# Teaching and mentoring statement

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"Don't worry about the level of individual prominence you have achieved; worry about the individuals you have helped become better people." --- Clayton M. Christensen, in *How will you measure your life*?

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Teaching and mentoring share essential elements with leadership. This has become increasingly apparent to me in recent years, in large part due to a workshop I attended on ***leadership*** at MIT in July 2019, as suggested by my department chair, Andrei Tokmakoff. With the realization that "leadership" is more than simply becoming the leading person or achieving personal prominence, I found myself wishing that I had undertaken such training much sooner. Recognizing that leadership is about using my own resources and personal growth to support others in my team towards their own goals, my teaching and mentoring approaches are based on the core elements of ***vision***, ***innovation***, ***inclusion***, and ***adaptation***. In this statement, I use photos and microscopy images that our lab recently modified to illustrate how these ingredients of ***vision***, ***innovation***, ***inclusion*** and ***adaptation*** fit into teaching and mentoring.

***Vision*****:** For most students, learning or training takes a tortuous, rather than a straight, path. These twists are usually helpful for the students because one learns most from their own setbacks or mistakes. My role is to provide guidance, while allowing the students the freedom to make their own mistakes. I set both short-term and long-term visions for the students (**Fig. 1**). During teaching and training, I align or adapt these visions with the students' own goals. From my side, my goal is to ensure that the students don't get lost in the tortuous path, or lose sight of the significance of their efforts, both of which can cause loss of self-motivation. In the lab, I give the graduate students the freedom to explore their own outlooks, to take short-range challenges or risks, to learn from their own setbacks. During this guided exploratory process, I also set short-term rewards or achievements so that the students are motivated enough to march forward.

**Figure 1, Vision.** I present short-term and long-term visions to the students, while allowing enough freedom for the students to explore opportunities and challenges. The original unmodified image comes from: https://www.reddit.com/r/roads
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**Figure 2, Innovation.** In addition to "forward" innovation, I work with my students on 'backward' innovations. Much as a uniform modification of the photo above turns the static water (left; photo credit: Chuanwang Yang) into splashing water in the lake (right), in 'backward' innovation, students find motivation and reward in new scientific connections by changing their perspective.

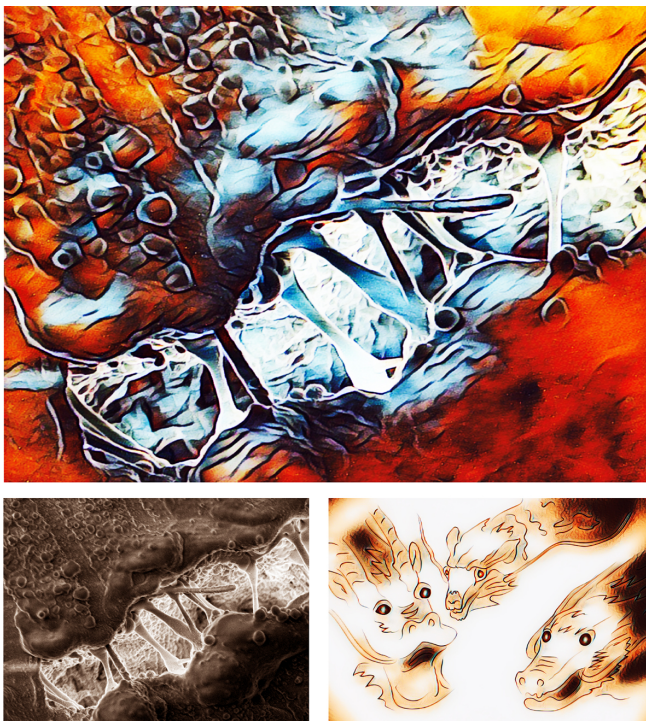

**Figure 3, Inclusion.** Inclusion is a scientific mindset and a method of organization and presentation. As illustrated in this graphic example, adding dragon-like features (lower right) and extra highlights can turn a plain SEM image (lower left, image credit: Aleksander Prominski) into something more energetic (top).

***Innovation*:** Innovation is a key factor in all aspects of teaching and mentoring. In academia, we focus predominantly on 'forward' innovation, striving to create something with a set of new efforts. In my lab, we work in parallel on 'backward' innovation, employing this strategy to identify previously overlooked opportunities with existing results. The realization that prior efforts, believed to be failures, contain a potentially different and possibly more significant value increases the students' motivation and morale. As a teacher and mentor, my goal is to help the student identify these opportunities (**Fig. 2**) using new evaluation methods (*e.g.*, Prominski and Tian, "Quiet brainstorming: expecting the unexpected", *Matter*, 2020) to connect the dots between unexpected results and a new hypothesis. Gradually, the students will begin to formulate their own methods for both 'forward' and 'backward' innovations.

***Inclusion*:** In my teaching and mentoring approach, diversity and inclusion extend beyond uniting people with different backgrounds or views. To me, inclusion also suggests a mindset of not ignoring the individual pieces that establish the entire scientific or educational picture. One way to consider it is like stochastic optical reconstruction microscopy (STORM) super-resolution imaging, where we have to collect signals from individual fluorophores in order to see the final sharp images. Inclusion also suggests a method of organization and presentation (**Fig. 3**); individual contributions or internal hidden connections among pieces can be identified, sorted and highlighted for better appreciation and recognition. For example, in my General Chemistry undergraduate classes, I find a thread between chapters. I organize chapter order so that each aspect of a big picture topic

(*e.g.,* polymers) is presented as a different perspective on the same topic. I draw diagrams in real-time to help explain abstract concepts – an approach that has translated well from in-person to Zoom classes and increases student engagement. When students can grasp difficult concepts, their self-esteem is strengthened and they appreciate how they can contribute to both their own learning and achievements and those of the team.

***Adaptation*:** Students decide their own career paths, and not all students want careers in academia. Unexpected changes can happen throughout their training. As teachers and mentors, we should adapt to either situation and work with the students to actively and positively identify a more suitable career path (**Fig. 4**). By demonstrating compassion and a genuinely sincere attitude, we also teach the students how to become successful leaders themselves in any career.

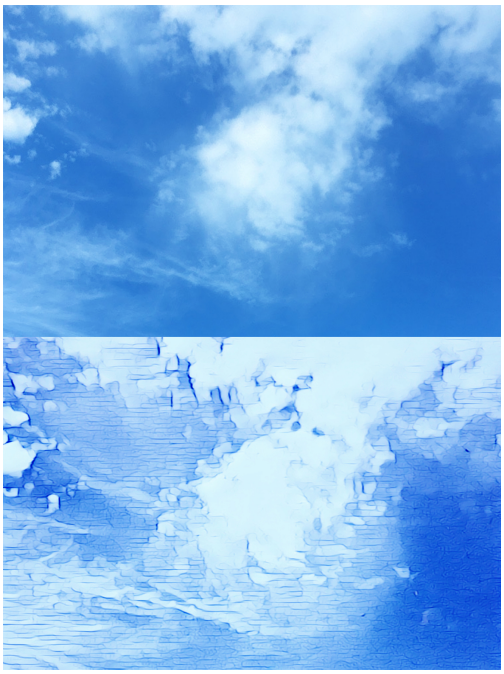

**Figure 4, Adaptation.** By adapting to changing circumstances, I can actively help students to identify and develop their career path. As shown in this graphic example, the cloud pattern in the sky can be adapted into a melting ice on the river, both appealing forms of water.

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Teaching and mentoring are not just a set of skills, but they require significant emotional and intellectual effort from the teacher or the mentor. The future will present me with more opportunities to become a better teacher and a mentor.
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