

Patrick J. Pagano, PhD, FAHA - "Holism and the Wonder of Science"

Mentorship has become the most rewarding aspect of my academic career and a philosophy that has evolved over many years. It is also a commitment that has brought me enormous personal and professional satisfaction. For many scientists who are first starting out, personal ambition will hold sway. Many years of hard work and application to honing one's seemingly limitless scientific tool set can easily engender a focus inward and non-altruistic emphasis on self. If you are lucky, however, you will have chosen mentors who imparted to you the immense importance and joy that could be derived from your own legacy as a mentor. My first lessons in this came from my first department chair and graduate advisor whose own experiences might as well have come from living on Mars. Theirs was a very classical training in physiology and pharmacology in which a firm foundation in fundamental principles, hypothesis-driven research and a holistic view of cell and organ physiology was the jumping off point for a successful career as a scientist. From my perspective at the time, their ethic was borne out of the *School of Hard Knocks* and a *No Pain, No Gain* philosophy that I later came to appreciate was, for them, a very personal and noble quest for learning and the generation of new knowledge. To my earliest mentors, scientific and even personal growth was acquired from long hours at the bench, attention to detail and a laser focus on the productive generation of new knowledge even if that meant sacrificing life's many other rich rewards. And although many of these lessons ring true still today, the *at all cost* approach to science they espoused never truly appealed to me, and I have railed against them from the start. I could have chosen to perpetuate this training philosophy, but instead I decided to craft my own, to some degree from trial and error but also firmly rooted in life's experiences, both positive and negative, that I have endured over the nearly 25 years since then.

Since my early days as a doctoral student, I have closely observed my own mentors and gleaned from them the attributes I have deemed integral to a good mentor. I have tried to learn how to best guide and advise students with the highest standards of excellence and integrity, all with an appreciation for the unique qualities and needs of each student. Clearly, much of what has defined me as a mentor today has come from indelible lessons and maxims passed down to me by my own mentors. However, it has also been lessons learned on how not to mentor that have had a lasting impact. All in all, as in any human relationship, the approaches need to be tailor fit to those involved, i.e. what works for one mentee does not necessarily work for others. I have learned that at the heart of good mentorship is the challenge of figuring out how to best convey your experience, how to guide, how to mold the next generation of scientist while respecting their individual needs. This often takes a large dose of patience, something that my mentees know doesn't come naturally for me. It is something I strive to do for each of the students and fellows who joins my laboratory. Above all, it is a pact made between mentor and student of mutual respect and learning.

The goal of mentorship in science, in my opinion, is ensuring the success of the student and future of scientific inquiry not only by the transfer of knowledge and technical skills to a new generation of researchers, but also the ethical and professional responsibilities associated with doing good science. As a mentor, a deep commitment to the successful future of my trainees is crucial. To that end, a mentor should take pride in fulfilling tripartite roles as a teacher, coach and advocate.

It should go without saying that the role of teacher is not favorably embodied by dictums or the handing down of specific directives. Of course, the fundamentals must first and foremost be taught, but it is my philosophy that the best projects mature over time. For certain, it is the mentor's job to work closely with the mentee to craft and agree on new hypotheses through dialogue. The best mentors, in my opinion, will also try to stoke individual creativity and encourage the student to toss ideas around with others like lab-mates and colleagues. The science and acquired art of consistently framing incisive and new questions is at the core of real and lasting success. I like to tell all of my students that science is as much about listening and learning from others, taking risks and diving head on into a problem as it is exhaustively running experiments that prove or disprove a hypothesis. Encouraging trainees from the get-go to seek out information, to be resourceful and self-reliant is also central to good mentorship. Encouraging them to also find a project that intrigues and inspires them is elemental to their success. In that vein, mentors cannot, nor should, try to get into the mind of mentees and make that aspirational choice for them. Metaphorically

speaking, I have likely bored my students and fellows to tears by the mantra that this is often more about setting out on a journey than having a specific destination. No doubt these recommendations can be very disconcerting to brave and timid students alike, but once discovered, the full experience of being a scientist comes into focus. Besides that, to force a hypothesis or inquiry in any one direction is not only unethical, it is foolish and impractical. I see too many who are “married” to their pet project or “brainwashed” by their proposals. Those who know me (my past and present students more than anyone!), know all too well that I think of science like a tree that grows naturally and steadily upward. If you follow the natural growth of that tree upward you will see a project to its fullest fruition. On the other hand, if you try to force a hypothesis in any one direction, you will eventually sell your project short, i.e. fall off the outer reaches of its branches.

Despite the challenge and courage that are required to achieve this, my experience is that, indisputably, the students who learn to acquire these skills early and who doggedly persist are the ones who are the most productive and gratified as their careers unfold. Of course, having an “open door” policy as mentor is essential whether that means always being available to speak one-on-one, or being available by phone or FaceTime at anytime, anywhere. I disagree with some who say that the best mentors are always in the lab if that comes at the price of being brooded over and micromanaged or the mentor focuses myopically on scientific productivity alone. It is something I detested as a student and try to avoid this at all cost in my own lab.

As a coach and advocate, I am committed to my students’ professional development, from providing advice on how to advance their careers to setting up contacts and job opportunities. This commitment does not end with their time in my lab. Early on in their careers, students should be encouraged to attend conferences, to network and to judiciously participate in trainee workshops. Opportunities to improve their skills in writing, critical thinking, communication and networking are essential. Being a coach or advocate also means blunt but constructive criticism from time to time that is never personal. Setting high standards for mentees is vital to this and means first setting the same or higher ones for myself. My students and fellows likely remember most the mantra that “science is not a sprint, it's a marathon” and I encourage hard work by working equally as hard or sharing in work experiences that through persistence got me to be where I am today. Another bit of advice I like to emphasize is that science is a world that doesn't begin or end at the lab door. By that, I mean that a student must be encouraged to forge relationships with collaborators both in the lab and across the world. Still another is about humility and being of service to your colleagues while never trying to prove your mettle or impress others especially when someone's ideas and funding are on the line. It is about always taking the high road especially when times are most challenging. As an advocate for my students, I try to support their professional development and mostly that means personally promoting them to leaders in the field and/or invited guests. This also means having the stamina and fortitude to stay actively engaged and abreast of the latest conceptual and technological breakthroughs in the field. The push-pull of endless demands of grant and manuscript writing and the attempt to balance this with time every day in the lab can seem intractable. However, it is one that is enormously gratifying and essential to growth of those around you.

Above all, fostering a culture of openness and a positive and collegial environment that is deeply respectful of each member of the lab, I find, allows students to speak freely and challenge the status quo. In fact, my laboratory has always been a rich mix of individuals from around the world, diverse in culture and creed, with a unique and open exchange of opinions and ideas. Integrity, integrity, integrity above all else is probably the most important message I can pass along to my students. I do my best to promote unencumbered dialogue in lab meeting, for example, that relishes discovery and new data that don't fit the hypothesis or buck the trend. I also like to say that it is never a scientist's job to prove or establish anything. The words *“I hope that by the end of this...I can convince you that...”* have no place in scientific discourse.

Most importantly, I suppose, it is the human factor that is the most rewarding aspect of mentorship. The satisfaction of seeing a well-rounded, motivated and bright individual achieve excellence in what she or he aspires, is and should be the greatest professional reward. Balancing both aspects of one's life is always challenging. My philosophy has been the common refrain of “work hard-play hard”. I like to think that despite the demands imposed by scientific life, I have always encouraged

my trainees to develop other interests outside the lab, be it painting, poetry or rock climbing. You see, all human beings need an outlet to “reboot” in order to sustain their enthusiasm for their work in the face of setbacks. Through the years I have met many brilliant scientists that end up burning out due to the lack of balance. It is imperative that all mentors be supportive of trainees undergoing psychosocial challenges, giving them the time and encouragement to face formidable mental challenges that come with the territory. Sometimes that means helping students find non-traditional career paths. I have come to realize that boosting the group’s morale is as important to the advancement of science as it is to working tirelessly to capture funding for stipends and the means to carry out the coolest state-of-the-art and crucial experiments. Even on the toughest of days, a mentor must be mindful of the best in discovery and people.

Mentorship, in short, is not just about giving but also about the selfish rewards of seeing my trainees achieve the goals they set for themselves, reaching that academic track position they work so hard for, or getting the grant that will fund those crazy ideas they developed on their own, which may not be so crazy after all. I rejoice at seeing them become spouses, parents, citizens of the world, and balancing all that life throws at them with integrity and joy. I see my mentees' success as my own.