

Special Topics: NEUROSCIENCE AND SOCIETY Spring 2023 (ONLINE)

Thurs 10:30AM-1PM EST
NEUR 461/592

INSTRUCTOR: N KABBANI (nkabbani@gmu.edu)

COURSE SUMMARY: This course explores the implications of developments in basic and clinical neuroscience and biotechnology on society. In particular, advancements in digital imaging, biochemicals, brain-machine technologies raise important legal and ethical questions. The course will examine timely topics ranging from genetic modification to artificial intelligence. The course encourages critical thinking through an understanding of the science and its implications and human safety.

LEARNING OBJECTIVES: The course is developed around *student-centered learning* where students work with one another to promote a space for knowledge acquisition and synthesis. This course is designed to provide students the opportunity to practice critical skills such as communication, creativity, and collaboration. Through reading, writing, and discussion the student will gain knowledge and augment their understanding of science. In addition, the course enables students to learn to communicate on issues at the interface of science and society through weekly practice in oral presentation, critical thinking, discourse, and writing. The various assignments are designed to promote the application of what is being learned in a “real world” scenario. By the end of the course, the student will have gained strong knowledge on the science, technology, and the ethical implications.

TEXTBOOK: All course-related material is provided via Blackboard.

SCHEDULE

1/26: Introduction
2/2: Artificial Intelligence
2/9: Aging and Disease
2/16: Drug Development/1st one-on-one meeting
2/23: Gene Editing Technology
3/2: Information Epidemiology/5 min presentation on your topic
3/9: Addiction and Public Health
3/16 No Class Spring Break
3/23: Biological Intelligence and Consciousness
3/30 No Class
4/6: Environmental Toxins and Brain Health

4/13: /5 min presentation on the outline

4/20:Climate Change and Human Behavior/

5/11:Final Report Due

GRADING:

1. Reading of articles and in class discussion of the topic (30%(3%each))
2. Weekly fun assignment submitted to Blog and presentation in class (30%(3%each))
3. In depth research project and a report (40%). See below project description and grading rubric.

1. Weekly Reading and Discussion of the Articles in Blackboard:

Each week will examine a topic. You are required to have read the topic's articles prior to class, and are highly encouraged to be active in discussing what you have learned from the reading.

What are important take away points?

What are some outstanding questions?

Are there any obvious concerns?

Your thoughts?

2. Weekly Fun ASSIGNMENT: A series of assignments are proposed. Complete the assignment and upload it as a Blog prior to class. You will get 5-10 min to discuss your blog entry/assignment to the class. Feel free to comment and discuss the blogs of others.

Here are some suggestions on the written report:

- Reports should be 1-2 pages (double spaced) in length, with standard margins and font.
- Write in complete sentences, organize your ideas into logical paragraphs, and proofread.
- You must cite a source when you use a direct quotation, paraphrase another author, or reference an idea that is not your own. Failure to do so is an Honor Code violation.

FUN ASSIGNMENTS

Assignment 1. Artificial Intelligence



Create a company that produces a new AI technology. Describe your main product(s) and how they may address an existing need that can be served through AI technology. Consider your target market. Who would buy this product and for how much? How will your technology compete with other or similar products? How will you deal with issues that may come up on privacy and/or regulation? What does your company need (skills and resources) in order to succeed?

Assignment 2. Alzheimer's Disease and Dementia



Develop a conference that uniquely brings together key figures that can advance knowledge and treatment for AD and dementia. List the kinds of scientists and policy makers that you may want to invite and other professionals pertinent to the cause. How will you promote interaction between diverse professionals on the issues? What would be your 3 primary goals for the conference? Where would the conference venue be and why?

Assignment 3. Pharmaceuticals and Drug Development



Pick an emerging drug, class of drugs, or a neuro related therapy:

- 1) Create an advertisement for this technology for the public. This can be a visual or animated add. Make sure to highlight the benefit of this drug and inform them on how it works. Make sure to note how this new drug may out perform other existing therapies.
- 2) Create an announcement for a warning, class action lawsuit, or recall against this therapy also for the general public. Make sure to highlight the issues that have prompted this recall/warning.

Assignment 4. Gene Editing Technology



Draft an NIH style RFP for research into a specific form of gene editing technology. Expand on which areas or topics are important for funding covered by this RFP.

Emphasize which approaches and technologies are most valued in the submitted proposals. You can also highlight which types of researchers and approaches are encouraged to apply. Include information on the funding range for each grant considering how much would be needed to enable the research. Which NIH institute could sponsor this and why? Look at RFPs on the NIH website for examples.

Assignment 5. Information and Technology



You are a world-renowned scientist and have called to testify at an important congressional hearing on the “State of Information, Misinformation, and Disinformation” on the internet. The aim of the hearing is to enable the congressional committee to decide whether the U.S. should or should not invest more

research on this topic. Draft a 2 page letter of the script of your speech. Consider carefully what you would tell the congressional committee and how to effectively make your case in the short amount of time you are provided (~7 minutes). Note while the members of the committee are familiar with the science they are not scientists.

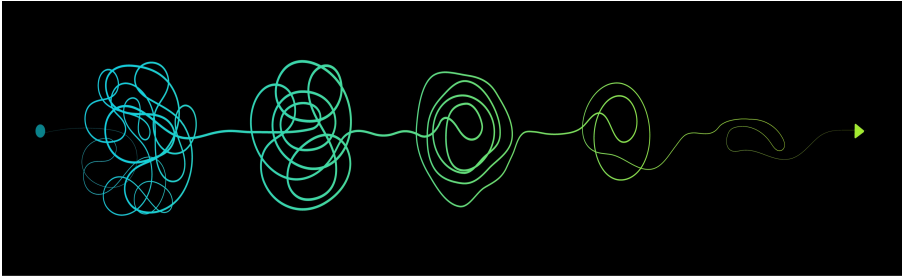
Assignment 6. Addiction

Main Point	Five years ago, the Department of Energy (DOE) launched SunShot, an initiative to make solar cost-competitive with traditional energy sources. Since that announcement, the price of solar has nearly halved, solar industry employment has doubled, and solar electricity generation has grown twenty-fold. What we need now is to replicate this policy success with a SunShot for Carbon Capture Storage (CCS).
Background	<p>The International Energy Agency and the UN's Intergovernmental Panel on Climate Change have made it very clear—we're unlikely to win the climate fight without CCS. We know that CCS technology works. But getting it deployed as widely and as quickly as we need to will require additional policy incentives to make CCS more cost-effective, including an increase in federal RD&D activity.</p> <p>As evidenced by SunShot and the more recent announcement of Mission Innovation, the Obama Administration clearly understands the importance and potential of aggressive, multi-year investment campaigns in energy R&D. The President's 2017 budget proposal streamlines DOE's CCS innovation activities and includes programmatic updates that prioritize the most effective and successful activities. With a few additional tweaks by Congress, this spending plan could lay the groundwork for an equally promising innovation effort—a "SunShot for CCS".</p> <p>To ensure this urgently needed technology is ready for an enhanced innovation effort in the coming years, Congress should:</p>
Recommendation 1 and Evidence	<p>Robustly Fund CCS and Advanced Power Systems</p> <ul style="list-style-type: none"> While the Administration's Fossil Energy request for 2017 was their largest to date, it is still slightly below 2016 enacted levels. Congress should meet or exceed previous funding levels for the recently-restructured "CCS and Advanced Power Systems" program within the Fossil Energy budget.
Recommendation 2 and Evidence	<p>Fund Carbon Use and Reuse</p> <ul style="list-style-type: none"> The 2017 budget proposal does not request any funding for the Carbon Use and Reuse activity. However, value-added products provide necessary cost reductions that allow for earlier and more effective CCS deployment and there is increasing private sector interest in carbon utilization, as demonstrated by the Carbon XPRIZE. As a first step, Congress should add to this momentum by providing \$10 million for the Carbon Use and Reuse activity within the Carbon Capture subprogram.
Recommendation 3 and Evidence	<p>Protect Demonstration Funding through the Clean Coal Power Initiative</p> <ul style="list-style-type: none"> The Clean Coal Power Initiative (CCPI) began in 2002 and is a cost-shared partnership with industry to develop and demonstrate cleaner coal power generation technologies at the commercial scale. The 2017 budget proposal requests that Congress include language to allow up to \$240 million in existing CCPI funds to be used towards the R&D budget, which would pull funding from potentially promising large-scale projects. Congress should leave these funds where they are in order to enable additional CCS deployment.
Recommendation 4 and Evidence	<p>Request a CCS Cost-Reduction Plan from DOE</p> <ul style="list-style-type: none"> 2017 is a first step, but accelerating clean energy technology can't be done in a single year. Like SunShot, CCS needs a long-term commitment. Congress should request the DOE produce a detailed, multi-year plan with the goal of cost-competitive CCS deployment. This plan should include both the large-scale pilots in the 2017 budget and future demonstration projects.
Conclusions	Climate change is a complicated problem, but this part of the solution is simple: We need CCS to meet emissions goals; we need to lower technology cost to deploy more CCS; and we have a proven model for cost reduction in SunShot. When you line up the facts, a "SunShot for CCS" becomes a rare no-brainer for climate policy. Congress has a chance this year to lay the groundwork for such an initiative. They shouldn't pass it up.

You are a Science Policy Fellow at the FDA. You have been tasked to draft a policy memo (see example below) on the addictive properties and regulatory guidelines for a drug/item of your choice. This memo is intended to help the Commissioner of Food and Drugs make an informed decision on action and regulation for this addiction.

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Assignment 7. Consciousness



Define “consciousness” in an animal or a system. Next design an experiment or a series of tests for examining consciousness in a model of your choosing. This experiment can be virtual or biophysical (e.g. in a laboratory). State your specific hypothesis and

method for data collection and analysis. List possible pitfalls and limitations in your work.

Assignment 8. Neurotoxins



Pick a scientist working in the field neurotoxin research and summarize his/her work citing major articles, contributions, and impact. Discuss his/her training and how they might have arrived at this work.

Assignment 9. Memory



How does neuroscience impact the legal landscape of testimony, eyewitness credibility, memory based facts, and claims of forgetting. In particular how can we incorporate neuroscience findings in areas such as neural plasticity and neuromodulation in the larger legal framework? For example, do we need neurotechnology in the courtroom? If so, which and why?

Assignment 10. Pesticides



Pick one type of pesticide that is still in use. Described in both scientific and regulatory terms the impact of this pesticide on insects, plants, other organisms including humans. Who produces this specific pesticide and how much is it in US? Does the compound have any impact on the nervous system? Which and how?

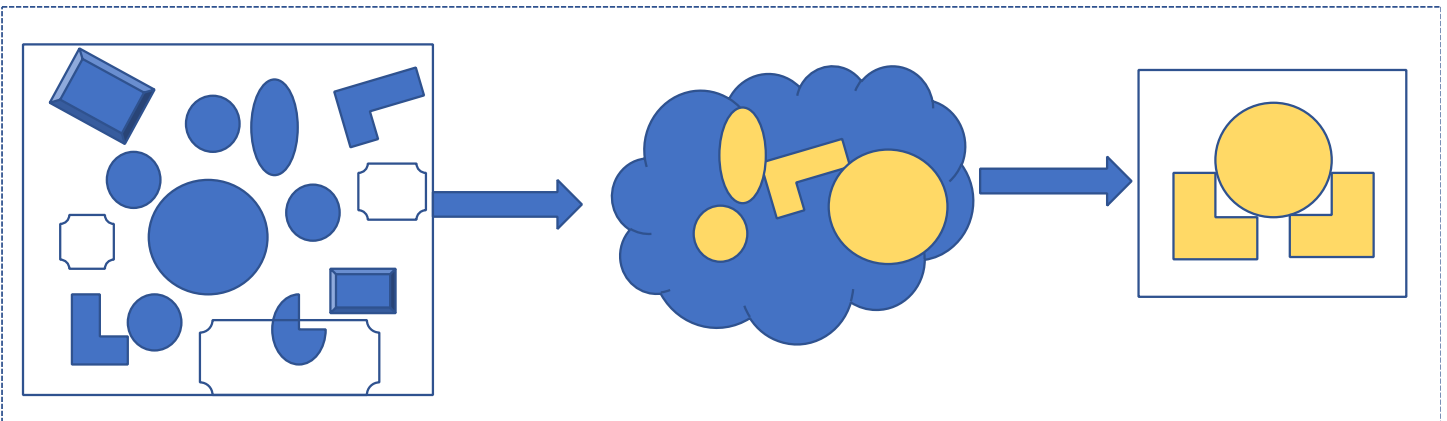
Assignment 11. Climate Change



Consider ways that climate change will impact human and/or animal behavior. Explore possible areas where the climate converges onto neural systems through its effect on health, survival, and adaptive evolution. Identify specific climate factor(s) with the potential to impact the nervous system.

IN DEPTH RESEARCH PROJECT

Write a research paper building on the existing literature and a synthesis of an original idea. This paper should be about 10-12 pages (double spaced). The goal is *not to summarize but to synthesize* an idea, concept, or theme based on what you have read. Think of this as an exercise in reading, deduction, and logic.



To do this, pick a topic that interests you and setup a first one on one meeting with me to discuss. Once we agree on the topic:

1. Identify relevant texts and sources of information. These sources can be journal articles, books, public databases, etc.
2. Spend significant time gathering background information by reading the literature.
3. Prepare a 5 min presentation for the class to tell us about your research project ideas
4. Schedule a second one on one meeting with me.
5. Begin to craft your idea(s) in the form of an outline.
6. Focus the logic of your hypothesis or argument.
7. Share the outline with the class.
8. Begin to write.
9. Tips: Use informative subheadings, figures, or flowcharts.
10. Allow time to proof read your project. Make sure to create a complete list of citations and references throughout. Use a bibliography manager (e.g. Mendley) to format to any standard biblio style.

Grading Rubric for Research Paper:

20% Class updates and presentations on the paper

30% Thoroughness of background research and data source identification

50% Final written report (25% content/accuracy; 25% structure/clarity)