Chiye Aoki's Philosophy of Teaching

I believe teachers must not only strive to benefit individual students but the communities from which they come. For both goals to be met, the impact of teaching on the student must be both immediate and life-long in its relevance. I believe that ideas, no matter how good, remain dormant until they are translated into actions. My philosophy of teaching goes beyond setting explicit declarations of short- and long-term goals. Rather, my teaching is accompanied by mechanisms that engage self-reflection by students and instructors, together. I use data gathered from these to promote students' intellectual and emotional growth. Because of these beliefs, my philosophy of teaching will be revealed through descriptions of the educational programs I have created. These programs embody how my philosophy about teaching is translated into action, how I evaluate the effectiveness of my teaching, and how my teaching has been able to evolve to handle new challenges in our ever-changing society.

Teaching via minds of a researcher.

A research lab has the potential to become a great equalizer for students and teachers. Rather than being the all-knowing expert, a professor in a research lab is brought 'down' to be at equal footing with students, waiting for data to emerge, not knowing which way the results will turn out, not knowing whether the hypothesis will be validated or overturned. I believe professors should share such moments of anticipation – insecurity and excitement combined – with students. Let students witness that professors can be proven wrong, fair and square, by data that speak for themselves. Let students witness how difficult it is for professors to attain scientific rigor. Let students witness that a professor's favorite hypothesis can appear to be supported by initial sets of data, only to be overturned, as data continue to accumulate. Let students witness the professor's emotion, including disappointments when hypotheses are overturned. Let students witness a professor's excitement when outcomes are contrary to expectation, hinting at possibilities for new ideas. Let students witness the necessity of resilience that enables one to re-approach the same question with a revised hypothesis. Let students also witness a professor's struggle as s/he strives to master new techniques that will open paths for new questions. Invite students to make their own interpretations of data and to question and challenge the professor and the published literature. Finally, give students the time and space needed to evolve and know that the requirement for that evolution will vary across students.

Over the past decades, I have invited over 67 undergraduates to work side-by-side with me at the lab bench. I currently mentor 7 undergraduate students, four of them in person and three remotely. When students join my lab, I invite them to read my grant proposals so that they can retrace my pattern of thinking that began with a question, evolved through critical reading of the scientific literature, and culminated in the experiments they witness in my lab. Most of these students have pursued the Honors track in Neural Science. No less than 7 of them have been awarded prizes for their thesis and one student received an NIH-Cambridge University Scholarship. By sharing naturally occurring events of a research lab, students realize that scientific knowledge is built piece by piece, slowly, involving multiple corrections, relying on a person's commitment to honesty, openness, hard work, patience and collaboration. I believe a research lab can be a microcosm of a peaceful yet adventurous world, when leadership stems from compassion and respect for diversity.

Within a classroom setting, I strive to introduce these elements of a laboratory setting by presenting the teaching materials in progression, from well-established textbook knowledge to the brink of unknowns. I aim for students to become aware of the still-incomplete nascent bodies of knowledge by bringing peer-reviewed primary literature into the classroom. I compare multiple papers on an overlapping topic, pointing out findings that are conflicting, thereby making students become aware of what lies ahead for them to solve. To be sure, I also share new findings that are in agreement across multiple research groups, using students' newly gained foundational knowledge to point out the elegance and profound importance of recent

discoveries. This approach has cost me points in Course Evaluations, since many students are uncomfortable with murky knowledge that sometimes seems unorganized, as it compels students to re-evaluate what they had learned and synthesize a cohesive story using multiple components presented across multiple lectures. However, I believe the classroom experience of witnessing murky knowledge provides an important lesson – namely that not everything in science is black and white.

The topic of neuroscience lends itself to being relevant and fosters compassion. This is because neuroscientists strive to reveal biological mechanisms to many illnesses that surround us, such as addiction, anxiety and depression. In this way, neuroscientific finding replaces blames and judgements ("Why can't he learn from his mistakes?" "She is so timid," "They are wreckless") with scientific explanations of individual differences in vulnerability to these conditions. Students find topics with such societal relevance to be the most interesting, so I aim to emphasize societal relevance when I lecture on drugs, brain and behavior.

This year, due to the COVID pandemic, I faced the necessity of converting the in-class exams to take-home exams. This prompted me to re-think how to assess students' progress in a new way. One change I made was to challenge students to read assigned journal articles and identify figures that provided data supporting the authors' conclusions. Conversely, I asked whether the authors could or could not draw certain conclusions based on the data shown or what experiments they could have designed to answer questions. I feared that my questions were too challenging, as these were the type asked of graduate students. However, to my delight, the number of students earning A/A- (36 out of 50) was the highest ever for this course.

When given the opportunity to teach Special Topics in Neural Science, a seminar with a smaller class size, I randomly divide the class into two teams that debate about unsolved questions. I provide both sides with the starting material, comprised of papers published in high-impact well-respected journals. Students usually come to the conclusion that both sides may be right, to some extent. I believe the exercise required for synthesizing a fair, cohesive story out of seemingly contradictory bits of knowledge is an important experience for every student, whether they aspire to become a researcher, a doctor, or start a business. This is because the exercise fosters healthy appreciation for the process of scientific inquiry that requires close evaluation of findings from multiple angles. The process trains students to listen carefully to the other side. The format of a debate forces students to convert their inner thoughts flexibly into a readily-digestible, rhythmic and dynamic oral presentation. Students at NYU will undoubtedly encounter many more bits of knowledge that are seemingly contradictory, beyond their years in school and even beyond science. It is my hope that when that happens, students will be prepared to tackle the challenge by recalling how to identify the source of controversy, rather than discounting all of it or siding with either side of the controversy irrationally and reflexively.

As I will explain more fully below, I have fostered diversity in my research lab. Here is one example of how diversity has stimulated a new scientific question in my lab this year. A first-generation undergraduate researcher, Ikponmowsa Pat-Osagie from the South Bronx noted commonality between my animal research on the neurobiological basis of anorexia nervosa (AN) and his knowledge revolving drug addiction. As a certified emergency medical technician, Ikponmwosa has witnessed people being rescued from an opioid (heroin) overdose using Narcan. He reasoned that since AN patients exhibit an addiction-like behavioral symptom comprised of over-exercising, which contributes significantly to mortality through severe weight loss (AN has the highest mortality rate of all mental illnesses), then might Narcan help AN patients overcome their unhealthy addiction by eliminating the 'runner's high'? He is pursuing this question by using mouse model of AN to ask (1) how opioid receptors within brain's addiction center may be linked to excessive exercising and (2) whether Narcan can reduce these animals' excessive exercising.

<u>Creating undergraduate research programs on NYU campus that foster individuality, growth and with broad impact to society.</u> I believe that diversity in cultural background, interests, learning style and personality are

each a source of strength for an intellectual community. My desire has been to create a *learning* environment whereby an individual student's unique qualities and personal history can be turned into a source of curiosity, creativity, and motivation for scientific inquiry. The evolution of Ikponmwosa's research project is one such example indicating to me that diversity is indeed a source of strength. My desire has also been to create a *teaching* environment whereby researchers at all levels (post-docs, junior and senior faculty) can become active participants in building such an intellectual community. These desires have pushed me to seek external funding from the National Science Foundation (NSF-REU) and the National Institutes of Health (NIH's BP-ENDURE). As I had hoped, these grants have served to ensure that mentors could plan experiments that allow students to try their very first hands-on experiments in a laboratory without worrying that their good will incur expenditure of precious research funds. Conversely, the stipend provided to undergraduates (10 summer weeks through NSF-REU, 2 years through BP-ENDURE) has liberated students from the need to take jobs that do not contribute directly to their intellectual growth (such as stacking books in the library). This summer, as PhD students engaged in peaceful BLM demonstrations, they approached me, asking how they could contribute towards improving diversity and inclusiveness of our research community. I was happy to be able to respond to this question by inviting them to become daily mentors for the undergraduate participants of the Summer Undergraduate Research Program (SURP) that sponsored the NSF-REU and BP-ENDURE students. Described below are some further details of SURP and BP-ENDURE.

SURP. Since 1999, I have designed, directed, and obtained continuous external funding from the National Science Foundation Research Experience for Undergraduates (NSF-REU) to run SURP at the Center for Neural Science (CNS). The program invites undergraduates from outside of NYU to become immersed in neuroscience research over 10 summer weeks by enabling participants to conduct research side-by-side with professors, NYU undergraduates (mostly neural science majors), PhD students and post-docs. Our Goal #1 has been to enhance diversity of the students entering a career involving neuroscience research. We have successfully recruited into this program students from under-represented minorities (URM), students who are the first generation in their families to attend college, students from small colleges lacking neuroscience research opportunities, and students attending Historically Black Colleges and Universities (HBCU). Specifically, 67% of the participants have been URM, greatly outnumbering the proportion in the applicant pool (22%). I facilitate matching the recruits with neuroscientists at CNS, Biology and Psychology departments, and the Medical Center. I help applicants revise their personal statements and CVs and provide advice about what courses may be helpful for strengthening their preparedness for neuroscience research.

Our Goal #2 has been to provide scientific skills and neuroscience research experience while Goal #3 has been to enhance students' educational aspirations, confidence and commitment to pursuing a research career in science. We believe we have been successful in attaining this goal, since the proportion of SURP participants that have entered a PhD program in neuroscience is 47%, of whom 57% identify themselves as URM. The proportion of female SURP participants admitted to PhD programs is also high (43%). Out of the 112 college graduates who participated in SURP between 2007 and 2017, 100% of the students gained successful employment as research assistants in laboratories (including those in PhD programs), software/web engineers, analyst positions in the private sector or educators/outreach advocates. 76% of SURP alumni continued their education by matriculating in post-baccalaureate, MA, MD, MD/PhD and PhD programs. 100% of the students answered "Yes" to the exit survey question, "Do you think this summer experience helped you find out more about career options?" and 66% of the students in 2014 and 90% of the students in 2019 answered, "Yes" to the question, "Do you think you will want to pursue a career in science?" This success rate year after year is one reason we are one of the few institutions across the US with continuous NSF-REU funding for 23 years.

I believe that all three of these goals are important for educators. How do we attain these goals? I believe the weekly milestones that I created serves to provide the structure and explicit goals for students and mentors prior to their first day of working together. One hundred percent of the SURP students of every year has succeeded in writing a term paper that critically evaluates their research data in the context of relevant literature. By 'critical,' I mean that students train to differentiate interpretations of their data that are the most immediate versus speculations, and consider what experiments are needed to test those speculations in the future. Recognition of the significance and limitations of their findings is equally important to recognize, so I urge students to include those points in their term paper.

Another important educational goal is to nurture communication skills. No matter how profound the research topic, if a student cannot convey its importance to others, that student's success will be limited. Thus, during the weekly meetings, I have students practice their elevator talks (1 minute long) and 10 minute talks about themselves and their research to a variety of imaginary persons – grandma, younger brother, colleague, director of graduate school admissions, etc so that they train how to explain the significance of their research succinctly without relying on usage of specialized terms. The program ends with a celebratory symposium where each student stands behind a podium to deliver an 8-minute oral presentation to NYU's neuroscience community. Most of the SURP students also prepare a poster, so that they can use this to share their accomplishments with classmates and professors at their home institutions, local high schools and at NYU's Diversity Undergraduate Research Incubator (DURI) summer event.

I strive for the SURP program to have life-long impact. By living together in dorms and sharing experiences through weekly meetings and fun outings in NYC, SURP creates a supportive network based on friendship and respect, rather than competition. Their networks extend across multiple US institutions (including the U of Puerto Rico and U of Hawaii) but always with NYU as its center. These networks yield wider choices for mentors at varying steps along their career paths. Using a more traditional scale of success, many students have become co-authors on publications in peer-reviewed journals. Some have returned to NYU to become PhD students and one has returned to NYU as a tenure-track faculty. All participants are exposed to survival skills in science (how to write an effective CV, how to communicate with mentors, what constitutes ethical conduct in biomedical research). The students also gain familiarity with research opportunities at NYU and become exposed to the breadth of the field by attending the nation-wide meetings.

While the benefits of SURP to undergraduates may be obvious, graduate students and post-docs who serve as mentors also report the benefits of participating in SURP. SURP provides experience that is vital for becoming effective, confident teachers and scientific leaders. SURP offers opportunities for making tangible contributions towards diversity in the scientific community. So as to protect mentors from losing precious time, resources and data, I have added a coaching session for mentors during the weeks preceding SURP, where I facilitate discussions about best practices for minimizing loss and optimizing mutual gains by SURP undergrads and mentors. I received training from two courses, "Entering Mentoring" (The Wisconsin Program for Scientific Teaching, supported by HHMI, run by Jo Handelsman et al) and "Teaching Survival Skills & Ethics" (run by Beth A Fischer and Michael J Zigmond, supported by NINDS of NIH and U of Pittsburgh). The single most important take-away point from these training sessions has been to 'Communicate Expectations'.

BP-ENDURE. While NSF-REU has provided the financial backing that put NYU at the center of a network of PhDs from URM backgrounds, I felt the need to find additional resources to financially support our very own NYU undergraduates. This prompted me to seek extramural funding. After two unsuccessful attempts, I was able to secure funding in 2010 from a new NIH program, called BP-ENDURE, by partnering with Hunter College. This program complements SURP at CNS by providing financial support to 3 or 4 undergraduates at NYU continuously for 24 months. This program enables mentors to teach intricate and challenging research

techniques and cumulative knowledge that cannot be attained in just 10 summer weeks. The selected students are freed of the need to take part-time jobs to pay for textbooks or meals. We are one of two institutions that have been successful in receiving continuous funding over three funding cycles (2010-2025), based on our track record of having succeeded in nurturing >90% of the participants to enter PhD or MD/PhD programs, including top-ranking schools, such as NYU, Harvard, and Stanford. Besides the elements described under SURP at CNS, we have added a mechanism of tracking each BP-ENDURE (and other) neural science majors' academic performances soon after mid-term exams. Students who are identified to be struggling are paired with tutors, who are designated as NS Undergraduate Teaching Fellows. To our delight, we have witnessed many of the NYU BP-ENDURE students transform from being recipients of tutoring during Year 1 to becoming NS Undergraduate Teaching Fellows in Year 2, teaching a new cohort of BP-ENDURE students.

~~Love~~ SURP in the time of ~~Cholera~~ COVID

As in other years, the regularized mechanism to identify, then recruit URM individuals into research labs began in January, 2020. However, in March, soon after hearing that the Olympics in Tokyo was to be canceled, we heard the sad inevitable news that NYU was mandating the Pause, comprised of closure of its campus to new (therefore non-essential) undergraduate researchers. We had to decide whether to cancel SURP altogether or attempt to proceed with a modified virtual program. I made the decision to proceed to the best of our ability with an entirely virtual summer program, but with a back-up plan in case the campus opened towards the end of the summer (it did open mid-summer to BP-ENDURE students). Although I was uncertain at that time about how effective we could be with a virtual SURP, I felt strongly that the BP-ENDURE students could not be deprived of their 10 week-long, 40-hour per week salary that had been promised to them in January. I believed that although the hands-on experience in labs could not be provided, we could still engage students in the intellectual training of becoming a scientist by exercising critical thinking and creativity. I ensured weekly progression towards this goal through weekly discussions, weekly writing assignments and oral presentations that were laid out in a syllabus.

As it turned out, this year's SURP had more participants than any other year. This was a consequence of combining, for the first time, all students that had already been accepted to the SURP at CNS through the NSF-funded track (6 students out of the 10 positions that we usually support), all BP-ENDURE students from NYU and Hunter College (12 students, who usually attend SURPs at other universities), NYU undergraduates who had been admitted to the Neural Science Honors track and had expressed the desire to begin research that summer (3) , an NYU-SH Neural Science Honors student (Andrew Du, who has written one of the letters of support), and a high school student. Each student was assigned to write a mock grant proposal, which required identification of an unsolved but important neuroscientific mystery, cover the background material regarding what is known versus unknown and significance of the question, generate a hypothesis, explore methods and tools that could be used to test the hypothesis, predict outcomes that would support the hypothesis, and be prepared to provide an alternative hypothesis in case the outcome of the experiment was contrary to expectation. The BLM movement this summer prompted PhD students to approach me, asking how they could contribute towards the movement of diversifying the scientific community. They happily took on the daunting task of providing constructive weekly guidance to the scientific writing of each SURP participant. During the initial two weeks, during which time students were searching widely and wildly for an interesting unsolved mystery, I ran a boot-camp. I believe that learning is always enhanced by imposing questions that recruit active participations. This boot-camp divided the students into 5 teams that each had to solve a scientific mystery that I had set up. On multiple occasions throughout the summer, students were given tasks to work interactively, exert leadership roles and practice speaking confidently, succinctly and clearly. I believe the boot-camp helped to develop an *esprit de corps* among the students. By the 11th week, everyone achieved the goal of writing about scientific research clearly, convincingly, and accurately, while also

gaining the skills to communicate effectively and succinctly through Zoom presentations. BP-ENDURE students received the full salary and to our surprise, NSF *volunteered* to provide the CNS with supplemental funds so that the NSF-REU students could also receive a stipend.

Besides COVID, the summer of 2020 was a difficult period, as the nation witnessed one more senseless brutality. Together with other BP-ENDURE directors at Hunter College, SURP devoted one of the weekly meetings to become a forum for students to speak freely about BLM. In preparation for that forum, I collected statements issued by multiple nation-wide neuroscience organizations (e.g., Marine Biological Laboratories, Society for Neuroscience) Dean Jarrett, the president of Hunter College Dr Jennifer Raab, CUR (Council on Undergraduate Research), and Society of Biological Psychiatry. I distributed them to the SURP2020 students, as a way to convey to them the strength of the shared belief of the research community to which they now belonged, with the message being that we will combat racism and social injustice together.

In retrospect, SURP during the time of COVID helped to build a new strong community, comprised of undergraduates and researchers that span multiple institutions, with NYU at its center. The community is diverse, supportive and respectful of one another and, most importantly, very exciting, as each member is an explorer, anticipating to witness something never before seen.

In closing, I would like to thank the NYU community for fostering highest standards for education by conducting the selection process for the Distinguished Teaching Award.