Establishing an academic laboratory: mentoring as a business model

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ABSTRACT **It is a tremendous honor for my group and me to receive the recognition of the 2014 Women in Cell Biology Junior Award. I would like to take the opportunity of this essay to describe my scientific journey, discuss my philosophy about running a group, and propose what I think is a generalizable model to efficiently establish an academic laboratory. This essay is about my view on the critical components that go into establishing a highly functional academic laboratory during the current tough, competitive times.**

WHAT HOOKED ME ON SCIENCE

Falling in love with science arrived quite late in my life. Growing up, I was fascinated by logical thinking and math. After bumping by chance into biology for my undergraduate degree, I became increasingly excited about it once I started to do my own experiments in the lab of Aldo Di Leonardo at the University of Palermo. What truly triggered my passion was an episode during my PhD interview at the European Molecular Biology Laboratory (EMBL). Using time-lapse videos in real time, Michael Way showed me how the bacterium *Listeria* infects cells. The ability to monitor processes as they occur in our bodies hooked me. I knew then that a scientific career would provide me with a long fulfilling journey of discovery.

MY JOURNEY DURING MY PhD AND POSTDOCTORAL TRAINING

I have had the privilege of training in institutions and laboratories where the richness of scientific thinking as well as resources propelled me through a rewarding learning experience. I did my PhD (1998–2003) with Suzanne Eaton at the EMBL and Max Planck Institute. Suzanne's free scientific mind and contagious enthusiasm for scientific discovery provided a stimulating framework for defining the questions that excited me. Of great influence also was the open-door policy at my PhD institutions. Hierarchy was only a formality, and scientific discussions happened freely among different labs and across the hierarchical ladder. This fertile context contributed to my passion for addressing mechanisms of tissue growth in development by live imaging using *Drosophila*. I did my postdoc (2003–2009) with Elaine Fuchs at Rockefeller University, studying tissue regeneration using skin hair follicle in mice as a model system. Elaine and her laboratory, a group of very talented scientists, provided me with strong training that fostered my independence and taught me approaches for efficiency and productivity.

Photo credit: Terry Dagradi, Yale University

Valentina Greco

MY LAB SCIENCE AND PHILOSOPHY: MENTORING AS A BUSINESS MODEL

I started my laboratory in 2009 in the Genetics Department at Yale Medical School, recruited by two terrific scientists, Richard Lifton and Haifan Lin, who believed in my potential and supported me at a time when it wasn't clear how things would turn out and who continue to support and inspire me to this date.

When I established my lab, I wanted to understand how cells orchestrate growth within a tissue and how hierarchical organization plays a role in cell choices at the level of single cells as well as in integration within a group of cells, resulting in a robust and harmonious

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Abbreviations used: EMBL, European Molecular Biology Laboratory; PI, principal investigator.

process of growth. The challenge in addressing these questions was posed by the fact that these processes are highly dynamic, but the field largely used static analysis to study them. During my doctoral thesis, I had experienced firsthand how live imaging had provided us not only a better understanding of the process we were studying but, especially, allowed us to discover new biology that we had not anticipated. Thus, as I began to set up my lab, I addressed the above questions with canonical approaches and invested in a high-risk/high-reward approach to establish live imaging in the mouse skin. After more than one year of troubleshooting and several discouraging roadblocks, we were finally able to visualize and manipulate hair follicle stem cells and their niches in an intact living mouse. This technology allowed my lab to uncover key principles in stem cell biology. For example, we showed that stem cells can be dispensable for tissue regeneration and that other cells can reprogram to adopt their fates during injury. Conversely, we demonstrated that the niche is required for hair follicle regeneration (Greco and Guo, 2010; Rompolas *et al.*, 2012, 2013; Rompolas and Greco, 2014; Deschene, Myung, *et al.*, 2014; Zito *et al.*, 2014). In retrospect, what I had accomplished was combining my passion for visualizing biological processes in vivo with my knowledge on stem cells gained during my postdoc. This allowed me to create a niche for my lab and distinguish myself from my previous mentors.

While defining the key questions and the unique angle for my lab was key to establishing my lab, the next challenge was to identify a way to execute them. In that regard, we depend on our lab members and colleagues to carry out our ideas (i.e., writing papers and obtaining grants). To establish a highly functional lab, I believe that, in addition to defining key exciting questions, the principal investigator (PI) must balance two critical components: business and mentoring. I will now define the words "business" and "mentoring," describe the challenges junior PIs face in embracing them, and conclude by describing some of the strategies I have adopted in my own lab.

Definition of "business"

How do we maximize the creation of ideas and data? How do we make these good ideas a reality that catches people's attention? In this regard, establishing a lab is analogous to setting up a business. In a way, I visualize it as being given a small shop to rent in a big mall. In order for us to be noticed, we need to create a product (our data) that people (our colleagues) can look at and decide whether it is worth their attention/investment or not. We need to make a brand (our unique angle for producing data), find investors (therefore excite future potential reviewers/funding agencies), and gain visibility by going around and creating publicity (giving talks).

Definition of "mentoring"

I define "mentoring" as the guidance provided by a more experienced researcher to a less experienced one (mentee) that contributes to the mentee's development as a scientist. This includes teaching trainees how to design experiments and align expectations and how to prepare for talks. All of that should be done within the context of a relationship based on truth and mutual trust. PIs are dependent on their students and postdocs for the realization of their ideas and, therefore, for the success of their labs. It is a mutual dependency. While it is clear that the PI's investment of time and energy in developing the competencies of the mentees are an investment in the business that supports all members involved, it is less clear how to provide good mentoring that feeds both parties, the mentee and the mentor.

Challenges in mentoring

There are a number of challenges that prevent people (especially young investigators) from being proper mentors and getting the most out of their labs. First of all, there is no training provided to starting PIs. They have to transition from postdoctoral training, in which they had to master benchwork and a working relationship with primarily one person, the PI, to productively managing a team. Second, there is a dramatic increase in the number of different tasks that we need to cover, which pull us in several different directions. Third, it is not easy to recognize that mentoring is instrumental in maximizing the efforts and the establishment of our lab. How can we improve the situation? 1) Institutions have to recognize these challenges and provide training to educate junior faculty on how to best manage and mentor a group. 2) Junior faculty members themselves have to be proactive about acquiring the necessary knowledge from midcareer PIs, preferably in groups with open discussion on current challenges. 3) PIs must educate their mentees on how to be leaders and mentors themselves.

Example of proposed solutions: this model in the context of a group

There are different models that can be adopted to best mentor a group while trying to feed into creating the products (papers and grants). One model envisions the leader as the one who seeds ideas and leaves the lab members in charge to develop them in practice. An alternative model, not mutually exclusive with the first one, sees the leader as the one who fosters an environment in which people generate ideas. While I naturally lean toward model 2, it can also be argued that this model has the advantage of 1) giving ownership to the mentee for the scientific project, 2) engendering continuous reevaluation of the excitement and novelty associated with the project, and 3) helping to identify the most practical and fastest way to execute the project. Model 1 is perhaps more efficient in the short term, but in the long term, it runs the risks (among others) of creating less independent scientists who cannot propagate knowledge to the next generation as efficiently or represent the lab at meetings.

Thus one of my mentoring approaches is to involve my group in the several tasks I need to perform, as this fills two purposes. It provides a more complete training for the mentees and it produces better outcomes. These tasks include training a lab member to give a talk outside the lab, having a lab member prepare a grant proposal, and so on. Thus everyone is called upon to be an active participant in the process. What this creates is a supportive, unified group experience that elevates the impact and depth of the science we do, thereby feeding into the lab business as well. Specifically, I created the following systems:

1. I set up a number of different forums in addition to the canonical lab meetings and weekly one-on-one meetings. These include brainstorming sessions, when each lab member takes a turn giving a chalk talk to the entire lab over beer and pizza about his or her vision on his or her current project and possible future directions. This is in addition to a broad review of all data with me every six months, when I spend 4–5 h with each individual, discussing all our goals, aligning them, and discussing all the data produced and the expectations we have moving forward. Since these forums have been put in place, these approaches have led to shaping stories earlier than I anticipated

and allowing lab members to contribute to one another's projects more effectively.

2. I seek opportunities for my lab members to give talks outside the lab in order for us to more effectively think about science. Every time we start a project, we get attracted to questions that excite us. The process, however, of going from our questions to finding answers is often lengthy and somewhat abstract (what Uri Alon [2009] in his essay refers to as a cloud), a process comparable to creating an object from clay. As it starts, it doesn't have a shape, and my mentee and I keep working that material, thinking over time about a product that excites us, is unique, and could be attractive to a broader audience. The way we get there relies strongly on giving talks and especially on the approach used to prepare for talks. To give a practical example, every time a lab member is giving a talk, the preparation follows three steps: 1) he/she will build it two weeks before the event, discussing it back and forth with me. This helps both of us start to think hard about the collected data, the best angle for presenting them, and what conclusions can we draw from them. 2) The lab member will give a practice talk to the lab one week ahead of the event, with everyone actively participating by constructively criticizing, dismantling, and remolding the entire talk. 3) The lab member will give a practice talk to me only few days before the event to finalize it and sharpen all the edges. Strikingly, while at first read this may seem to be a lot of work, this has been the best investment of my time from the beginning, because it has, first, allowed me to put together our manuscripts much faster as a result of this intense thinking; second, it has allowed me to give ownership to the lab member for his or her own project; and third, it has created a sense of unity that allows everyone to feel protected while pushing hard for their own projects as well as for those of their colleagues. These were always moments when we created our "new product."

Thus my mentorship (lab meetings, brainstorming, six-month review, etc.) leads to scientific success (papers) and, therefore, business success (funding). Finally, my mentorship feeds into my business model not only by producing successful science but also by producing a healthy, happy work environment.

CONCLUSIONS

While generally thought of as independent entities, science–business–mentorship go hand in hand in my opinion. Mentoring brings depth and quality to business, and business brings effectiveness and productivity to mentoring. While everyone naturally enjoys witnessing the accomplishments that our lab members obtain, the process for getting them there is not as intuitive and is sometimes quite intense, which makes us question whether it is the right investment of our energies. Because of this, seeking sources of mentorships through established courses and internal resources at our university is paramount for the effectiveness and establishment of junior PI laboratories. Investing time in meaningful mentorship fosters a productive and harmonious work environment that results in successful science and, therefore, business.

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