
Games as a Gateway for Non-Major Students

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Outline

- the role of *Ideas in Math*
 - the structure of the class
 - the content of the class
 - projects
 - student feedback & observations
 - about math
 - about perseverance
 - about games & humanity
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Ideas in Math at BC

Mathematics core for most students is fulfilled by

- Calculus I (or higher)
- Finite Probability
- Ideas in Mathematics

This course is designed to introduce the student to the spirit, beauty and vitality of mathematics. The emphasis is on development of ideas rather than problem solving skills. Topics vary, but are typically chosen from diverse areas such as geometry, number theory, computation and graph theory.

Learning Goals

More specifically, this math class gives you the chance to develop your math practices and learning strategies. These are tools for how you learn and do math and you can use and adapt these to your other courses and future careers, regardless of the field.

- **Problem Solve:** become proficient and flexible in problem-solving. Translate from a real world situation to a mathematical representation, understand the problem, make and implement a plan, communicate the solution, and reflect on the answer.
 - **Apply Mathematics:** Recognize places that we can use the tools we develop in different disciplines (and in everyday life).
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Learning Goals (con't)

- **Communicate verbally and in writing:** Be able to explain the reasoning and concepts (the “why” and “how”) behind the computations you do, using words, graphs and math notation.
 - **Collaborate productively with others:** Learn how to work with peers on math problems, giving feedback and asking questions about others' ideas.
 - **Reflect and Ask Questions:** Engage in self-questioning, about how you learn, about the content and concepts, and about how math might connect to your wider world.
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**What organizing
frameworks would let
us explore interesting
mathematical ideas
with non-majors?**

Math & Games: Structure

Unofficial Course Description

In this course we will enter the world of mathematics through the doorway of games – card games, board games, and strategy games. What questions do they raise that we can explore with the help of mathematical tools? We will think about strategy, “what if?” explorations, and more. We’ll think about what parts of mathematics games can help us see (including a four-dimensional space). We will harness curiosity and mathematics to more clearly understand both games and abstract ideas.

Required Course Materials

A deck of SET cards.



Assignments

- approximately weekly homework
 - quizzes about every other week
 - weekly reflection prompts
 - 3 projects
 - final integrative essay
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Math & Games: Content

SET as a spine for the class

- learned to play SET the first day
 - play and document 5+ games of SET
 - what questions do you have about SET?
 - modular arithmetic: one way to check if a SET is a SET
 - Mancala also uses modular arithmetic
 - **Project 1:** Tic-Tac-Toe – how to win -> more interesting?
 - counting: how many cards? SETs? what else?
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SET as a spine for the class

- probability: how many cards left at end of SET?
 - Poker hands and probability
 - Gaming dice and expected value
 - **Project 2**: probability or counting question of your own
 - Strategy & Solvability: Nim
 - ... which led us to binary
 - ... which let us to thinking about ciphers
 - **Project 3**: Code Breaking and Making
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SET as a spine for the class

- geometry: what are points, lines, planes in SET?
 - *Flatland*
 - parallel lines in SET
 - SET cubes and “parallel” cubes -> 4D SET space
 - Bridges of Königsberg: a bar bet?
 - 4 color theorem
 - tiling checkerboards with dominos
 - Wrap up: keeping a card aside from the SET deck
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Math & Games: Projects

Project 1: Tic-Tac-Toe

- play Tic-Tac-Toe until you remember why it's kinda boring, and figure out how to describe why it's boring
 - come up with variations on Tic-Tac-Toe that might be more interesting
 - pick one, and describe it – what's different, what do you do, what are the rules, how does someone win
 - document 2 play-throughs of your game
 - come up with 3 things you can say about strategy in your new game
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Project 2: In a Game You Choose

- Choose a game you'd be interested in thinking about.
 - Come up with a counting or probability question question (or related series of questions) you want to think about.
 - Figure out how to count the things you want to count, and compute the probabilities you're
 - interested in!
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Project 3: Ciphers

- Read a short chapter for background on ciphers.
 - Decode the message provided (encoded in binary).
 - Come up with a trinary (using three symbols) or up to a 5 symbol code. Use your code to encode the message “The panda sneezes at midnight.”
 - Explain the decoding and encoding processes (the way you would to a friend that isn’t in this class).
 - Talk briefly about the advantages and disadvantages of these codes.
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Math & Games: Students on Math

When we solved a problem by drawing a picture for the first time, it was like a light bulb went off in my head. I asked myself, "Wait, math can look like this?"

But in this class, I found myself wanting to finish the logic of a SET cube or perfect the code I built, not because I had to, but because it was actually fun to think through. It reminded me that I learn best when I get to interact with ideas, not just write them down.

In high school the question was always, "But how does this apply to real life." My high school teachers often left us with[out] explanations and would say things like "You'll see soon" or vague statements about how the concepts apply all around us without telling us where to look. This class, though, cemented mathematics in games -- this may not be the big answer we were looking for in high school, but I like this answer.

But this class reminded me that math is not just formulas, but more of a language, a window into a different way of seeing the world. I found myself engaged in ways I didn't expect. I wanted to figure things out because the problems were interesting. That curiosity was new for me in a math setting, and I think it's because the games and topics explored made it feel like discovery rather than work.

Playing Nim and learning that there was a "winning strategy" based on binary counting surprised me-- it was one of those moments where math actually felt powerful. It wasn't about memorizing equations; it was about thinking differently.

Math & Games: Students on Persistence

For the first time, I didn't feel like I was being judged for not understanding something right away. I felt like I was being invited to engage with the material in a way that actually made sense to me. ... I started to feel less like I was failing at something and more like I was participating in something I could actually understand and enjoy.

... I would get discouraged easily if something didn't click right away. But in this class, the focus was different. It wasn't just about getting the right answer, it was about how you thought through the problem. That made it easier to stay engaged and be curious instead of frustrated.

One thing I did not expect from this class was how much we focused on reflecting on the learning process itself. In most math classes I have taken, it was all about getting the right answer as quickly as possible. There was not much room for making mistakes or thinking through how and why you got something wrong. In this class, it felt like learning was treated as a process, not just a result. I appreciated that. It helped me see that making mistakes and trying again is a normal and useful part of learning. It also made math feel less intimidating. I started to feel like someone who could improve at math with practice instead of someone who was either good or bad at it.

What this class taught me, beyond any individual unit, is that I'm not a lost cause when it comes to math. I've learned that when material is presented in a way that's engaging, relevant, and filled with curiosity, I can not only understand it--I can enjoy it. That realization has been huge for me as a student. Curiosity, not natural ability, is what makes learning possible.

... and if I didn't understand something immediately, I'd panic a little. But in this class, it felt okay to be stuck or talk through an idea that didn't totally make sense yet as each homework and reflection provided more time to understand the topic before the quiz arrived. I also think that feeling of being okay with being stuck came from the way we learned as so much of the class was built around trying things out, testing ideas, and talking through what we noticed. It felt low-pressure in a good way, and I realized I actually enjoy learning more when I'm allowed to be confused at first and work through it, instead of always rushing to the answer as it helps more with the true, long-term comprehension of the material.

**Math & Games:
Students on Games &
Humanity**

To be honest, I was nervous when I first read that this course was about math and games. I was worried that my dislike for math might carry over and "infect" my love for games. But instead, something surprising happened: my love for games ended up nourishing a budding interest in math. This class didn't just make math bearable--it helped me see math as something that could be playful, creative, and even meaningful.

But even more than that, this class reignited my love for physical games. ... there's something wonderfully human about the entire process.

What makes this math class different from any other I've taken is that it inherently fosters community of some sort. Math is usually thought of as being a rather isolating field. But most games are meant to be played with other people. From day one we had to interact with other people in the class in order to play SET. ... This is the first time I have had a math class bring people together in a positive way rather than a stressful one.

All in all, this class surprised me and made me a more complete math student. It was more creative, more social, and more fun than I expected. It made math feel more human.

An interesting aspect of the course was the way in which games (especially with math) bring competitive energy which is really motivating. At the same time, games ignite the collaborative energy as well. Games may be unique in terms of creating an experience to feel both very competitive and also to feel closer to the people around who you may be competing against.

All jokes aside, the classroom had a real positive, collaborative vibe. I loved being able to sit back and listen when I was stuck. Sometimes my groupmates ... didn't even have a clear answer either, but we were able to build on each other's thoughts. Getting closer to the solution each time felt awesome.

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If this is a student's last formal math class, what do we want them to take with them? What kind of experience do we want them to have?

Thank you!

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