Montserrat 104N – Modeling the Environment
Syllabus – Fall 2019

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Natural World Cluster Cover Page

This year, the Natural World cluster will explore the fundamental question, "How natural is our world?" If we define nature as "untouched by humans," then it turns out that nature has completely disappeared from the world around us. Wildernesses are managed. Animals that had been eradicated earlier by humans, such as wolves, have later been reintroduced into their former habitats by humans. Humans modify their food genetically. Humans have even started to manipulate themselves, for instance by seeking cures for human diseases through genetic therapies. The news of a Chinese scientist editing the genes of twins was met with outrage from many. And yet we also know that humans gravitate toward "natural" places and "natural" things. We like our parks and river walks, and we pay a premium for "natural" and organic food. So what's natural? And what's unnatural? Or if everything is already unnatural, then what's too unnatural? Together, we will explore why and how humans try to separate the physical world into parts that we label as "natural" and "unnatural," and if this binary is even productive. Seminars will consider the ever-changing boundary between these two categories from conceptual, ethical, moral, philosophical, creative, historical, scientific, and quantitative perspectives.

Natural World Cluster Required Events

- River Walk & Picnic
  - Saturday, Sept. 14, 11:00 am - 1:00 pm (The classes of Professors Paxson, Reents, Hess, and Staysniak)
  - Saturday, Sept. 21, 11:00 am - 1:00 pm (The classes of Professors Luria, Fenichel, Little, and Schmitz-Burgard)
- Coffee House Discussion of *The Uninhabitable Earth*: Tuesday, October 29, 7 - 8:15 pm, Loyola Ballroom
- The Sunrise Movement: November 11, 12, or 13, 7 pm., Location TBD

Natural World Seminars

NATURALLY UNNATURAL
Professor Teresa Fenichel
(fall) Reason & Self-Mastery
(spring) Freedom & Self-Creation

ENVIRONMENTAL MATHEMATICS
Professor John Little
(fall) Modeling the Environment
(spring) Analyzing Environmental Data

WHY AREN'T WE ALL FROGS?
Professor Julia Paxson
(fall) What is the Nature of Embryos?
(spring) Can Embryos Become Unnatural?

HABITAT EXPLORATIONS
Professor Sylvia Schmitz-Burgard
(fall) Germany's Greening
(spring) Bauhaus: Design for Democracy

ENVIRONMENTAL JUSTICE
Professor Kendy Hess
(fall) Justice in Theory
(spring) Justice in Practice

THE STORY OF HERE
Professor Sarah Luria
(fall) Mapping Nature at Holy Cross
(spring) Mapping Change in Worcester

WRITING/READING PLACE
Professor Stephanie Reents
(fall) 13 Ways of Writing Nature
(spring) The Myth of the Frontier

(UN)NATURAL FOOD IN AMERICA
Professor Christopher Staysniak
(fall) The Rise of Modern Food
(spring) A More Natural Food System

Montserrat Student Ambassadors
Rebecca Henion
Jacqueline McCarthy

Natural World Cluster Librarian
Barbara Merolli
O'Callahan Science Library
508-793-2643
bmerolli@holycross.edu

General Information

This course is a part of the Natural World Cluster of the Montserrat program. This means that at various times we will be addressing one or several of the following:

- The general aims of Montserrat – continued development of your thinking, writing, and communication skills, and the connection of living, learning and doing in college education,
- The theme of the Natural World Cluster, and
- The specific subject matter of this seminar – mathematical techniques used for modeling and understanding our natural environment.

Some Additional Information and Groundrules

It is my intent that students from all backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity

that the students bring to this class be viewed as a *resource, strength, and benefit.* It is my intent to present materials and activities that are respectful of diversity in all forms: diversity in socioeconomic status, ethnicity, nationality, religion, culture, political opinions, gender identity, sexuality, disability, age, etc. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for other students or student groups.

The College policy on excused absences from class is available at

`www.holycross.edu/sites/default/files/files/registrar/excused_absence_policy.pdf`

Any student who feels the need for accommodation based on the impact of a disability should contact the Office of Disability Services to discuss support services available. Once the office receives documentation supporting the request for accommodation, the student would meet privately with Disability Services to discuss reasonable and appropriate accommodations (which might include extra time and/or distraction-free environments on examinations, services of a note-taker or sign language interpreter, etc.) The office can be reached by calling 508-793-3693 or by visiting Hogan Campus Center, room 215A.

Many class meetings will be devoted to discussions, work in smaller groups, or oral presentations. Your active participation will be important for the success of what we do.

- On days when the class is devoted to a mathematical presentation or a discussion, please *turn off* electronic devices–cell phones, tablet or laptop computers–unless you are using one of them to take notes. If you do use a tablet or laptop computer that way, please have *only* your note-taking application open during class. From time to time, we might want to look up some information on the web, though. In that case, a web browser is OK.

- On days when the class works on group projects, you will be making (heavy) use of Google Sheets spreadsheets and Google Docs documents (or Microsoft Excel spreadsheets and Word documents, if you prefer), so you will want to bring a computer to class for those meetings.

- No distracting or "provocative" clothing, headgear, or other personal items in class, please.

- In on-campus events, off-campus trips, etc. you are representing this seminar, the Montserrat program, and by extension, Holy Cross in a wider community. Take responsibility and regulate your behavior accordingly.

- In discussions, there may be times that you disagree with a classmate or Prof. Little. *Please feel free to express that disagreement.* Be prepared to say why you do not agree and back up your ideas with evidence and as much eloquence as you can muster. But please keep the conversation civil and respectful.

This seminar

At the end of the second decade of the 21st century, humans are grappling with a number of tough decisions concerning our place in the natural world and the consequences of how we have used various resources and impacted our environment. For instance, if we continue to use fossil fuels to generate energy for our industry and transportation, what effects can we expect to see from the pollution they generate? It is increasingly clear that human activity is causing long-term changes in the Earth's climate. Are there realistic alternatives to those fuels that would sustainably provide for human society's energy needs and have fewer harmful effects? How do we decide what alternatives make more sense?

Our ability to develop answers to such questions and to understand the political, economic and social issues involved depends on being able to deal with *quantitative information*. Mathematical models–equations of various sorts capturing relationships between variables involved in a complex situation–are fundamental for understanding the potential consequences of choices we make. In the mathematical component of this course we will introduce a number of basic techniques for constructing models and see ways they can be applied to study environmental issues.

More specifically, we will study the following topics:

1. Basic techniques of measurement, data analysis, and presentation of data in numerical and graphical forms

2. Functions and modeling – we will see how to use linear, exponential, and power functions to describe different situations and how to select an appropriate model for a given situation

3. Difference equations and modeling – we will see how to set up and solve difference equations that describe how systems evolve over time (treating time in discrete units).

We will not make use of any calculus or mathematics more advanced than ideas about functions, graphs, algebra, some geometry, etc. So everyone should have seen all the mathematical prerequisites and some of the basic ideas behind material we study may be familiar from mathematics courses you took in high school. What will probably be different, though, is the consistently applied and environmental focus of everything we do. *We will be consistently referring to the real-world data collected by scientists that underlies some of the scenarios described in* **The Uninhabitable Earth***, so there will be many opportunities to develop your understanding about where some of the dire predictions come from.*

Course Objectives

The major objectives of the seminar will be:

1. To acquaint you with, and develop your skill in applying, various techniques of mathematical modeling (especially use of various functions and difference equations to construct models).
2. To study ways that the mathematics from point 1 can be used to address environmental questions.
3. To further your development as speakers and writers.
4. To create a group atmosphere where civil and constructive conversations can take place concerning difficult questions. Many of the topics we discuss will have controversial aspects and reasonable people can have very different viewpoints on them. Recognizing that, everyone (including Prof. Little, of course) should listen carefully and seek to understand where others are coming from, especially when your first inclination might be to disagree. (Good academic *writing* can also be seen as a conversation between the writer and others who have thought about similar questions. So this way of doing things will carry over into the way we approach writing assignments as well.)
5. To participate in and contribute to the common activities of the Natural World Cluster of the Montserrat program.

Texts

The text books for the course (this is for both semesters) are:

1) J. Little, *Modeling and Data Analysis*, American Mathematical Society, ISBN 978-1-47044869-1. We will do almost everything in Chapters 1 - 8 this semester and continue with the rest next semester.

Natural World Cluster common reading:

2) David Wallace-Wells, *The Uninhabitable Earth*, Tim Duggan Books, ISBN 978-0-525-57670-9.

It is expected that all Holy Cross students will have textbooks and other required class materials in order to achieve academic success. If you are unable to purchase course materials, please consult with Prof. Little about the main text and/or go to the *Financial Aid* office where a staff member will be happy to provide you with information and assistance.

Course Schedule

A detailed day-by-day course schedule and listing of required and suggested outside events will be maintained on the course homepage (and will be accessible through the Moodle course management system). That listing is a tentative, evolving schedule, so it may change and you will probably want to refer to it frequently. Any important changes will also be announced in class well in advance.

Assignments and Grading

1) *Midterm exam* (15 % of course grade) – tentative date: Friday, October 27.
2) *Final exam* (25 % of course grade) – the final will be given at the established time for MWF 9 am classes, when that is determined.
3) *Individual problem sets* (about 7 through the semester – 15 % of course grade)
4) *Writeups from group project days* (about 7 assignments – 15 % of course grade)
5) *Two roughly 5 page papers*, and other shorter writing assignments. (Information and guidelines to be distributed later) (20 % of course grade)
6) *News Journals and Presentations*: You should obtain *two notebooks* for this class: one for your daily notes and workspace for the problem sets and other assignments, and a second where you will write short summaries of or comments about news articles about some environmental topic you have read. Some suggestions for places to look will be maintained on the course homepage. Aim for one or two of these entries per week. *Start now and keep up with this!* Each one should be about one handwritten page. I will collect the journals once or twice during the semester and return them with comments. At the end of the semester, each student will take part in a short (10 minute) presentation with another student from the class about some story from the current news and the group will lead a class discussion on the issues involved. These can be based on one of the articles you wrote about in your journals previously, or it can be something new. More details on this later. (10% of course grade)

I will be keeping your course average in numerical form throughout the semester, and only converting to a letter for the final course grade. The course grade will be assigned according to the following conversion table (also see Note below):

- A – 94 and above
- A- – 90 - 93
- B+ – 87 - 89

- B – 84 - 86
- B- – 80 - 83
- C+ – 77 - 79
- C – 74 - 76
- C- – 70 - 73
- D+ – 67 – 69
- D – 60 - 66
- F – 59 and below.

Note: Depending on how the class as a whole is doing, some downward adjustments of the above letter grade boundaries may be made. No upward adjustments will be made, however. (This means, for instance, that an 85 course average would never convert to a letter grade of B- or below, although it might be a B+ in some circumstances.) If you ever have a question about the grading policy or your standing in the course, don't hesitate to ask me.

Advice On How To Succeed In This Class

A good "work ethic" is key. As you should be able to tell from the course description above, you do not need to be a "math genius" to do well in this course. But you will need to put in a consistent effort and keep up with the reading and assignments.

Come to class. Unless you are deathly ill, have a genuine family emergency, are away at a game or meet of a college athletic team, etc. plan on showing up here at 9:00 am every Monday, Wednesday, and Friday this semester. Many of the class meetings will be structured around discussions or student presentations. Your participation is expected and needed for the success of the course!

Take notes and use them. This may seem obvious, but it is worth saying! Used intelligently, your notes can be a valuable resource as you work on problem sets and prepare for exams.

Use the texts and class notes actively. Reading about mathematics is not like reading a novel. You will probably need to read and think over things more than once. You may want to work through examples to understand some of the topics that we do.

Set up a regular study schedule and work at a steady pace. It's not easy to play catch-up in a mathematics course (even when the course is part of a first-year program with additional goals beyond the mathematics). You should expect to budget at least 6 hours in a typical week for work outside of class. The best way to use your time is to do a few problems, some reading from the books, and reviewing of class notes every day.

Most importantly, if you are having difficulty learning something, get help as soon as possible. You can do this by asking questions during class (any time something isn't clear), or seeing me during office hours.

The College Academic Honesty Policy

All education is a cooperative enterprise between faculty and students. This cooperation requires trust and mutual respect, which are only possible in an environment governed by the principles of academic honesty. As an institution devoted to teaching, learning, and intellectual inquiry, Holy Cross expects all members of the College community to abide by the highest standards of academic

integrity. Any violation of academic honesty undermines the student-faculty relationship, thereby wounding the whole community. The principal violations of academic honesty are plagiarism, cheating, and collusion.

Plagiarism is the act of taking the words, ideas, data, illustrative material, or statements of someone else, without full and proper acknowledgment, and presenting them as ones own.

Cheating is the use of improper means or subterfuge to gain credit or advantage. Forms of cheating include the use, attempted use, or improper possession of unauthorized aids in any examination or other academic exercise submitted for evaluation; the fabrication or falsification of data; misrepresentation of academic or extracurricular credentials; and deceitful performance on placement examinations. It is also cheating to submit the same work for credit in more than one course, except as authorized in advance by the course instructors.

Collusion is assisting or attempting to assist another student in an act of academic dishonesty.

At the beginning of each course, the faculty should address the students on academic integrity and how it applies to the assignments for the course. The faculty should also make every effort, through vigilance and through the nature of the assignments, to discourage and prevent dishonesty in any form.[1]

It is the responsibility of students, independent of the facultys responsibility, to understand the proper methods of using and quoting from source materials (as explained in standard handbooks such as The Little Brown Handbook and the Harbrace College Handbook), and to take credit only for work they have completed through their own individual efforts within the guidelines established by the faculty.

The faculty member who observes or suspects academic dishonesty should first discuss the incident with the student. The very nature of the faculty-student relationship requires both that the faculty member treat the student fairly and that the student responds honestly to the facultys questions concerning the integrity of his or her work.

If the faculty is convinced that the student is guilty of academic dishonesty, he or she shall impose an appropriate sanction in the form of a grade reduction or failing grade on the assignment in question and/or shall assign compensatory course work. The sanction may reflect the seriousness of the dishonesty and the facultys assessment of the students intent. In all instances where a faculty member does impose a grade penalty because of academic dishonesty, he or she must submit a written report to the Chair or Director of the department and the Class Dean. This written report must be submitted within a week of the faculty members determination that the policy on academic honesty has been violated. This report shall include a description of the assignment (and any related materials, such as guidelines, syllabus entries, written instructions, and the like that are relevant to the assignment), the evidence used to support the complaint, and a summary of the conversation between the student and the faculty member regarding the complaint. The Class Dean will then inform the student in writing that a charge of dishonesty has been made and of his or her right to have the charge reviewed. A copy of this letter will be sent to the students parents or guardians. The student will also receive a copy of the complaint and all supporting materials submitted by the professor.

The students request for a formal review must be made in writing to the Class Dean within one week of the notification of the charge. The written statement must include a description of the students position concerning the charge by the faculty. A review panel consisting of a Class Dean, the Chair or Director of the department of the faculty member involved (or a senior member of the same department if the Chair or Director is the complainant), and an additional faculty member

[1] NOTE: If you are in any doubt about whether what you plan to do or write violates academic honesty, PLEASE ASK!

selected by the Chair or Director from the same department, shall convene within two weeks to investigate the charge and review the students statement, meeting separately with the student and the faculty member involved. The Chair or Director of the complainants department (or the alternate) shall chair the panel and communicate the panels decision to the students Class Dean. If the panel finds by majority vote that the charge of dishonesty is supported, the faculty members initial written report to the Class Dean shall be placed in the students file until graduation, at which time it shall be removed and destroyed unless a second offense occurs. If a majority of the panel finds that the charge of dishonesty is not supported, the faculty members initial complaint shall be destroyed, and the assignment in question shall be graded on its merits by the faculty member. The Class Dean shall inform the student promptly of the decision made. This information will be sent to the students parents or guardians.

The Class Dean may extend all notification deadlines above for compelling reasons. He or she will notify all parties in writing of any extensions. Each instance of academic dishonesty reported to the Class Dean (provided that the charge of dishonesty is upheld following a possible review, as described above) shall result in an administrative penalty in addition to the penalty imposed by the faculty member. For a first instance of academic dishonesty, the penalty shall be academic probation effective immediately and continuing for the next two consecutive semesters. For a second instance, the penalty shall be academic suspension for two consecutive semesters. For a third instance, the penalty shall be dismissal from the College. Dismissal from the College shall also be the penalty for any instance of academic dishonesty that occurs while a student is on probation because of a prior instance of dishonesty. Multiple charges of academic dishonesty filed at or about the same time shall result in a one-year suspension if the student is not and has not been on probation for a prior instance of dishonesty. Multiple charges of academic dishonesty filed at or about the same time shall result in a dismissal if the student has ever been on probation for a prior instance of dishonesty. Suspension and dismissal are effective at the conclusion of the semester in which the violation of the policy occurred. Students may appeal a suspension or dismissal for reasons of academic dishonesty to the Committee on Academic Standing, which may uphold the penalty, overturn it, or substitute a lesser penalty. A penalty of dismissal, if upheld by the Committee, may be appealed to the President of the College.

Specific Guidelines for this Course

In this course, all examinations will be closed-book. No sharing of information with other students or consultation of online sources in any form will be permitted during exams. On group discussion write-ups, close collaboration with the other members of your group is expected. On the individual problem sets, discussion of the questions with other students in the class and with me during office hours is allowed, *even encouraged*. However, your final problem solutions should be prepared individually and the wording and organization of your final problem solutions should be entirely your own work. Moreover, if you do take advantage of any of the above options for discussion of problems with others, you will be required to state that fact in a footnote accompanying the problem solution. Failure to follow this rule will be treated as a violation of the College's Academic Integrity policy. For the papers, if you do consult a source other than the course texts, include a full reference in a bibliography section at the end of your paper, and identify any direct quotations. Information about the acceptable formats for doing this will be distributed with the paper assignments.