<td>20</td>
</tr>
<tr>
<td>Week 8, October 10</td>
<td>Environmental structure of LCA</td>
<td>Assessment 5: EOLCA HW</td>
<td>20</td>
</tr>
<tr>
<td>Week 9, October 24</td>
<td>Environmental structure of LCA</td>
<td>Prep 4: Read Chapter 2 of Computational Structure of LCA</td>
<td></td>
</tr>
<tr>
<td>Week 10, October 24</td>
<td>Environmental structure of LCA</td>
<td>Assessment 6: EOLCA HW</td>
<td>20</td>
</tr>
<tr>
<td>Week 11, November 7</td>
<td>Processes based on LCA software</td>
<td>Assessment 7: Read Chapter 3 and 5 of Computational Structure of LCA</td>
<td>20</td>
</tr>
<tr>
<td>Week 12, November 14</td>
<td>Green product or peer reviewed literature</td>
<td>Assessment 8: Project second progress report (peer graded)</td>
<td>10</td>
</tr>
<tr>
<td>Week 13, November 21</td>
<td>Urban sustainability, municipal codes</td>
<td>Prep 5: To be determined based on topic</td>
<td></td>
</tr>
<tr>
<td>Week 14, November 28</td>
<td>Student selected topics</td>
<td>Prep 6: Browse through urban sustainability and food LCA links</td>
<td></td>
</tr>
<tr>
<td>Week 15, November 5</td>
<td>Student selected topics</td>
<td>Prep 7: To be determined based on topic</td>
<td></td>
</tr>
<tr>
<td>Week 16, December 25</td>
<td>Project presentation</td>
<td>Assessment 9: Final presentation (peer graded)</td>
<td>20</td>
</tr>
<tr>
<td>Finals, December 14</td>
<td>Project report submission</td>
<td>Assessment 10: Final report (peer graded)</td>
<td>30</td>
</tr>
<tr>
<td>Varying times</td>
<td>Green product or peer reviewed literature</td>
<td>Assessment 7: Green product or peer reviewed paper</td>
<td>20</td>
</tr>
</tbody>
</table>

Total available pts: 200
First Meeting's Activities
1. Change class time.
2. Go over syllabus and intro to life cycle engineering ppt by Dr. Aguil
3. Student introductions and expectations from this class. Write on a piece of paper:
   a. your name and something about yourself.
   b. why you are in this class.
   c. what do you expect to get out of this class.
   d. where you want to be headed with your career.
   e. what methods work best for YOU when you are learning something (e.g. reading, listening, doing, projects, work by yourself, watching something, internet etc...)
   f. some productivity tip you practice
4. Dr. Aguil hands out following documents:
   a. Mihalcea et al., 2003 Sustainability science and engineering: the emergence of a new metadiscipline, Environmental Science and Technology, 37(23), 5314-5324
   b. World Commission on Environment and Development, 1987 Our Common Future, Brundtland report

Homework for next class
For the following questions, read the relevant material, then type and bring your answers to class.
From Mihalcea et al. and the Brundtland report:
   a. What is the most commonly cited definition of sustainability? Where in Brundtland report is this definition written?
   b. How does Mihalcea et al 2003 define sustainable engineering?
   c. What is a peer reviewed article and how is it different than a report or other articles?
   d. What do you think might be the significance of Mihalcea et al, 2007?
   e. Why do you think might be the significance of the Brundtland report?
   f. Mihalcea et al mentions a tool called EIOFLCA. Browse through www.elaton.net. Write two questions that come to your mind related to EIOFLCA.

From news articles on Bill Gates and his goal of reinventing the toilet:

i. Why does Bill Gates want to reinvent the toilet?
ii. How, if at all, is reinventing the toilet related to the news articles you read?

Assessments
Assessment 1 (Individual)
Responses to questions related to Mihalcea et al., Brundtland Report, and Bill Gates articles (see page 4 for what you need to submit for Assessment 1).
Assessment 2 (Individual)
You will need 10 resources for this assignment:
Resource 1: CVE 4900 Spring 2011 students' report on Climate Action Plan for UT
Resource 2: CVE 4900 Spring 2011 students' presentation on Climate Action Plan for UT
Resource 3: CVE 6900/8900 Fall 2011 students' report on GHG inventory of City of Toledo
Resource 4: CVE 6900/8900 Fall 2011 students' report on GHG inventory of Lucas County
Resource 5: CVE 6900/8900 Fall 2011 students' presentation on Toledo and Lucas County GHG emissions
You can access resources 1-5 by going to the following page:
http://www.era.utoledo.edu/researchwork/indiv_hypertext/Sustainability_Curriculum.html
Resource 6: Local government operations protocol for greenhouse gas inventory. You can access resource 5 at:
Resource 7: GHG Protocol website and its standards section
http://www.ghgprotocol.org
http://www.ghgprotocol.org/standards
Resource 8: President's Climate Commitment
http://www.presidentsemissionsreport.org
Resource 9: University GHG Reporting System
http://usa.nступro.com
Resource 10:
http://www.techno-coreplanet.org/usaslist/
Prepare a typed document that answers the following questions:
1. What are scope 1 emissions? (copy/paste is ok)
2. What are scope 2 emissions? (copy/paste is ok)
3. What are scope 3 emissions? (copy/paste is ok)
4. What is a carbon footprint? What does it involve?
5. Each report has slightly different headings. Make a preliminary outline for the report YOU will be submitting at the end of this semester and submit this outline.
6. Write two questions about YOUR project for this semester.
7. What are some strengths and weaknesses of the students' reports?
8. What are some strengths and weaknesses of the students' presentations?
9. Using resource 6, answer the following questions:
   a. Look at Table D1 on page 185 of Resource 5. What do you get out of this table? Spend a little more time on sections of the table on solid waste and wastewater calculations as we might use these later on in class.
   b. Look at Table E1 on page 108 of Resource 5. What do these numbers mean?
   c. Look at Table G8 on page 211 of Resource 5. What do these numbers mean? What number would you use for emission calculations for Toledo area?
10. Write down at least 2 questions that came to your mind as you Browse through all the resources. Write down what is unclear to you.
11. Our library is a member of the OhioLink system. OhioLink has subscription to several databases that track peer reviewed publications. The database that I like is ESI Web of Knowledge. You can access this database by going to:
http://www.ohiolink.edu/webresources.cgi?op=select&c=ESI& Click on Engineering & When list of databases comes up, click on ESI Web of Knowledge. Use this database to locate the Mihalcea et al (2003) article.
   a. How many times has this article been cited?
   b. Copy paste the list of references that cited this article. Browse through the references that cited Mihalcea et al (2003). Is what kind of journals, reports etc. were these other references published?
   c. Use Google scholar to determine how many times Mihalcea et al has been cited and by whom. Do your results from ESI Web of Science and Google Scholar match?
Assessment 3 (Individual)
Personal Carbon Footprint Assignment

Calculate your carbon footprint and provide the answers to the following questions.

a. Provide the results to your carbon footprint that shows the breakdown of emissions from different activities.

b. Why did you pick this calculator? What are its benefits compared to other calculators?

c. What are some of the major limitations and uncertainties associated with the carbon footprint that you just calculated for yourself? Discuss limitations and uncertainties separately. Consider what should ideally be included in your emissions.

d. Calculate the yearly cost of purchasing carbon offsets from three services that are available on the internet.

e. Develop a plan to reduce your carbon footprint and show the plan including how much reduction it will help you achieve. Some calculators do this for you. You can present their results.

f. On average, what is the carbon footprint of a US resident?

g. On average, what is the carbon footprint of a world resident?

Here are some resources for your use:

1. Carbon Footprint Calculators on the Internet
   - American Forests: http://www.americanforests.org/learn-more/carbon-calculator/
   - Austin’s calculator: http://www.city.austin.tx.us/epa/02_fo calculator.htm
   - The Conservation Fund http://www.conservationfund.org/genera
   - USEPA http://www.epa.gov/climatechange/emit/sod_calculator.html
   - Nature Conservancy: http://www.nature.org/greening/carbon-calculator/index.htm
   - SafeClimate: http://www.safeclimat e.net/calculator/
   - TempPass http://www.temp pass.com

2. Peer Reviewed Paper on Comparison of Carbon Calculators
   - Available for download from:
Assessment 4 (Group)
First Progress Report for Your Project
Project Description:
This semester you will work on developing design guidelines for rainwater harvesting systems. Rainwater harvesting is not a new technology but it is not widely used. Depending on the building type, location, and other site specific parameters, it may or may not make sense to use rainwater harvesting. You will use life cycle cost, energy, GHG emissions, available natural resources (e.g. water) and ecological design principles as your criteria to develop design guidelines for rainwater harvesting. You will refine your findings in the LEED building rating system. You can develop the guidelines for the US or for Toledo. We’ll discuss this decision in class.

Some local groups are interested in your work:
1. City of Toledo, City Council Member Steve Sied
http://www.ci.toledo.oh.us/ToledoCityCouncil/CityCouncilMembers/tabid/209/Default.aspx
We will meet with Steve Sied at UET: http://www.utiedo.com
Steve is especially interested in changing/improving the city municipal code
2. Toledo-Lucas Sustainability Commission Chair, Jeff Grabski
http://www.lucascountygreen.com/
3. American Rivers Healthy Waters Campaign, Katie Rousseau (Sewer)
http://www.raingardeninitiative.org/contactus.html

Some national organizations are interested in your work:
1. ARCSA: American Rainwater Catchment Systems, Bob Boulware
http://www.arcsa.com/
You should read Mr. Boulware’s rainwater design guidelines document. Email me for a copy if I forget to post it on BIB.
2. USGBC LEED research program
Research to Practice Program: http://www.centerforpremierbuildings.org/r2p3.aspx and
http://www.css.com/Research/Documents/Research_to_Practice_Call_for_Interest.sth
3. Analysis tool for your project:
BEAST model: http://modelgrid.wikipedia.org/Water_sustainability
Other life cycle costing and analysis methods/tools.

What to submit for the first deliverable:
1. Cover page
2. Tentative table of contents (i.e. your outline) for your anticipated final report
3. The introduction/problem statement section of your report. Due to three paragraphs.
4. The objective section of your proposal. This section should start with: “The goal of this study was to...”
5. Your outline should include a section on Toledo municipal code. Write a preliminary version of this section on whether the code regarding rainwater harvesting should change and if yes in what way. You can access the Toledo municipal code by going here:
6. In addition, try out team member roles and deadlines. Include this as an attachment.
7. Send a confidential email to Dr. Aprul on your peer grades using the peer grading excel spreadsheet. This email is sent to Dr. Aprul only, not to your team members.

Assessment 5 (Individual)
EIO-LCA assignment
A household is considering purchasing a washing machine and has narrowed their choice to two alternatives. In addition to the two functional items, they wish to assess the energy consumption and greenhouse gas emissions over the lifetimes of the two alternatives:
- Machine 1 is a standard top-loading unit with a purchase cost of $500. This machine uses 40 gallons of water and 2 kilowatt-hours of electricity per load (assuming an electric water heater). The household would use 8 loads of laundry per week with this machine.
- Machine 2 is a front-loading unit: it costs $1,000, but it can wash double the amount of clothes per load, and each load uses half the water and electricity.

Which machine should this household buy?
a) Estimate the total annual costs of water and electricity for each of the two machines. Use these values along with the manufacturing costs to develop a purely cost-based comparison of the two machines over a 10-year period. Assume the electricity cost is 8 cents/kWh and water is $2 per 1,000 gallons.
b) Use the same cost values as inputs into EIO-LCA to estimate the relative energy consumption and greenhouse gas emissions over their life cycles. Ignore the disposal phase. Be sure to express the comparisons of the two machines in terms of use versus manufacturing effects.
c) Briefly discuss your results.

Student solution worksheet:
a. Calculate the total annual costs of water and electricity.

<table>
<thead>
<tr>
<th>Cost ($)</th>
<th>Machine 1</th>
<th>Machine 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption per load (gal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity consumption per load (kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loads per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity cost ($/kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water cost ($/gal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total annual cost of water: Machine 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total annual cost of electricity: Machine 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost in a 10-year period: Machine 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine 2:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Assume lifetime of washing machines is 10 years and ignore the disposal phase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing: Go to EIO-LCA.net. Choose “lighting, electronic components, batteries and other industry”. Select “household laundry equipment manufacturing” sector. Put in $500 and $1,000 as producer prices.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water use: Industry: mining and utilities Sector: water, sewage and other systems Dollar amount:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity use: Industry: mining and utilities Sector: Power generation and supply Dollar amount:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Assessment 6 (Individual)

**EASEST Assignment** (More details might or might not follow)

Use EASEST to analyze the economic and environmental implications of using alternative sanitation technologies in different types of buildings. Vary building type (home, dormitory, educational building and office).

- Home (5 flushes/person/day)
- Dormitory (5 flushes/person/day)
- Educational building (3 flushes/person/day)
- Office (4 flushes/person/day)

Turn in a mini-report that includes a cover page, objectives, methods, results and discussion, and conclusions sections. For purposes of this mini-study, we will skip the introduction, and shortend sections in methods section. Describe the parameters you changed and their values. In results present graphs of cost, energy, and CO2 payback periods. Discuss all figures/tables presented. Think through which figure to present don’t copy paste all EASEST output to the report.

This is a mini-report, so keep it to the point but include all necessary information.

**Input Parameters:**

- Precipitation Data - Toledo, Ohio
- Building Length - 200 ft
- Building Width - 150 ft
- Building Height - 24 ft
- # of Stories - 2
- # of toilets per floor - 10
- Irrigation area - 3600 sf
- Building Type - Office (4 flushes/person/day)
- Occupancy - 150 ppl/day
- Toilet type - Standard (1.6 gpf)
- Pressure Provided by City - 30 psi
- Discount Rate - 3%
- Loan required - Yes to all (use assumed loan data)
Assessment 7 (Individual)
Green product or peer reviewed paper presentation
You have two options for this assignment. You will either analyze a green product or you will review a journal article. Both are described below. You need to pick only one of the two. For either one of the assignments, you should share relevant materials with the class at least a day ahead of time to give class sometime to think and learn about your topic before coming into class.

Option 1: Green product assignment (out of 50 points)
Assignment grading is based on your in class performance. You should share materials (e.g. links, ppt, etc.) with the class ahead of time to give students some headway.

1. Select a “green” product or technology and present it in class in 20 minutes. In analyzing why the product is “green” or not, it usually makes sense to compare the product to its alternative. If someone has already analyzed the product/technology you have in mind using LCA, you are welcome to present their findings.
2. Things you should discuss:
   a. (10 points)
      - Introduction to the product/technology and the functions/services it provides
      - Explain why you picked this product
      - Provide literature on the product (e.g. show its website, handouts, specifics, show articles related to it)
   b. (20 points)
      - Discuss what is green and what is not green about it
   c. (10 points)
      - Make a preliminary conclusion on whether you think the product is really green or not.
   d. (10 points)
      - Answer questions from the audience

For part a, do your homework and know your product well. Use google, google scholar, google news and other information finding techniques to fill in your knowledge gaps.

For part b, present multiple perspectives:
- do a preliminary life cycle assessment to estimate energy use and emissions from throughout product lifecycle
- compare “sustainable product” to “conventional alternative”
- consider economic, environmental, and social implications of the product
- consider waste associated with different life cycle phases
- consider whether it promotes sustainable lifestyles
- consider if it requires too much expertise or high tech materials
- consider if it requires a lot of water, land, materials, energy, and other resources throughout its lifecycle
- consider other points...

Option 2: Peer reviewed paper presentation
Choose from the following list or choose an article of your interest that Dr. Apul has approved for you to present:

4. Any of the good papers on rainwater or wastewater LCA

Suggestion for how to critically review the paper:
1. Read the title and the abstract
2. Look at the figures and tables
3. Look to see who the authors are, where was the research done? In which journal was it published?
4. Read the conclusions
Here are some examples of questions you might want to discuss. Pick a few or generate your own.

**Examples of General Questions**

i. What is the scientific value of the paper?
ii. What is the overall message of the paper?
iii. What are the specific questions asked in this paper? Did the paper answer the questions thoroughly? What parts of the questions remain unanswered?
iv. Do you think the work was well done? Do you think the work was worth publishing?
v. What is new about this work? Do you think the work is important? If yes, why?
vi. Who would care about this? What are the implications of this work?

**ix.** Did the authors discuss their data and support the evidence based on prior publications?
x. How would you rate the originality, technical quality, clarity of presentation, and importance of this work (excellent, good, fair, poor)?
xii. What is the most important idea/finding of the paper? (Ideally, every paper should have one clear idea, instead of several diffuse messages with no clear outcome.)

xiii. Originality means new experimental data, new interpretations of existing data, or new theoretical analysis of environmental data.
xiv. Are various sections of the paper well written?
xvi. Do you think the figures and tables were worth including?

**Technical Writing**

xv. Is the writing clear, concise, and relevant? Is the message clear?
xvi. Are various sections of the paper well written?

**xiv.** Abstract? Intro? Methods? Results? Discussion?

**Methods**

xxvii. Here are some items you should pay attention to when reading a paper:

What are the components of the paper? In what experimental etc...
What type of information is given in the introduction, methods, results, discussion sections?
What kind of sentence structures were used? What tense, passive or active voice?

xxiv. Did the authors appropriately cite prior work?
xxv. What does figure/table xxx mean?
xxvi. Any other questions specific to the paper you picked

**Results and Discussion**

xxv. Do you believe in their data?
xxvi. Did the authors present raw data or processed data with meaningful interpretation?
xxvii. Did the authors appropriately cite prior work?
xxviii. What does figure/table xxx mean?
xxix. Any other questions specific to the paper you picked

**Examples of Paper Specific Questions**

- What computer model did they use?
- Are data sources well documented and appropriate?
Prep 1:
Browse through these resources:
2. www.epclac.org
5. http://www.epa.gov/toxicology
9. Do a search on web of knowledge using the keywords "life cycle assessment". What do you see?

Prep 2:
1. Read this article:
2. Browse through the EEAST model web page including the EEAST model and its description:
   http://dials.tamu.edu/EEAST/EEAST_web_content.html

Prep 3:
1. Browse through pages 90-113 of the Local Government Operations protocol available from:
2. Browse through this website: http://www.floridastrategic.org/

Prep 4:
1. Read chapter 2 of Computational Structure of LCA. Email Dr. Apul if you don’t have access to this chapter.
2. Browse through this website: http://www.fleming.riverview.net/DrAnsmann/ComputationalStructure.html

Prep 5:
1. Read chapters 3 and 5 of Computational Structure of LCA. Email Dr. Apul if you don’t have access to these chapters.

Prep 6:
Browse through the following websites:
1. Urban Environmental Institute of Toledo: http://www.unipeds.com
3. Nitrogen Footprint: Think about why this is relevant: http://www.ofn.org
d 4. CHEPS model: http://www.demotecooling.org/chlpn.org
5. Browse through the following articles:

Prep 7: To be determined based on topic