COURSE DESCRIPTION
How do we learn, understand, and teach science, technology, engineering, and math (the STEM disciplines)? In this class, we will explore the nature and development of the scientific mind; how we formulate theories, design experiments, and understand scientific, technological, and mathematical concepts; and how we learn and teach related skills in the classroom, addressing the debate about the effectiveness of direct instruction and hands-on approaches.

The main goals of this course are to:
- Become proficient at reading empirical research articles in experimental psychology, neuroscience, and education focusing on STEM learning
- Become familiar with the major concepts and theoretical models from psychology and neuroscience that relate to STEM learning
- Become adept at evaluating the merit of claims from proposed educational interventions regarding science and math

COURSE REQUIREMENTS
- All required readings will be available on Canvas.
- Developing the skills of critically reading empirical research articles and writing for a scientific audience are central to achieving the course goals.

GRADING OVERVIEW
33% Exam 1
33% Exam 2
10% Class Debates and Policy Memo
10% Final Project, including Project Writeup
10% Quizzes (average of all 6)
4% Completion of all assignments and participation
ASSIGNMENTS and ASSESSMENTS

Two exams – MONDAY, JANUARY 31ST and MONDAY, FEBRUARY 28TH
- Mix of fill-in-the-blank questions (~1-3 word responses) and short answer questions (~1-3 paragraph responses)
- Covers material from lectures and assigned readings (the aspects of the readings highlighted in lectures are the most relevant)

Debates and Policy Memo
- An important skill to develop is the ability to distill a large body of opinions and research on a given topic down to a concise set of practical actions that can be argued for and implemented. Accordingly, in this course you will practice doing just that, in the form of crafting an argument with your debate team and then writing a short policy memo (~ 1,000 words) which presents a clear case for a specific course of action regarding your debate topic.
- For the members of each debate team, a short policy memo is due after each debate. The full description of the assignment for each paper will be found on Canvas. For each position paper I’m looking for a well-researched, well-reasoned essay relating to your take on each topic, of roughly 1,000 words in length (about 3 double-spaced pages). Additionally, each paper must reference at least 4 sources (peer-reviewed journal articles, news pieces, etc.) that were not assigned in class; and remember: always cite your sources when you assert a fact (see details on the next page). Each position paper is an individual assignment (not a group project), and will be graded as such – you are expected to do your own research and convey your own assessment and understanding of the material.
- For the audience members, each debate team will post the most convincing single article they can find the week before the debate; audience members should come to class prepared having read the article and generated questions to ask of both teams. If you are an audience member, email me at least one question for each team based on the readings prior to class on the debate day.

Quizzes – Six quizzes throughout the term
- Any material covered to date is fair game, including that day’s assigned readings
- These are intended to be low-stakes opportunities to gauge your understanding of the material.
- Your quiz grade will be the average of your 6 quiz scores

Final Project and Writeup – Presentations During WEEK 10, Writeup by MARCH 14TH
- Design lesson plans for informative activities that teachers can use to guide students through various STEM learning experiences.
- Work with your group on a specific project (determined after the first exam) and then write up a brief report as a group on the lesson you design, with everyone contributing a specific individual component of the report.
- During week 10, the groups will share a demo of their activities with the class
COVID-19 INFORMATION
Source: https://covid.dartmouth.edu/faculty-teaching-undergraduate-courses-faqs

Attendance:
You are expected to attend class in person unless you have made alternative arrangements due to illness, medical reasons, or the need to isolate due to COVID-19. For the health and safety of our class community, please: do not attend class when you are sick, nor when you have been instructed by Student Health Services to stay home.

If you need to miss class:
- Recordings of class will be posted to Canvas and will be available for everyone.
- Let me know if you need help connecting to classmates who can share class notes.
- Also let me know if you need help with any material and would like to meet.

Safety:
In accordance with College policy, all members of the Dartmouth community are required to wear a suitable face covering when indoors, regardless of vaccination status. This includes our classroom and other course-related locations, such as labs, studios, and office hours. If you need to take a quick drink during class, please dip your face covering briefly for each sip. Eating is never permitted in the classroom. (The only exception to the face covering requirement is for students with an approved disability-related accommodation; see below.)

If you do not have an accommodation and refuse to comply with wearing a face covering or other safety protocols, I am obligated to assure that the COVID-19 health and safety standards are followed, and you will be asked to leave the classroom. You remain subject to course attendance policies, and dismissal from class will result in an unexcused absence. If you refuse to comply with masking or other safety protocols, and to ensure the health and safety of our community, I am obligated to report you to the dean’s office for disciplinary action under Dartmouth’s Standards of Conduct. Additional COVID-19 protocols may emerge. Pay attention to emails from the senior administrators at the College. I will communicate any changes and their resulting implications for our class community.

Quarantine and Isolation:
Given the evolving state of the COVID-19 pandemic, students may need to quarantine or isolate at some point during the term. Students are not required to disclose health information to faculty, including their quarantine or isolation status. However, in compliance with Dartmouth’s Academic Honor Principle, students are expected to act with intellectual honesty and integrity in the performance of their academic assignments and responsibilities.

Students who need additional academic or access support due to a medical condition can reach out to the following deans:
Morgan.A.B.Ogreen@dartmouth.edu (covers ’22s and ’24s)
or Loren.L.Bowley.Dow@dartmouth.edu (covers ’23s and ’25s).
GENERAL POLICIES

1. **Before you turn in your papers...** make sure that you use 12-point Times New Roman font, that you double-space the whole document, that your print margins are 1-inch on all sides (not the default in Word), that all your pages are numbered, and that your document is stapled together (if printed). For citations in all papers, you must use APA Style formatting (refer to the APA Style Manual or online guides, such as: [http://owl.english.purdue.edu/owl/resource/560/01/](http://owl.english.purdue.edu/owl/resource/560/01/))

2. **Accommodations:** Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services ([Getting Started with SAS webpage; student.accessibility.services@dartmouth.edu](mailto:student.accessibility.services@dartmouth.edu); 1-603-646-9900) and to request that an accommodation email be sent to me in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with me to determine relevant details such as what role SAS or its [Testing Center](mailto:testing-center@dartmouth.edu) may play in accommodation implementation. This process works best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

3. **Plagiarism is unacceptable.** All work submitted as your own must be written by you and not previously submitted for any other class. It is important to attribute material that is the work of others to the original source. If you are unsure how to properly cite a source, please consult with me prior to handing in an assignment (and see: [http://www.dartmouth.edu/~writing/sources/](http://www.dartmouth.edu/~writing/sources/)). You should be familiar with Dartmouth’s [Honor Principle](http://www.dartmouth.edu/~uja/honor/), which applies to all courses at Dartmouth. If any concerns do arise, I will forward all related materials to Dartmouth’s Committee on Standards.
Notifications regarding recording of instruction:

(1) Requirement of consent to recordings

By enrolling in this course, I hereby affirm that I will not under any circumstance make a recording in any medium of any lecture, one-on-one meeting with the instructor, or meeting with other students without obtaining the prior written consent of all those participating, and I understand that if I violate this prohibition, I will be subject to discipline by Dartmouth up to and including expulsion, as well as any other civil or criminal penalties under applicable law.

(2) Consent to recording of course and group office hours

a) By enrolling in this course, I affirm my understanding that this course and any associated group meetings involving students and the instructor, including but not limited to scheduled and ad hoc office hours and other consultations, may be recorded by the instructor within any digital platform used to offer remote instruction for this course;

b) I further affirm that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part, and distribution of any of these recordings in whole or in part without prior written consent of the instructor may be subject to discipline by Dartmouth up to and including expulsion;

c) I authorize Dartmouth and anyone acting on behalf of Dartmouth to record my participation and appearance in any medium, and to use my name, likeness, and voice in connection with such recording; and

d) I authorize Dartmouth and anyone acting on behalf of Dartmouth to use, reproduce, or distribute such recording without restrictions or limitation for any educational purpose deemed appropriate by Dartmouth and anyone acting on behalf of Dartmouth.
Topics and Readings

(ASSIGNED READINGS ARE POSTED ON CANVAS)

January 5
INTRODUCTION and COURSE OVERVIEW

January 7 + 10
1. MAGNITUDE AND THE APPROXIMATE NUMBER SYSTEM (ANS)
   Readings:

January 12
2. NUMBER REPRESENTATIONS AND THE TRIPLE CODE MODEL
   Readings:

January 14
3. NUMBER LINES: LOG VS. LINEAR REPRESENTATIONS
   Readings:

January 17
Martin Luther King, Jr. Day – class will not meet today
January 19

4. MATH INSTRUCTION STRATEGIES; ELEMENTARY MATH
   Readings:

January 21

5. FRACTIONS AND ADVANCED MATH
   Readings:

January 24

DEBATE 1

MOTION: “It is important for elementary math classrooms (specifically, grades 2-5) to use physical manipulatives or demonstrations as a regular part of instruction.”

Readings:
1) TBD by Debate Group 1
2) TBD by Debate Group 2
January 26 + 28

6. MATH ANXIETY, TEST ANXIETY, AND STEREOTYPE THREAT
   Readings:

January 31

EXAM 1

February 2

7. DESIGNING A LESSON PLAN
   Readings:
   1) See example science lesson plans for Inquiry-based activities on Canvas

February 4

8. NAÏVE SCIENCE CONCEPTS AND LEARNING TO THINK SCIENTIFICALLY
   Readings:

February 7

9. CONCEPTUAL MENTAL MODELS; ANALOGY IN SCIENTIFIC DISCOURSE
   Readings:
February 9
10. ACTIVE AND CONSTRUCTIVE LEARNING
Readings:

February 11
Winter Carnival – class will not meet today

February 14
11. “HANDS-ON” LEARNING
Readings:

February 16 + 18
12. SPATIAL SKILLS FOR STEM LEARNING AND EXPERTISE
Readings:
February 21

DEBATE 2

MOTION: “Hands-on labs are an integral component of high-school science education.”

Readings:
1) TBD by Debate Group 1
2) TBD by Debate Group 2

February 23 + 25

In-class time to work on group projects and solidify project ideas with guidance

February 28

EXAM 2

March 2 + 4

Groups meet independently and check in with Prof. K for feedback

March 7 + 8

CLASS DEMONSTRATIONS OF GROUP PROJECTS

Note: March 8 is a Tuesday, we will meet during the x-hour @ 1:20-2:10