NatSci 189IH
Global Challenges, Scientific Solutions [iCons I]
Spring 2020

Syllabus

Instructors (alphabetical order only):

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Class Meetings, ILC N111

Tu/Th 11:30 AM – 12:45 PM

Course Description

iCons I: “Global Challenges, Scientific Solutions” is a 4-credit course that brings together topics from Life Sciences, Physical Sciences, Natural Systems, Social Systems, and Engineering in the context of real world scientific issues. Students are expected to grapple with the scientific underpinnings of complex problems, including issues surrounding Clean Water, Climate Change, Energy Demands, and Disease & Biomedicine. Case studies serve as the format and foundation in which students learn and use fundamental scientific principles to investigate these challenges and examine scientific contributions to solutions. Each course activity integrates content with context; as the case studies reveal a need for students to use a particular concept or skill, those fundamentals are discussed and developed. The specific skills that students master are described in the Student Learning Goals, and the context through which those concepts and skills are motivated is described in the Case Study Outlines. This is the first course in the iCons program, and is a prerequisite for the three subsequent iCons courses. There are no prerequisites for this course, but admission to the iCons program is by application in the semester prior to enrolling in iCons I.

Attendance

Attendance is necessary for every course period. This is not a course in which you can “get the notes” from someone else. Each day you will be expected to work in and on behalf of your team, and to engage in group- or whole-class discussion and presentation. If you are absent, your team's efforts and product will suffer.
Learning Goals
By participating in iCons, you will work towards several learning goals that permeate the course. Students who demonstrate a high level of skill in these areas by the end of the semester have met the course objectives.

1. Apply distributed expertise in diverse teams to collaboratively solve complex problems and develop leadership qualities.
2. Use scientific principles and concepts, direct observation, and analytical reasoning to understand, explain, and solve real-world problems.
3. Ask scientifically appropriate questions and pose testable hypotheses.
4. Acquire new knowledge through scientific investigation.
5. Identify the components of societal challenges that are appropriate for scientific investigation (and those that are not).
6. Accept and give appropriate feedback and constructive criticism.
7. Articulate the value of individual scientific achievements through their contribution to societal needs.
8. Accurately assess your own abilities, contributions, work, learning processes, and opportunities for growth. Make informed value judgments about them.

Additionally, each case study will have specific scientific content or skills that you will need to master in order to succeed. Examples of these are:

- Communicate scientific information to both scientific and non-scientific audiences.
- Create appropriate experimental design from a scientific question or hypothesis.
- Use computer programming to generate and analyze data sets.
- Formulate a scientific argument supported by primary data.
- Apply mathematical skills to evaluate magnitudes, rates, and cause-and-effect relationships associated with societal challenges.
- Explain how experimental design affects the results of a scientific inquiry.
- Determine the validity and reliability of experimental data, and critically assess scientific statements based on that data.
- Develop and use a model to help understand and explain complex relationships.

Symposium Project
Student teams will, over the course of the semester, research, develop, and deliver a complete set of materials for a novel case study that may be used in the next offering of iCons I. This work will be done outside of class time, and the new case study materials and results will be presented at an end-of-semester iCons symposium. Details will be presented after completion of the first case study of the semester.
Course Expectations
In this course, you will experience:

Interdisciplinarity
iCons 1 is team taught by faculty from different fields confronting relevant, non-disciplinary specific, challenges.

Integration
Every topic is examined with participation from all students and instructors.

Discovery
You will be engaged in an active learning process, discovering scientific principles as they become required for mastery.

Connections
Complete understanding is achieved only through agile use of ideas from all disciplinary fields.

Collaboration
You will work in teams to solve problems and discover concepts. Teams are formed and re-formed as different challenges are presented and different skills are needed.

Mastery
You will become an expert in certain topical areas, so that as a member of a team of experts you can approach a problem as more than a sum-of-parts.

Content
Scientific depth will be developed around timely, relevant, and weighty societal challenges.

Analysis
You will use primary sources (literature and data) to develop understanding through data interpretation and analytical reasoning.

Human Connections
Topics include not only scientific concepts, but also their relevance to and impact on human life and society.

Assignments, readings, and course materials
The iCons I course will not use a textbook. Instead, readings, images, and videos drawn from published sources will be used to introduce case studies. These materials will be made available to enrolled students through Moodle. You will be responsible for completing all assigned readings and web-viewings before class. You will be expected to seek and use other sources on your own as we progress through each case study.

While many assignments (reports, experiment design, critiques) will be started in class, you are responsible for continuing to work on these assignments with your team outside of class. Many assignments (data analysis, proposal design, model design) will only be completed outside of class time. This will require you to organize the most effective means to work with your team (evening face-to-face meetings, Skype, electronic postings, collaborative shared documents, etc.).
**Grades**

We will explore three case studies in iCons 1. Two will be “In-Class,” meaning we will work cooperatively on different aspects of a common societal challenge. The third will be “External,” meaning you and your teammates will select a societal challenge that is compelling to you and develop your work relatively independently.

We expect to assign final grades based on the following contributions:

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<td>External Case Study</td>
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In each case study, there will be a mixture of individual submissions and team submissions that will take appropriate forms: papers, presentations, data sets, analyses, etc. Additionally, there will be personal reflection activities asking students to articulate growth, challenges, opportunities for further improvement in both scientific and team-based skills and peer-evaluation activities. Weighting of these activities will vary between case studies based on the topics and eventual products that demonstrate impact on the problem areas we address.

If you have problems during the semester that may impact your performance in the course, please come and talk to us right away.

**Course Outline and Pedagogical Structure**

NatSci 189IH will meet Tuesday and Thursday (11:30 – 12:45). During this time, we will explore case study topics in multi-period, multi-week segments. Each case study will be based on current events that:

1) Illustrate specific societal challenges
2) Have testable, tractable, scientific components
3) Produce broad impact
4) Are fundamental in nature
5) Evoke strong public support or interest
6) Offer hope of an eventual solution
Each segment of a case study will proceed through five stages that can describe the activities of an “Expert Learner” as they solve real-world problems.

1. **Inception:** The first stage introduces the topic, the issues, the problems, and the underlying science. Here, we *generate questions requiring scientific inquiry*. *Inception* may involve any/all of: articles, videos, animations, demonstrations, data sets.

2. **Engagement:** The second stage requires teams to become personally invested in the case study. *Engagement* may involve a discussion, initial report, debate, design, list, vote, etc. In *Engagement*, teams of students think about and begin to learn something about the topic; we *explore the boundaries of our knowledge*, and determine what further information or understanding is required to fully comprehend the topic(s).

3. **Research:** In this stage, teams of students answer what has not been fully or adequately explored and understood during preceding stages. In *Research* students may design an experiment, critically evaluate data, formulate and address hypotheses, compile information to fill in knowledge gaps. At this point, individuals and teams *grow new skills and knowledge based on opportunities and necessity* evoked by the challenges at hand.

4. **Create:** This is the stage where students *integrate new understanding based on what was learned through their research, and build a scientifically meaningful and useful product*. In *Creation* a tangible product of the activity is created, such as a research report, public policy recommendation, environmental forecast, product pitch, etc. Importantly, the products of the *Creation* step are communicated to the rest of the group, the entire class, and/or experts and scientific leaders from outside of class.

5. **Reflect:** At the end of each segment, we will critically examine the process, obstacles, solutions, and outcomes of your own and your team’s work on the case. We will *recognize areas of measurable growth, areas where improvements could be made, and specific skills that you will take from the case and transfer to other areas of your work or study*. Your own reflection and self-assessment will be included in your iCons ‘portfolio,’ and help articulate and guide your progress through this course.

**General Education**

iCons I is a 4-credit Interdisciplinary General Education course (GenEd ‘I’ designation). This means that questions, methods and concepts from numerous disciplines will be used, often with no reference to the field from which they are drawn. Students will be expected to bring expertise from their own disciplines to bear on problems, but also integrate across disciplines by working closely with teammates and seeking information wherever necessary.

The UMass GenEd Statement of purpose (www.umass.edu/gened) outlines the expectations of all GenEd courses. You should expect to experience growth in all of the areas described below over the course of the semester, and you will be asked to
reflect on and articulate if and how the course experiences have led to personal gains in knowledge and skills associated with these objectives.

**The purpose of the General Education requirement is to stretch students’ minds, broaden their experiences, and prepare them for:**

- Their college experiences and subsequent professional training
- Their careers and productive lives
- Community engagement and informed citizenship
- A diverse and rapidly changing world
- A lifetime of learning

**The General Education curriculum does this by engaging students in:**

- Fundamental questions, ideas, and methods of analysis in the humanities and fine arts, social sciences, mathematics, and natural and physical sciences;
- The application and integration of these methods of analysis to real world problems and contexts;
- Creative, analytical, quantitative, and critical thinking through inquiry, problem solving and synthesis;
- Pluralistic perspective-taking and awareness of the relationship among culture, self, and others;
- Understanding and evaluating the consequences of one’s choices and the implications of one’s actions.
- Opportunities to develop and practice the skills of critical thinking, reasoning, communication, and integration of knowledge and perspectives, including:
  - Communicating persuasively and effectively orally and in writing;
  - Working effectively and collaboratively (in groups, across perspectives);
  - Developing information and technological literacy

**Evolving Course**

iCons 1 is intended to be a continuously evolving course. In this course, we will learn in ways that remain new to us, and we expect will be new to you as well. Because of that, we share an obligation to not only participate in but also continue to guide the development of an exciting course that starts an exciting program. We encourage you to approach iCons 1 as both a learner and a builder, and focus not only on what we are doing, but also how we are doing it. In fact, we are counting on you - and all future iCons students - to play an integral role in the evolution and sustainability of this program.
Accommodation Statement

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Academic Honesty Statement

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).