Dr. Andrew Speidell - Statement of Teaching Philosophy

As a neuroscientist, teacher, mentor, and even a lifelong student, my central aim is to explore how fine changes at the molecular level sustain complex neurological systems and shape behavior in both health and disease. My overarching goal is to develop the same drive for neuroscientific exploration within my students and trainees through an emphasis on the process of scientific inquiry. To this end, I focus on strengthening three core aspects in my students and trainees: 1. Mastery of contextual information 2. Identification and development of important research questions and 3. Design of experiments, even if hypothetical, to answer these open questions and integrate the predicted results into conceptual frameworks. In doing so, students learn to appreciate the rigor and careful lines of experimentation which have been essential to shaping our current understanding of how the brain works.

I believe students learn best when they feel that they have agency over which topics they will explore and how they engage with the course content. To this end, I invite anonymous feedback at the beginning of the course (and sometimes even at the start of a lesson) for which open questions and topics students would like to see explored throughout the semester. This feedback helps sculpt specific lecture content and personally connects students to the course material. My course material is delivered through a combination of lecture slides, large group discussions / flipped classroom activities, and live demonstrations. I also make sure to provide multiple ways for students to interact with the course material on their own time. This may include PowerPoint slide footnotes which link to “Two-Minute Neuroscience” videos or web-based simulations of complex physiological systems. I’ve also found that connecting current trending topics to neuroscience themes – e.g. artificial “neural networks” vs human neural population computation – energizes lectures and keeps students’ motivation to learn at a high level. Finally, as active learning approaches are demonstrated to contribute to success in STEM [1], activities such as real-time polling, paired discussions, and case study are incorporated into my lectures as a means to drive student engagement and learning.

My personal interest in Huntington’s disease research was first ignited through an undergraduate professor’s passing mention of a mysterious intrinsic instability of certain nucleotide combinations during DNA replication. I’ve found that fleeting comments from students such as “That’s strange...why does that happen?” alludes to a similar and sincere curiosity which can spark a student’s lifelong passion for neuroscience in much the same way. Unfortunately, the timeframe of a typical university course often impedes further exploration of a personally captivating research question. To support students’ familiarity with open research questions while helping build engagement with scientific literature, I assign short student-led discussions around the main findings of a particular recent research article of interest. Pairs of students engage with self-selected articles and explain how the authors approached a particular hypothesis while fielding questions from other students about experimental rationale and methods. These mini journal clubs often take on a life of their own when co-instructors remain silent and let students speculate and deliberate about the merits and limitations of the article. Most importantly, the student presenters show understanding of their selected article and the larger subdiscipline to which it belongs by proposing and defending self-identified “next-step experiments” to both students and course directors.

Students who engage early and often with the process of scientific inquiry discover “the routine of science” – the set of time-tested practices which are integral to the execution of scientific research. Almost automatically, students learn to recognize what constitutes “good science” in formal scientific literature or lay communication. I increasingly worry, however, that careful planning and consideration of alternative hypotheses are increasingly bypassed in favor of generating any result, meaningful or not, from large-scale and data-driven science. To avoid succumbing to this type of thinking, I incorporate open-ended experimental design questions within lectures and on exams and assignments outside the classroom. “How would you design an experiment to test that?” is a question I often propose to the larger class in order to jog creativity and higher thinking when students ask follow-up questions. I find that an emphasis on experimental design helps move students from the simple understanding of relevant knowledge to the synthesis, application, and evaluation of this information – in much the same ways actual scientists do. Most importantly, students and trainees at all levels of instruction are further encouraged to provide alternative mechanistic explanations for the observed data and reach different conclusions based on their own interpretations. Reinforcing this broad capacity for inductive reasoning is required in current STEM students. Most importantly, it keeps these future scientists’ thinking in tune with the ideals of the scientific method as envisioned by Aristotle centuries ago.

In my students and trainees, I primarily aim to cultivate an enduring set of investigative skills and reasoning abilities necessary in the biomedical sciences. This includes the ability to engage with scientific literature, evaluate data in a thoughtful manner, and express oneself logically to both scientific and general audiences. I model these behaviors in my own research whenever possible and insist that my students and mentees practice and develop these same skills when in my courses or working as a member of my lab. This strategy is not only modeled but strongly reinforced by involving students at every stage of our experiments – from inception and design, to meeting with collaborators, to responding to peer reviewers. In this way, trainees feel like an integral part of the broader scientific process and are more likely to assume ownership and independence in their projects. Overall, it is my hope that even if students do not wish to pursue research as a medical or graduate student, these investigative skills and experiences will shape how they engage with their peers and the broader world in the pursuit of knowledge.

References

1. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, and Wenderoth MP, *Active learning increases student performance in science, engineering, and mathematics.* Proc Natl Acad Sci U S A, 2014. **111**(23): p. 8410-5. PMCID:PMC4060654 DOI: 10.1073/pnas.1319030111.