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Jim Crumley

*College of Saint Benedict/Saint John's University, jcrumley@csbsju.edu*

Kristen Nairn

*College of Saint Benedict/Saint John's University, knairn@csbsju.edu*

Lynn Ziegler

*College of Saint Benedict/Saint John's University, lziegler@csbsju.edu*

Pamela L. Bacon

*College of Saint Benedict/Saint John's University, pbacon@csbsju.edu*

Yu Zhang

*College of Saint Benedict/Saint John's University, yzhang@csbsju.edu*

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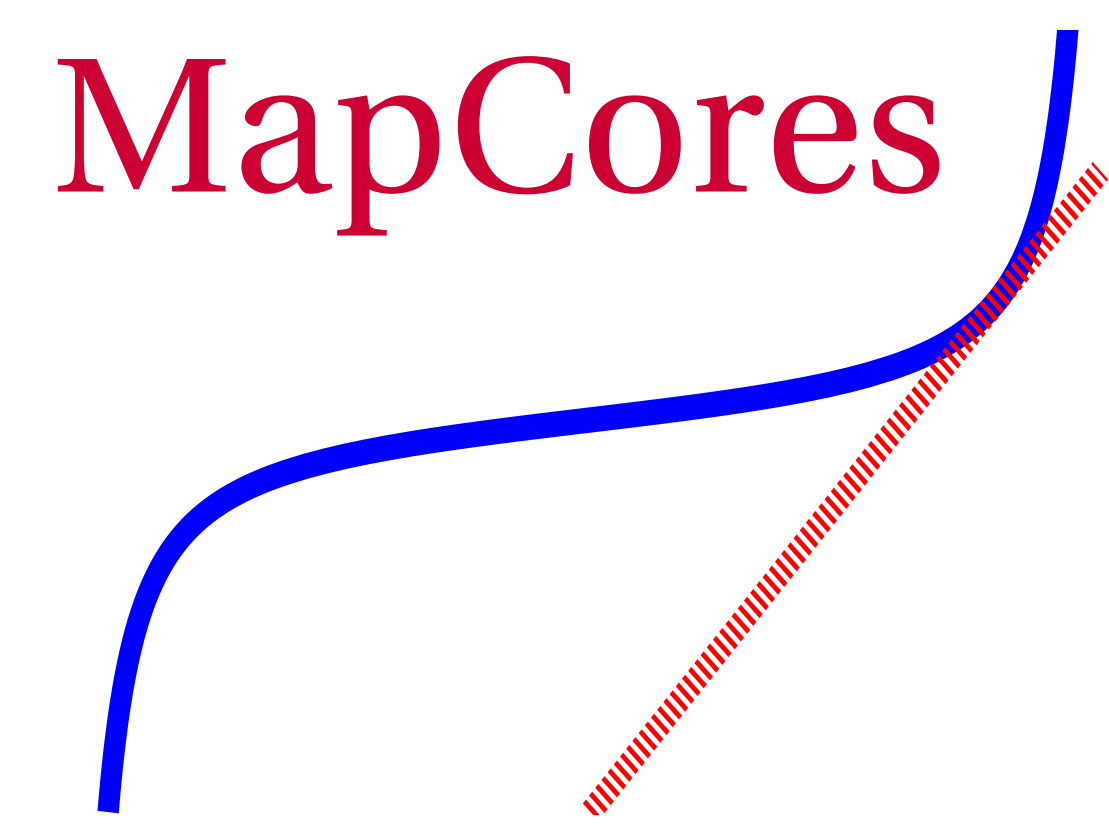
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# A Women in Mathematics, Computer Science, and Physics Course

Jim Crumley, Kris Nairn, Lynn Ziegler, Yu Zhang, Pam Bacon

College of Saint Benedict / Saint John's University, Collegeville, MN 56321

jcrumley@csbsju.edu



## 1. Abstract

Increasing women's participation is a concern in disciplines beyond physics. As part of our Mathematics, Physics, Computer Science Research Scholars (MapCores) program, we teach a women in science class covering these three areas. Our course is a special version of our college's first year seminar (FYS), which is a course designed to prepare our students to read, write, and speak at a college-level. We structure our FYS to promote academic confidence and interest in our disciplines for the women in MapCores. It covers not only contributions that women have made and barriers that women face in these disciplines, but also research frontiers and science policy issues in these disciplines. While the women in MapCores find covering these topics beneficial, the most important benefit of the course is the supportive cohort that develops from it.

## 2. Background

### 2.1 College of Saint Benedict (CSB)

- is a women's liberal arts college in St. Joseph, MN.
- enrollment roughly 2000 women.
- 70 miles northwest of Minneapolis.
- is partnered with Saint John's University - enrollment roughly 1600 men.
- almost all courses co-educational.

### 2.2 Women in Physics

- The "pipeline is leaky" in every step from junior high school through the senior professor level. [Freeman, 2004]
- Physics and other analytical majors are perceived in society as bad choices for women. [Hyde et al., 2008]
- Being vastly out-numbered by men in mathematics and physical science classes decreases women's confidence. [CMPWASE, 2007]



Figure 1: Sophomore MapCores students programming Lego robots to follow a tape track.

## 3. MapCores Program

### 3.1 Background

- Enrollment of women in some science majors at CSB lagged behind the national averages.
- Started program called MapCores — Mathematics, Physics, Computer Science, Research Scholars [Crumley et al., 2014].
- Physics, Math and Computer Science departments partnered because:
  - Women face similar issues in these disciplines
  - overlap between disciplines allows for natural cross-disciplinary student projects
  - bringing students together allows for manageable cohort size
- First cohort began in Fall 2009.
- NSF S-STEM grant funded December, 2009 [Nairn et al., 2009].

### 3.2 Curricular Program

Classes team taught by faculty from Mathematics, Computer Science, and Physics.

- First Year — First Year Seminar class
  - Build cohort and support network
- Sophomore — 1 credit Problem Solving Seminar
  - Work on interesting cross-disciplinary problems
- Junior — 1 credit Research Seminar
  - Work in groups semester long research projects
- Senior — Senior/Thesis Research projects



Figure 2: Junior MapCores presenting their projects at Celebrating Scholarship and Creativity day.

## 4. First Year Seminar

### 4.1 FYS Overview

- Course goals focus on reading, writing, speaking and information literacy at a college level.
- Year long, four credits per semester class.
- Class size sixteen with equal split of men and women in normal sections.
- Any material can be used for the class, as long as the required skills are emphasized
- Course taught by professors from across CSB/SJU, but by relatively few natural science professors.
- FYS acts tool for transitioning students to college.
- FYS professor is the first advisor for students.

### 4.2 Our MapCores FYS

- Our section is all women in MapCores.
- Topics in our section:
  - Women in Physics, Math, and Computer Science
  - Current topics in Physics, Math and Computer Science
  - Career and advising — we discuss summer research, career and graduate school opportunities
  - Philosophy of science, science policy, and scientific ethics — we discuss what science is, how to evaluate science policy, and what circumstances lead to scientific misconduct.
- We have varied specific material covered and approaches to it.
- Class time spent on:
  - discussing reading in small and big groups.
  - working on papers, particularly research papers.



Figure 3: First Year Seminar party.

### 4.3 Women in Science Topics

- First year of FYS had units on history of women in physics, history of feminism, current issues for women in science.
- We received a fair amount of push back:
  - Some of our students said they had not been discriminated against and that they would not run into these problems.
  - The history seemed distant to them.
  - The social science that we presented discouraged some, and did not interest others.
- Our current approach:
  - Start slow with this material at first, mixing it with other units.
  - Transition into these topics with discussions of less threatening areas — portrayal of women in media, etc.
  - Go into more depth late in the year when the students know us and each other.
  - Give these issues personal context by having our women interview two women they know about their career choices.

### 4.4 Physics Topics

- Look for Physics topics that are:
  - accessible to first year students with no physics background.
  - currently in the news.
  - not likely to be covered in regular physics classes.
  - that have angles that are suitable for discussion and argument.
- Examples that we have used and related discussion topics:
  - Extra-solar planet finding — Why does this matter? Is this a good use of resources?
  - The Drake equation / life elsewhere — How likely is life elsewhere? what would change if we found life elsewhere?
  - Superluminal neutrinos — How do mistakes happen? How should discoveries be publicized?
  - Higgs Bosons — Why does it matter? How is credit shared?
  - Energy policy — What factors should be considered? How should research resources be split?

## 5. Results

MapCores is helping us recruit, retain and graduate more women in math, physics, and computer science, and our FYS is a key part of that success.

- Of our first two MapCores cohorts, 70% graduated with a major in math, physics, or computer science, as compared to 34% students who entered planning on those majors.
- Our FYS is a key part of our retention success. In FYS students:
  - form a supportive cohort, which helps them feel at home in our majors [Nairn et al., 2014];
  - meet women from other MapCores cohorts, which begins the process of cross-cohort mentoring;
  - receive advising, which informs them of career possibilities;
  - learn about hot topics in science, which keeps them excited about their options;
  - learn about barriers, which prepares them to face later challenges.

## 6. Future Work

- Continue to update and revise the material we cover in first year seminar.
- Draw other faculty from our departments into program.
- Encourage other faculty at CSB/SJU and elsewhere to attempt similar models of engaging under-represented groups..



Figure 4: Sophomore and junior MapCores students presenting their projects to FYS students and others.

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