Why we need good mentoring

Martin Clynes, Anita Corbett and Julie Overbaugh

Abstract | Cancer research relies on key values such as creativity, collaboration, research integrity and resource sharing. A positive research environment which fosters these key values is becoming a decisive factor for some funders and research institutions. To create a supportive research culture in laboratories, the training and mentoring of young scientists is important. However, the fast-paced and fierce competition for funding and jobs can present a challenge to the younger generation of scientists who depend on the guidance and mentorship of scientific leaders. The annual *Nature* Awards for Mentoring in Science have been created to bring attention to one of the most essential but least recognized skills in scientific leadership. Thus far, 35 scientists from across the world, who are working in a range of disciplines, have been recognized by this award for their outstanding scientific mentorship. In this Viewpoint, we have asked three recipients of this award who work in fields associated with cancer research about their views on good mentoring, and how a revised approach to mentorship can help to achieve a positive research culture and contribute to scientific discovery.

What in your view is good and effective mentoring?

Martin Clynes. The central purposes of mentoring are to help young scientists to discern their strengths and weaknesses so that they can make appropriate career choices and fulfil their potential, to develop confidence in their own abilities, again so that they can fulfil their potential, and to understand and embrace ethical values in terms of honesty and integrity in reporting of data, in terms of humane and ethical treatment of humans and animals in research and in terms of how science is applied (including impact on human rights, the environment and society). Importantly, young scientists require support in understanding not only the need for hard work, self-discipline, dedication and care for reporting of data but also the critical importance of work–life balance. I think it is important for a mentor to encourage young scientists to generally work normal working hours (but, of course, at critical times some weekend and evening work is necessary). However, while encouraging people to work social hours, the mentor should be tolerant of the fact that some scientists' circadian rhythms make them owls, while others are larks. Mentors should also support young scientists in shaping their attitude and approach to the scientific method. Two important aspects for young scientists are developing a critical and analytical approach to their data, and learning how to make judgements based on evidence, thereby minimizing hierarchical deference to individuals, the literature or the scientific establishment. A key piece of advice to mentees is to avoid arrogance and instead listen respectfully to the opinions of others while still evaluating these opinions on the basis of evidence, and apply the same criticism and analysis to their own hypotheses as they would apply to their colleagues' ideas and hypotheses.

Anita Corbett. In my view, good and effective mentoring requires a commitment of time, attention and effort that pushes mentees to excel and stretch themselves to produce their very best work. One can easily simply edit a written document or give a presentation; however, working with a mentee to provide critical yet constructive feedback catalyses the growth of the mentee. This process is almost always iterative and is commonly frustrating, but there is nothing more rewarding than seeing the pride in mentees who know that they have done their best. A good mentor cannot be afraid to be critical, but criticism should be accompanied by assurance and positive feedback.

The aspects of my mentoring practice and my personality that make me a successful mentor include my ability to listen, compassion, willingness to make sacrifices for others and boldness. These characteristics allow me to understand what mentees need, put in the time and effort to do the hard work of mentoring and confront those who may not be aware that they need mentoring or push mentees out of their comfort zone. As an example, I think of the hours that I spend editing written documents, including manuscripts from my own laboratory, an obvious responsibility, but also grants from trainees in other laboratories, manuscripts from colleagues and grants from faculty colleagues who have heard that I provide strong constructive criticism. I edit with a pen (typically red) on paper and then meet with the author(s) to discuss and explain my comments. I am never afraid to state my opinion, although obviously the authors do not always agree with or implement my comments. Fortunately, I find that I am more energized and fulfilled by the success of my mentees, whether they are formally appointed mentees or not, than I am by my own successes.

One of the lessons that could be passed on to others as a result of my success at mentoring is the realization that successful mentoring requires one to allow mentees to fail. One never wants their mentees to fail, but failure is part of the learning process. If mentees are not given the chance to fail, they will not learn the most difficult lessons. Mentoring is about challenging mentees and pushing them to do their best, not making their life easy. Trainees in my group are accustomed to hearing the phrase 'it builds character' with respect to a difficult technique, an intimidating oral presentation or a difficult paper to write. If my mentees are always comfortable, then I am not doing my job of challenging them. Finally, we have to glory in the successes of our mentees. When someone I mentor succeeds, this reflects positively on me. Too many scientists do not adequately celebrate the success of their mentees.

Julie Overbaugh. A major goal of mentoring is helping people achieve their goals and find a career path that aligns with their interests and talents. This often happens quite naturally with a mentee who communicates well and is thoughtful, motivated and a quick learner. But sometimes a person's goals and talents are not well aligned, and that is the harder part of mentoring. It is rare that the process of bringing these into alignment is fast or smooth. For the mentor, it is important to go slowly and not to expect one discussion will be enough to alter a career path a trainee has imagined for himself or herself for some time. For mentees, it is important to listen and where possible seek input from a range of experienced people who have observed them in their work environment. What are they saying? Are they all saying similar things? Also, mentees should ask themselves whether it rings true, because mentors are not always right. There are also trainees who are struggling to find the path they want to pursue. In all these cases, it is useful for both the mentor and the mentee to keep in mind the most important outcome is a career where the mentee will thrive and be happy and there is not just one such option.

It is not particularly hard to be a good mentor if you enjoy spending time with people and naturally care about their well-being. But it is challenging to be both a good mentor and a productive and successful scientist, as both are demanding. To do both requires finding the right balance, including making sure you protect some of your time for your roles as the scientific leader — the person who helps define the research direction, procures the funds and goes out as the face of the laboratory to present the work. It is therefore important to be realistic about your time and make decisions about who to add to your team on the basis of the time you will need to teach and mentor them. This is also critical if you want to have any semblance of work–life balance, which I view as valuable for many reasons[1]. Mentees also need to be mindful of their mentor's time and use it effectively and efficiently. The good thing is that investing in mentoring probably saves time over the years because it attracts top talent and creates a collegial and happier group of laboratory members that support each other and work well together, all of which enhances productivity.

Q *How do you support mentees in their scientific career and personal growth as a scientist? Can you give examples?*

M.C. Much of scientific mentorship is about apprenticeship, although increasingly courses in specialist topics are also a feature, which is to be welcomed as no adviser/mentor is an expert in all of the relevant topics and most research projects now are effectively multidisciplinary. Attitudes are more often caught than taught, and senior scientists should practise what they preach. Teaching by example is important.

Before presenting at large public meetings, young scientists should be given the opportunity to present and defend their work in a friendly but challenging atmosphere, where everything is up for discussion and it should be okay to challenge also the views of their mentors. They need to learn that there can be robust and critical discussion, based on evidence and facts, not personalized, without being rude or aggressive, and that humiliating another scientist in public or private is not acceptable (some senior scientists need to learn this also); again mentors must lead by example. Ideas should win on their merits, not on the basis of whose ideas they are.

A related issue that young scientists need to be brought to realize is that everyone makes mistakes and that it should be acceptable to admit to mistakes without the fear of negative consequences from their principal investigator or mentor — this is critical if you want to encourage honesty in reporting of data.

There is a lot of wisdom in the following quotation from the Irish playwright Samuel Beckett: "Ever tried. Ever failed. No matter. Try again. Fail again. Fail better."[2]

Mentors also need to help young scientists to realize that science often yields unexpected results, and furthermore that the scientific literature, while being an important guide, is not a divinely inspired text and should be read with a critical eye; if your results do not agree with the literature, it does not necessarily mean that you are wrong.

Good mentors will encourage young scientists to collaborate within their own group and with others. They will also — again most of all by example — encourage courtesy and respect towards work colleagues at all levels, from department heads and senior staff to colleagues, new recruits, technicians, secretarial and administrative staff, cleaners and security staff. Also, they need to realize that their safety protocols must consider all those groups as well.

The work environment, in general, and the manager–young scientist relationship, in particular, should be friendly and informal, but it should also be businesslike. For example, scientific meetings, whether one-to-one or group meetings, and indeed all official business should be conducted in the workplace and not in a social environment such as a bar. Social activities should be optional and clearly separated from core work discussions. Of course, on a voluntary basis many productive discussions may well take place at lunch or over a drink but this should be voluntary — otherwise, some more junior scientists may find the environment oppressive and stifling even though the mentor is trying to be friendly and informal.

Scientific mentors should be careful not to impose their views on other things, such as politics, religion or lack of it, on younger scientists. If the latter bring such topics up for discussion, so be it, but vice versa is generally not appropriate.

The contributors

Martin Clynes was founding Director of the National Institute for Cellular Biotechnology at Dublin City University, Dublin, Ireland, and he has an interest in several applications of cell culture. His cancer-related interests, working closely with clinical experts, include research on mechanisms of chemotherapy resistance and investigation of potential therapeutic targets and biomarkers in pancreatic, lung and breast cancer and in cutaneous melanoma. His research has contributed to a number of clinical trials.

Anita Corbett received her undergraduate degree in chemistry from Colgate University and her PhD degree in biochemistry from Vanderbilt University. She was a postdoctoral fellow at Dana Farber Cancer Institute/Harvard Medical School before joining the Department of Biochemistry at Emory University School of Medicine in 1997. In 2016, she moved to the Department of Biology at Emory University, where she is a tenured professor of biology and Co-Director of the Emory MD/PhD Program.

Julie Overbaugh, PhD, is the Endowed Chair for Graduate Education and Associate Director for Cancer Research Career Enhancement at Fred Hutchinson Cancer Research Center. Her research focuses on HIV transmission and the study of HIV immunity, including how it evolves and its impact on infection risk and pathogenesis. This research has been a long-standing collaboration with the Kenya Research Program. She has served in numerous leadership roles for grant review groups and major meetings in her field.

Principal investigators should involve young investigators as much as possible in external interactions, meeting visitors and so on. For cancer research, collaboration and interaction with other science laboratories, with active clinicians and with industry are very important, and exposing young investigators and students to such interactions, rather than keeping them for the principal investigator alone, helps young scientists and students to develop their own networks.

A.C. Part of supporting mentees is helping them to explore and define their own goals. A continuing challenge in scientific mentoring is defining 'success' as the classic academic trajectory. For me, success is helping mentees to define their own success and then providing them with the tools to achieve their own definition of success. Often the greater challenge lies in helping mentees to realize their definition of success rather than arming them with the necessary tools to get there.

One way that I can help all mentees regardless of how they define success is to help them develop skills that are broadly applicable. There are skills that we can develop in our mentees that will arm them for success in a broad range of careers. Key among these skills is the ability to communicate with a broad range of audiences. One of my mantras (and I have many) is 'know your audience'. I work particularly hard with my trainees to hone their written and oral presentation skills to make their presentations accessible to multiple audiences.

For written skills, I am old-fashioned. I break projects down into small sections and then read a printed document, write comments and then meet to explain those comments. This process means that ultimately all the words composed come from the trainee, but they are massaged and developed through multiple rounds of feedback where the mentee understands why the original text was unclear, grammatically incorrect or factually wrong or whatever the issue that prompted an edit.

For oral presentation skills, I work with mentees to have them 'tell a story'. Everyone wants to start by understanding why they should care about what you will tell them and then they want to be able to follow the story. Strategies to achieve this goal include a focused story that is told in depth, interconnecting threads, such as slides that mark the path along the story, and an emphasis on what we have learned. We work to polish slides so that they are easy to read, attractive and focused on a single point.

In addition to these more traditional academic forms of communication, I urge my trainees to have a version of their work to share that serves as their 'Uber driver pitch'. This is today's version of 'how would you explain your work to your grandmother?' Instead, we land somewhere to attend a meeting or present a seminar and hop in a ridesharing car or taxi. The driver might ask, 'What brings you to town?' I encourage all my trainees to respond, 'I am a scientist and I am here for … fill in the blank.' This response exposes a broad swathe of society to scientists and makes them realize that scientists are normal people. After this initial exchange, I want my mentees to be able to respond with a few sentences that would explain their science to anyone regardless of education and background. My version of this pitch is to say, 'All of the cells that make up our bodies have the same information, or the same chromosomes or DNA, but they all look really different and do different things. The cells in your heart allow it to beat and pump blood and those in your skin hold you together. If we had a single set of blueprints and were asked to build ten houses from that blueprint, they would all appear identical. However, our cells take the same information and build very different products. We study how cells do this and we also try to understand how, when those processes go wrong, this leads to disease.'

J.O. One of the ways a mentor supports their mentees is by considering what they need to advance their careers and then find a way to balance their needs for the mentoring with the overall needs of the programme to be productive. Accepting a student or fellow into your group should come with a strong sense of responsibility for that person's education and career advancement. A common example of striking a balance is writing papers, where the process may be slow with a new trainee because this skill has to be learned. Most seasoned group leaders can write a paper relatively quickly, whereas the process of having a trainee write drafts and giving the trainee input to help that person learn good science writing skills can be a longer-term project. Given that being an effective writer is critical as a scientist, supporting and guiding mentees to develop this skill set is an important part of their training.

Conversely, one of the ways mentees can support their mentor is recognizing this approach is not always possible or reasonable. For example, if submitting a paper quickly would maximize the chances of success for a major grant application, the mentor may have to take a major role in the writing to get a paper out quickly. In such cases, communication is key so that mentees feel assured of future opportunities for training.

Q *How does effective mentorship benefit the research environment in your laboratory and your institute?*

M.C. Applying the ideas mentioned in response to the previous questions should help to generate a group of people who are hardworking, relaxed and collaborative, and who generate reliable data.

A.C. Effective mentorship benefits the research environment in my laboratory by bringing different ways of thinking to all the projects. This is accomplished because we have trainees at all levels, from high school students to senior scientists, and we have people from different backgrounds and areas of training. There is ample evidence that diversity is a major strength in problem solving[3–5]. In addition, as I strive to push mentees to take ownership of their projects and their research questions, they can truly own and celebrate their successes. We also have a highly collaborative environment providing a support network within the laboratory for those inevitable times when experiments cause disappointment, dismay and frustration.

Due to the diverse stages of training of the members of my laboratory group, there is an opportunity to develop mentoring skills in mentees. Nearly all members of my group have their own mentees. Thus, when I meet with my mentees, we not only discuss their work but we also address their working relationships with their mentees. Such training builds critical life and career skills.

My laboratory is a microcosm for the training environment at Emory University, where we focus on developing complete scientists. We value mentoring, collaboration and diversity. The university provides support for both formal and informal activities that support these values.

J.O. My laboratory practises a team mentoring approach where more senior mentees also become active mentors for more junior laboratory members. This often takes the form of one-on-one mentoring of new laboratory members by senior students or fellows. But we also mentor together; for example, by gathering to listen and give feedback on practice talks. I see considerable

value in this, for a variety of reasons. First, there are some things members of the laboratory may have better or different insights into than me; as such, they have a lot to offer to other trainees that may complement my mentoring. Second, this spirit of mentoring and support throughout the group creates a very positive laboratory environment. Third, it allows trainees who aspire to lead their own team to hone their mentoring skills and decide if they want a career that includes mentoring trainees.

Perhaps most importantly, a supportive mentoring environment also creates trust, which I believe fosters a more collaborative spirit. I am lucky to work at a cancer centre where there are many faculty members and educators who are committed mentors, and I think it is part of our secret sauce and what makes our culture so unique and collaborative.

Q *In your experience, how would you describe the general approach to mentorship in academic cancer research, and what changes would you like to see happening?*

M.C. In cancer research worldwide, on balance, I think that the overall environment has become competitive to the extent that it is difficult for young researchers to develop a healthy balanced lifestyle and still progress in their careers. There is a poor career structure in most countries for researchers. In cancer research, the contribution that young scientists can make may in some cases be underappreciated and this may inhibit progress in cancer research overall. For the health of cancer research, and retention of more researchers in the field, I would like to see more rolling contracts, for example '4 plus 2' or '3 plus 3', where a researcher has a 6-year rolling contract but must generate additional funds for two or three of the 6 years, giving some degree of security and a reasonable length of warning before exit.

A.C. In my opinion, the general approach to mentoring is in transition or perhaps a better way would be to state that there remains a biphasic distribution. Traditionally, mentoring focused primarily on training a student to perform experiments and publish papers leading to a PhD degree. Too many mentors still subscribe to this form of training. Fortunately, there is a growing movement to build formal structures and tools to provide broad mentoring and professional development. The National Institutes of Health (NIH) catalyses much of this culture change with requirements for NIH funding of training programmes, but the most successful mentors are ahead of the NIH-mandated curve. Mandated mentor training would be invaluable. Emory University has implemented such mandated training for new faculty members in the Graduate Division of Biological and Biomedical Science. Many of the new mentors value mentoring and are eager to dedicate time to this training. The mentors who are most in need of training are those who do not see the value in such training. Often these mentors are highly accomplished scientists with dozens of trainees to their name. How this issue can be addressed is not at all clear. Students will continue to join these groups due to the prestige of the science and the mentor, but often they struggle. In the end, the mentor–mentee relationship depends on the two people involved, and there is no doubt that the environment that is ideal or at least viable for one mentee may be completely toxic for another. While those of us in leadership roles that interact with students in challenging or even toxic mentoring situations use a 'poor match' to soft-peddle poor mentoring, some mentors simply should not be allowed to oversee student training.

Another aspect of mentoring that remains a challenge is that the work of mentoring is often seen as nurturing and thus naturalized as feminine. While this characterization is a stereotype, it remains a common assumption, and there are a variety of specific examples to support this assumption. There are many stories of 'ghost advising'[6] where Joe Famous Scientist is the mentor of record but the mentee has to call on another individual to provide guidance and hands on mentoring. Often, the ghost advisor, who does the work but does not receive any formal credit, is female. Such work is time-consuming, but more importantly there are two nefarious outcomes: the work of the ghost advisor advances the career of Joe Famous Scientist, as the mentee's work is now polished and ready for primetime, while simultaneously detracting from the time the ghost advisor has to dedicate to his or her own work, thus potentially undercutting the career and advancement of the ghost advisor who is putting in the time and effort. The ghost advisor is torn with wanting to help the mentee, but in helping the student, the ghost advisor perpetuates the system[6].

These issues can be particularly challenging in fields where some researchers see a clear hierarchy and where student training is not a major goal. Unfortunately, in the field of cancer research, there are many scientists who were trained in an environment where mentoring was not valued, performed or even considered. This situation can make the efforts to value mentoring as part of the work we should be doing as scientists an even harder sell in such an environment.

A major goal is to find ways to quantify value and reward the hard work of mentoring beyond counting PhD theses. As a current member of the tenure and promotion committee at my institute, I can appreciate that we do not have a way to quantify and value these contributions. Certainly, a start is to have recognition of this work through awards such as the *Nature* Awards for Mentoring in Science, but this is not a general answer to the issue as such awards are few and far between.

J.O. When I started my career, the concept of mentoring in academic science was more of 'if you are into that kind of thing, that's great' but not something that was required for the job or even particularly valued. Producing well-trained scientists was not viewed as being in the same league as producing a high-profile paper; that is probably still true, although the tide seems to be slowly turning towards both being recognized as important in science. The momentum to better recognize effective mentoring, including with awards such as the *Nature* Awards for Mentoring in Science, is a great start, but I think we could put more teeth into this. Many mentoring awards are driven largely by a nomination from trainees, and while there is no greater satisfaction than having your trainees recognize you in this way, mentoring should also be recognized by peers and institutions. For example, coveted honorary scientific societies and awards could start to place some weight on the overall impact a person has on science, both their publications and their training record and contributions to mentoring. Meetings could have named lectures that reward good mentors who do impactful science. For this, I would advocate that the selected scientist be able to showcase the science of the team in the lecture, in addition to taking time with trainees. Perhaps granting agencies whose mission it is to advance science could consider that scientific advancement includes training the next generation of scientists. At present, we mostly have grants for training and grants for science. Maybe there is room for grants that consider both the short-term science

produced and the long-term impact of producing well-trained scientists from that same funding stream.

Some of these types of recognition may have modest direct impact because it seems to me the people who really care about supporting the aspirations of their trainees will devote effort to mentoring in any case. But it could reduce stress for scientists who are trying to produce strong science and be good mentors if they feel their mentoring and education efforts are valued. For example, if mentoring is recognized as an important part of academic science, then it may make it easier for a laboratory head to help the student learn to write, even if it means a competing group that places less value on the needs of their trainees gets the first, higher-profile paper. In the end, people drawn to mentoring tend to take their greatest pride in their trainees rather than their scientific papers or major prizes[7].

What is your top piece of advice for fellow principal investigators, young investigators and students to achieve an effective mentor–mentee relationship?

M.C. Work hard on maintaining mutual respect, encourage high standards, encourage openness about mistakes or failures, have frequent face-to-face meetings and keep channels of communication open, and ensure that the culture values scientific rigor over status or hierarchical decision-making on scientific issues. Principal investigators and young investigators and/or students should always remember that they are dealing with people on both sides of the relationship.

A.C. My top advice is a single word: 'listen'. We need to hear what our mentees are saying and help them to achieve their own definition of success and stay strong in the face of obstacles. Of course, 'listen' is one half, likely the more critical half, of communication. Strong mentoring relationships rely on the ability to communicate and understand one another. In my group, we have started a tradition of dedicating a laboratory meeting every year to using a communication inventory instrument, which is aimed at assessing communication styles in the group[8], to remind ourselves that individuals have different styles of communication. While knowing who in the laboratory uses which style is helpful, the key point is the purposeful reminder that we all communicate differently.

Good communication takes time, and thus ensuring that sufficient time is allocated to support trainees is of the utmost importance. Time is an ever-vanishing resource in the world we inhabit, so this requirement often becomes one of the most challenging to meet. From a practical point of view, the need for sufficient time can mean turning potential mentees away when there would not be sufficient time to allow appropriate time to be dedicated to mentoring within the group.

J.O. The recipe has some simple ingredients: communication and respect, including respect for the individual — their goals, talents and areas for improvement — and respect for their time and other facets of their lives. These ingredients are important on both sides, mentor and mentee.

Martin Clynes[1,2]*, *Anita Corbett*[3]* and *Julie Overbaugh*[4]*

[1]*National Institute for Cellular Biology, Dublin City University, Glasnevin, Dublin, Ireland.*

[2]*Synthesis and Solid State Pharmaceutical Centre — Science Foundation Ireland Research Centre, Dublin City University, Glasnevin, Dublin, Ireland.*

[3]*Department of Biology, Emory University, Atlanta, GA, USA.*

[4]*Division of Human Biology, Fred Hutchinson Cancer Research Center, Seattle, WA, USA.*

**e-mail: martin.clynes@dcu.ie; acorbe2@emory.edu; joverbau@fredhutch.org*

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Competing interests
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