Faculty Perspective

The benefits of mentoring undergraduate research students

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Science or history?

I initially chose to pursue a degree in Cell and Molecular Biology as an undergraduate because I loved the subject. I loved learning about cells, how they are shaped, how they function. I loved learning about how organized molecules formed the basis of heredity and inheritance. But always at the back of my mind was the question of "how do we know these things?" I was thus inspired by classic experiments by following the logic presented in impeccable experimental design. The cleverness of scientists like Thomas Hunt Morgan, Louis Pasteur or Hershey and Chase made me appreciate the human endeavor to understand the world around us. These moments of inspiration were always interrupted by a pang of longing, as I perceived the stream of facts being presented as a complete and static collection of knowledge. A history lesson, if you will. The work was done, we knew how the natural world worked. So much intimate detail about life, how could there possibly be more to learn? Thankfully this misconception was shattered through a stint in undergraduate research.

My breakthrough

What I did not realize when I initially chose my degree program was that it was designed for students interested in pursuing graduate school and/or careers in research. Accordingly, the program had strict requirements for participating in undergraduate research. I therefore found myself entering a research laboratory with little to no idea of what to expect. The first small project I was assigned was to clone and sequence a gene involved in organizing microtubules in plant cells. The goal was to understand the evolution of these microtubule organizing centers in the *Arabidopsis* family of plants. My mentor explained it: "There is this oddity in plant cells, they lack the organelles that organize microtubules. Yet they clearly get along just fine. The question we're asking is how have plants evolved independently to accomplish this feat without these seemingly fundamental structures?". There for the first time I was presented with the unknown. It was not only the question that caught me, but the existence of the question itself. I quickly realized that what we know about the natural world is but a mere beginning to a comprehensive understanding. Perhaps even more excited was then being presented with the opportunity to help discover the unknown.

Mentorship is the key

I had amazing research mentors as an undergraduate student: Dr. Regina McClinton at Grand Valley State University and Dr. Aikseng Ooi at the Van Andel Research Institute. They both took a keen interest in fostering the excitement and curiosity I brought to the lab. They not only trained me to be technically proficient, but really spent time to train me as a scientist. In hindsight this went beyond the nuts and bolts of scientific inquiry. I learned other fundamental skills: perseverance, critical thinking, foresight, and imagination just to name a few. This took patience and dedication on their part. Their investments in me paid off when I realized that I was better prepared for graduate school success than peers whose previous research experience was more task-oriented. I excelled in graduate school where others struggled. I attributed this not to my own intellect or ability, but to the mentorship I received as an undergraduate research student.

The payoff

I have had the pleasure of mentoring many undergraduates throughout my career, and the biggest lesson I have learned is that there is not one catch-all approach. Students are motivated and inspired by different ideas or different aspects of the scientific process. One of my primary jobs as a mentor therefore is to listen and be attentive. When asked if they think a proposed experiment is exciting or useful, most will respond "yes" to be polite, but body language and mannerisms often tell otherwise. While there will always be unenjoyable tasks in research, my experience has shown that if these are not punctuated with tasks that excite the student (or myself) will not be doing their best work. I strive to perceive the real experience students are having in the research lab and guide them accordingly.

It is important to me that I bring undergraduates into the scientific process. My ideal goal for each student entering my research lab is for them to achieve a certain degree of independence with the process of scientific inquiry. I view the student as a researcher in the laboratory, not as a producer of data. To truly engage a student in my research requires exposing my thought processes and rationales rather than simply delivering ideas and goals. This is where the real time commitment comes in, but it is also the source of the big payoff for both myself and the student. As students gain experience in research I try to start asking rather than answering the questions: "What do you think we should do next?", "What do these data mean to you?", "How would you test that hypothesis?" etc. Watching students develop the skills to critically think about and answer these questions is truly one of the best parts of my career.

But also, reality

These are idealistic circumstances of course. In reality, not every student that participates in our research will be inspired. Most of them may not even pursue a career in research. Occasionally a student realizes quite quickly they want nothing to do with research. Nonetheless, undergraduate research experiences are still valuable. To give a student a glimpse at the reality of research can provide the fundamental understanding that science is a process and not a collection of facts. How science goes far beyond the dense content we present in our courses, how the work of the pioneers I admired is not complete, how scientific knowledge is not static, but dynamic and under constant revision. This seems imperative now more than ever, as I currently sit writing this in my makeshift home office as a result of the ongoing COVID-19 threat. The public response has illuminated many misconceptions about science, both its benefits and limitations. The more students we can expose to the realities of science, the better off we will be.