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The most meaningful part of my professional career has come from mentoring young scholars and watching them develop. I have mentored more than 200 trainees, with a large percentage of them going on to enjoy highly successful careers in academe or industry. Many have won major research awards, and one has even received the Nobel Prize. Due to this track record, I have often been asked, How do you do it? What is your secret formula for producing generation after generation of standout scientists?

For many years, I was flummoxed by such questions. I had no secret formula for mentoring. In fact, in my first two decades running my own lab, I hardly thought about mentoring at all. Yogi Berra, the legendary Yankees catcher, was once asked what he thought about while batting, and his response was, “How ya gonna think and hit at the same time?” That was exactly how I felt about mentoring. I wasn’t thinking about it -- I was just doing research and trying to exhort the students in my lab to come along on the journey with me.

Over the years, though, I have become more mindful about my mentoring approach. I have learned a lot from my mentoring successes, as well as my mentoring failures, and accumulated a lifetime’s worth of wisdom in this area. I am not so presumptuous as to believe that I have discovered the one true way of mentoring, but I know what works for me. After a half century spent mentoring hundreds of trainees, here are my 10 golden rules for being a good mentor.

1. Tailor mentoring to each individual's needs. Every trainee is different. Some need a daily pat on the shoulder; some need a kick in the pants. For this reason, I have always customized my mentoring style to each individual who joins my group. Sometimes this means shifting my approach around for a while until I find what works for each person. Obviously, such custom tailoring of mentoring style requires getting to know the members of my lab very well, which is why I view daily chitchat as not simply an exchange of pleasantries, but instead as a crucial opportunity to get to know my junior colleagues' personal stories and understand what motivates and excites them.

Mentoring should also be tailored to the personality of the mentor. The specific strategies that work for me as a mentor might not work for someone else. For example, I am a social and gregarious person. I love face-to-face meetings and crave constant contact with the members of my group. However, I know some scientists who are much more reserved yet are still great mentors. They might prefer regular communication with their trainees via email or other written forms of communication. Every mentor has to find the specific approaches that work for them, which is why I have crafted the remaining nine precepts below as general guidelines rather than detailed rules.

2. Encourage focus. Whenever any new trainee joins my group, I meet with them on their first day and give them two pieces of advice, starting with "Your success in my laboratory will be determined by four factors: the first is focus, the second is focus, the third is focus and the fourth is … focus." In research, as in any creative endeavor, an ambitious young person might proceed in any one of countless directions. I view my primary job as helping my trainees focus on productive and interesting directions. Everything else is secondary to focus.

When I was a medical student, I had an old microscope that I'd purchased for a pittance from an older student who no longer needed it. I used this microscope in my classes and also in my dorm room to study for exams. This ancient microscope was so beat-up that the stage was always slipping, which would cause the scope to drift out of focus every few seconds. Over time, I became skilled at holding the microscope in focus by keeping my fingers on the fine-tuning knob and exerting just the right amount of pressure. Many years later, I realized that my most crucial job as a mentor is to manage my

trainees in the same way I managed that microscope: by constantly exerting just the right amount of pressure to keep things in focus.

Whenever I travel for a week, I find upon my return that certain projects in the lab have drifted out of focus. Perhaps there was a surprising finding that led a trainee down a side road, resulting in a series of unplanned experiments. Sometimes side roads can lead to new discoveries, but more commonly, they just lead to dead ends. When I talk with a student who is spinning their wheels in a dead end, I'll say, "Let's remember the big-picture goal of this project. How is what you're doing right now helping to reach that goal?" Through discussion, the student will usually realize they've lost focus and gotten distracted by insignificant details. My aim in such conversations is to gently exert the right amount of pressure on the fine-tuning knob to keep the student in focus, just like I used to do with my old microscope.

3. Fan the flames of enthusiasm. The second piece of advice that I give to new members of my lab on their first day is, "You can work on any project you want, as long as two conditions are met: the first is that *you* should be very excited about your project, and the second is that *I* should be very excited about your project." Those two conditions are not sufficient for a given project to succeed, but they are necessary. Research is 90 percent failure, so it's easy for students to get down when their project isn't going well. A vital role for mentors is to keep trainees pumped up so they can make it through the hard times and maintain their focus.

Many years after one of my postdocs headed off to Cornell University to direct his own research group, he confided to me that during his time with me he felt like he was working on the most important project in the lab. However, when he talked to other folks in the lab at that time, he realized that each of them also believed that *they* were working on the most important project. And in truth, when I was talking with each of those folks about their experiments in the early days of my lab, I probably did believe in the moment that each project was the most important one. I wasn't faking it -- I was authentically psyched up and conveyed this passion to my students in a way that fanned the flames of their enthusiasm. Such shared delusions of grandeur between mentor and

trainee can be very powerful motivators for young scholars and may lead to achievements beyond what they believed possible.

Enthusiasm needs to be balanced with rigor. My first two mentors, Jesse Roth and Ira Pastan at the National Institutes of Health, represented the personification of these two ideals. Jesse was Mr. Enthusiasm: he would ooh and ahh over just about any piece of data I showed him. In contrast, Ira almost never got excited. When I showed him data, he would just grill me over whether I had included the appropriate controls. Off the top of his head, Ira could name 10 different reasons why any given result might be a complete artifact. Years later, when I became a mentor myself, I did my best to combine Jesse's enthusiasm with Ira's rigor. Trainees need both of those ingredients to thrive.

4. Teach trainees to build their careers around problems, not techniques. Sometimes trainees learn a new technique and then spend the next few months or years, or in some cases their entire careers, looking for other problems to which they can apply their newly learned technique over and over again. That is exactly the wrong approach for developing a career in research, or indeed in any creative field. Techniques are always changing as new technologies evolve. Thus, mentors should advise their trainees to ask big-picture questions about important problems and then try to answer those questions using whatever techniques are necessary.

Nobel Laureate biochemist Joseph Goldstein coined the term "PAIDS," which stands for "paralyzed academic investigator syndrome." This condition occurs when a scholar learns a narrow set of techniques and then becomes limited to only asking questions that can be addressed with those techniques. He also coined another term I love, "technical courage," which is the fearlessness exhibited by scholars who choose to work on an important problem and commit themselves to learning whatever techniques are necessary to address that problem. One of the most crucial things mentors can do is to model technical courage and push their trainees to be bold in learning new techniques and adopting new technologies.

5. Promote risk taking. When students take laboratory classes, they usually perform cookbook experiments with known outcomes. In such prefabricated

experiments, you are supposed to get a certain result, and if you get a different result, then it means you screwed up. But true scientific research is the opposite: if you get a result you didn't expect, it's often a sign that you're onto an interesting story. Pursuing ideas that cut against existing paradigms seems risky to many trainees, though, which is why mentors must encourage boldness when projects start moving into uncharted waters. I tell all my trainees that every great researcher needs to possess some degree of chutzpah, the Yiddish term that loosely means "brazen audacity."

Researchers who are afraid to take risks will never reach their full potential. I had dinner once with a researcher in the visual signaling field who said he had made a significant discovery about the visual receptor rhodopsin some years earlier. The finding was so unexpected that he had doubts about it and was afraid to publish it because others would doubt it as well. He dawdled and pursued various tangential studies, feeling uncertain how to proceed. Eventually, two other labs published his novel finding before he did, so he got scooped and received no credit for his big discovery. This was a classic case of a scientist who would have benefited from a mentor who encouraged more chutzpah.

6. Model dogged persistence. As mentioned above, success rates for cutting-edge research experiments are quite low. Thus, the best way to achieve success is to do a *lot* of experiments. However, it's insufficient to tell trainees they need to work hard to succeed. Actions speak louder than words, so it's crucial for mentors to serve as role models of dogged persistence.

Whenever one of my trainees sends me a rough draft of a manuscript to be submitted for publication, I make every effort to send the edited manuscript back to them with the fastest turnaround time possible. If one of my trainees needs a letter of recommendation, then *boom*, I get it done as fast as I can. Fast turnaround times show my trainees that I give them high priority and also send the message that I expect equally fast turnaround times on their end.

I have heard stories about mentors who try to push their trainees by keeping track of the number of hours people are working or other such nonsense. To me, such approaches are ineffective and will only lead to trainees feeling

stressed out. The best way for mentors to encourage persistence and hard work is simply to model such behavior themselves.

7. Empower trainees. People achieve their maximum level of motivation when they feel ownership over their work. For this reason, I want every person in my group to feel like they are pursuing their own ideas, as opposed to working on a project cooked up by me or someone else. When I have weekly meetings with my trainees, I never say to them, “Well, based on these data, you should next do this and then do that.” Instead, I ask what new directions *they* would find interesting to pursue. When I hear a direction that excites me, I say something like, “Wow, yes, that would be interesting to explore, wouldn’t it?” In this way, my trainees are driving their own projects, and my role is simply to serve as guide and cheerleader.

I know some scientific mentors who create daily to-do lists for the members of their labs. I’ll admit to being impressed with anyone who has the brainpower to write out detailed schedules for a lab full of scientists every day, but to me this is still an example of ineffective mentoring. When trainees are micromanaged in this manner, they lack a sense of ownership over their projects, decreasing their motivation and also stunting their growth as independent thinkers. Inevitably, mentors who micromanage produce few if any trainees who later achieve success as principal investigators, as those trainees were never allowed to spread their intellectual wings during their training period and thus didn’t learn how to develop projects.

Moreover, even when such micromanaged trainees make good progress under their mentor’s close guidance, they never develop the confidence that comes from knowing that they were truly the ones responsible for their own success.

8. Emphasize storytelling. One of my clinical mentors, Mortimer Bader, was an attending physician at Mount Sinai Hospital who was legendary for challenging medical students to come up with different narratives that would fit the facts of a given clinical case. “Many people think data tell a story, but nothing could be further from the truth,” Bader would say. “Data are just data. A *story* is something you impose on the data.”

Bader's insight was crucial to my development as a clinician and even more to my eventual evolution as a researcher. When I have meetings with my trainees, I don't just want them to show me their data; I also want to hear a story that explains the data. Ideally, I want my students to present *multiple* stories that might explain the data and then propose future studies that will help to discern which narrative is closer to the truth.

In addition to its importance in making sense of experiments on a day-to-day basis, storytelling is also important to a mentor over years and decades. I want my trainees to feel like they are key players in an ongoing story that began long ago and has continued for many years with numerous twists and turns. The feeling that you are part of something larger than yourself is one of the most powerful human emotions, especially when you feel like you are contributing to a narrative arc that stretches far back in time.

For this reason, I love telling my trainees stories about earlier generations in my lab and how certain studies performed back in the day connect with experiments that are currently ongoing. This sense of a cohesive narrative through the years motivates trainees, who feel excited to understand how their current experiments fit into the grand scheme of research in the field.

9. Laugh and have fun. In my experience, the more people are laughing, the more creative they become -- perhaps because humor requires seeing unusual connections between things. Getting a joke is like making a little discovery: you have a flash of insight and suddenly see a funny connection that you didn't see before. The creativity required for humor can prime the mind for other sorts of creativity, so I am constantly joking around in meetings with my trainees, with the humorous tone hopefully setting the stage for inspiration.

A few years ago, I had a conference call with a pharmaceutical company about a potential collaboration. I was on the call with four young postdoctoral fellows from my lab, and we were talking with four or five scientists from the company. The leader of the company's scientific team started off the call.

"OK, Professor Lefkowitz, let me introduce my team. We have here Carlos, who is our director of chemistry, and Nina, who's our director of molecular

screening …”

When I heard these introductions, I decided on the spot that I was not going to be outdone. The four young postdocs from my lab didn’t have any titles -- they were just postdocs. However, the pharmaceutical company folks on the other end of the call didn’t know that. When it was my turn to speak, I ad-libbed a series of introductions.

“Great, thank you, now I’ll introduce my team. I’ve got here Erin, who is our director of protein purification, and Scott, our director of mass spectrometry …”

As I introduced them with these fancy-sounding titles, my trainees began cracking up. Fortunately, it was a regular phone call, not a videoconference, so the people on the other end of the call couldn’t see all my postdocs trying to stifle their laughter. It was a funny moment, and it led to a productive conference call with lots of creative ideas being tossed around by the members of my group.

10. Respect your own mentors. Everyone needs mentoring, even seasoned mentors. Thus, it’s important to maintain strong relationships with past mentors, such that they can serve as sounding boards for any mentoring problems or career issues that might arise. Over the years, I have sought out my mentors at national meetings, or sometimes just called them out of the blue, to discuss various issues. In turn, many of my alumni who are now established mentors in their own right call me regularly to talk through various issues relating to their research groups.

Mentoring is not something you do just for a couple of years while someone is working with you; the position of mentor is a lifetime appointment, much like being a parent. I am always delighted to catch up with my past trainees and provide whatever insights I can to help them at different stages of their careers.

I am old enough now to have hundreds of scientific children (i.e., former trainees from my lab) and probably thousands of scientific grandchildren and great-grandchildren (i.e., the trainees of my trainees). When I attend meetings these days, I love schmoozing with members of my scientific family. I derive so

much pleasure from seeing all the exciting work my trainees are pursuing and the ways in which they are passing on the torch -- including my philosophy about the art of mentoring -- to the next generation of scientists.

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Nobel Laureate Robert Lefkowitz is James B. Duke Distinguished Professor of Medicine and professor of biochemistry, pathology and chemistry at Duke University. This article is adapted from A Funny Thing Happened on the Way to Stockholm: The Adrenaline-Fueled Adventures of an Accidental Scientist*, by Robert Lefkowitz with Randy Hall (just published by Pegasus Books* [1]*).*

Links

[1] http://pegasusbooks.com/books/a-funny-thing-happened-on-the-way-to-stockholm-9781643136387-hardcover