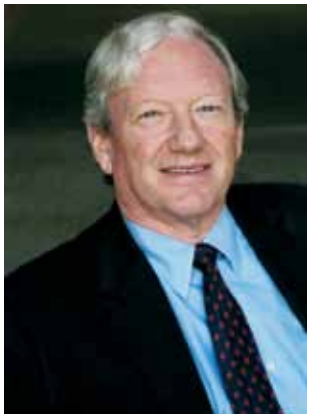
Mentoring in microbiology: tips and traps for PhD supervisors



Adrian Lee

68 Austin Street
Lane Cove
Sydney NSW 2066
Tel/Fax (02) 9427 5321
Email adrianlee2@mac.com

This article focuses on postgraduate supervision as a critically important part of university teaching in microbiology. It is written for the PhD supervisor and is intended to encourage reflection on their role as a mentor for the students under their care. Much of the material comes from the documentation supplied by a large number of scientists in Australia and beyond who proposed their mentor for the 2006 *Nature* Awards for Mentoring in Science. As one of the judges for the Australasian awards, the author had access to this material which he, with Carina Denis and Philip Campbell, the editor in chief of *Nature*, used as a basis for the *Nature*'s guide for mentors.

Introduction

I would like to congratulate Cheryl Power and Chris Burke on this issue of *Microbiology Australia* dedicated to teaching. Microbiology has a long history of fostering excellence in teaching. There is something about microbiologists that results in a larger proportion being interested in teaching and being great teachers than in many other disciplines. I'm not sure why, but maybe it correlates with the great time we have at ASM meetings when we let our hair down! Maybe the common denominator is fun. We love microbiology and teaching microbiology not only because it is interesting but also because it is fun.

I taught microbiology to science and medical students for a hundred years at UNSW where I came to via a postdoc in New York, having done my PhD at Melbourne in the Bugs school when Syd Rubbo was Head and we were taught by a galaxy of amazing microbiologists. I was going to be a biochemist, but the inspiring teaching at Melbourne turned me. The education group of ASM was first led by Horst Doelle in the late 1960s and I took over in 1971 for 11 years. This interest in education in microbiology and good teaching stayed with me and was a strong factor in my decision to cross to the 'dark side' of university administration by becoming Pro Vice Chancellor (Education and Quality Improvement) at UNSW. Although my focus was mainly on undergraduate teaching, which I have continued in my retirement, I also had a strong interest in trying to improve the quality of postgraduate supervision. Having led a committee to investigate the PhD, I had been horrified at some of the poor practices I observed and determined to try to help academics provide a more fulfilling and productive postgraduate training for their students. The theme of this article is to reflect on strategies that will help supervisors in microbiology provide a better postgraduate experience for students under their care.

This article partly comes out of my own experience as a supervisor but also from the words of nearly 100 scientists who had experienced a very positive time as a young and budding scientist and had proposed their mentor, often their PhD supervisor, for a *Nature* award for mentoring in science. These were initiated in 2005 following the realisation of the Editor in Chief, Phil Campbell, that one of the least rewarded aspects of science was the mentorship of young researchers. These awards for outstanding mentorship are now awarded annually in a specific country or countries each year [1]. In 2006, I had the honour of being on the judging panel for the Australasian awards. It was a daunting task with a superb group of mentors being strongly supported by large numbers of their mentees. Following discussions about what are the attributes of a good mentor, we realised that there, in the massive supporting documentation written by the mentees and by the mentors themselves was the answer. Thus more than 200 informative quotes were distilled, synthesised and finally written as a publication called *Nature's guide for mentors* which looked at what made a good mentor [2]. Below, I give my impression of the lessons to be learnt from the comments of the mentees and my own experience. I do this in the hope that readers reflect on their role as a mentor currently or what they would like to be when they take over a supervisory role in the future and that they are able to improve the experience of those young scientists under their care. The tradition of quality supervision remains high in microbiology but we can always do better.

Be available

This is the tough one. By far the most common attribute spoken of by the mentees was the availability of their mentor. They spoke of the open-door policy of their supervisors, of rapid responses to emails, always being there to talk about problems, to inspire and give advice. In our hearts we know how important this is but how hard it is to maintain. As mentioned later, group meetings are important but we must make a regular timeslot to meet with

all our graduate students, postdocs and research assistants for 30 minutes minimum each week or 2 weeks. Life is busy but no excuses. No last-minute cancellations. If we can't do it, should we be supervising? Of all the tips in this paper this is the one we have to adhere to. Did I? Do you?

Respect

A good supervisor treats their postgraduate students as thoughtful colleagues. The students are an integral part of the team and junior students should feel the science they are doing is as important and as interesting as the student about to submit their PhD. The worst supervisors are the ones who treat their students as an 'extra pair of hands'. This does happen and it is noticed. A supervisor who does not openly and visibly respect their student loses the respect of their peers.

Be generous

A very obvious trait of the great mentors was their unselfishness and willingness to share. They share their own ideas and are happy when someone picks them up and runs with them. They generously allow them to take on senior authorship, even though they could claim it for themselves. They allow younger people to take credit for their work even if it is to the apparent disadvantage of the mentor. Of course it is not. The generosity is apparent to all and only enhances the status of the supervisor. We have all seen leaders of big and important groups who are more concerned with using group members to promote their own scientific standing. I like to feel this meanness of spirit does not benefit them in the long term. Such generosity is harder in the early years before our international reputations are fully established but it will be of benefit in the long run and reduces the chance of our egos taking over.

Individual differences

We are all different. Different in the way we learn. Different in the way we think, become interested and lead our lives. We come from many varied and different cultures. A good supervisor or mentor appreciates these differences and does not try and fit square pegs in round holes. They know when to back off and let people make their own decisions and when to come in and offer support and sympathy. Not everyone wants to be a leading researcher and some are better suited to other occupations. We should acknowledge this and help them along that pathway.

Sit down with a cup of tea or glass of red and write down the strengths and weaknesses of each of your current team, the personal issues that confront them and their special circumstances. Now reflect on how you work with them. Do you feel you treat them differently taking account of these individual differences? There is more to life than what they do in the lab. They need freedom to 'smell the roses' as one mentee put it. If things change and appear to be going wrong, we need to try and understand why. If personal life is becoming tough, then give them time and space. Good mentors make themselves aware of this. Again we are often so busy we don't notice.

Mentor for life

There is a subtle difference between a supervisor and a mentor. As someone put it:

> *With the latter you find that you are not simply a student with a research project but a student with a career in front of you that the mentor helps you start.*

It was remarkable how often the mentees mentioned how the mentoring relationship had continued; they spoke of mentors forging a rapport with the student that potentially last for a lifetime. We need to do that more deliberately. It is easy to lose touch. I regret that I have lost contact with many of my former students. The great mentors continue contact and link their former students with outstanding scientists throughout the world.

Actively research

As supervisors we need to remain in the lab and actively research. As our careers progress, our lecturing responsibilities increase and we have more and more meetings, there becomes a temptation to stay in our office and not get our hands dirty and do benchwork. Research students, postdocs and research assistants are doing the work, thus we think it reasonable to stay in our rooms reading, writing, meeting our students and thinking up the next great experiment. We should fight this and allocate one common time each week when all know we will be at the bench with a white coat on. It's a discipline our students appreciate and allows us to look over their shoulders and help with a technique. Just as we should be strict with having dedicated time for discussion with our team so we should have a dedicated bench-active time. Also, we need to see the raw primary data or observation, not just a written-up version of it.

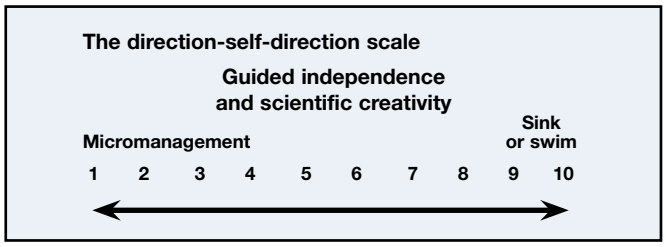
Get the direction-self direction balance right

One of the great skills of good supervision is to get the right balance between allowing the student to develop and explore their own ideas, research plans and projects and providing them with expert guidance and direction when needed. As someone stated:

> *The scientific acumen to on the one hand encourage promising ideas and on the other recognise a 'dead end', is one of the great mentoring skills.*

One of the worst deficiencies in a supervisor is to micromanage. They have thought up the experiment, written it up in their grant application and the students' job is to do the experiment. This can stifle the student and give them no chance to develop the critical problem-solving skills students require to be a research scientist. Experiments don't always work and they have to be given the freedom to appreciate that the unexpected result may be the right one, even though it does not fit with existing theories. Our role is to encourage and prompt students to follow their own ideas and judgement and to provide an environment

where this is possible. In the *Nature* article we created a direction-self-direction scale.



Where would you place yourself on the scale? If you have the courage, ask your team members to also mark where they think you are on the scale. Have a great and fruitful discussion comparing notes!

Celebrate

Success in research is not celebrated enough, be it that first great breakthrough or the final submission of a thesis. All the *Nature* mentors described or were praised for their regular practice of celebrating achievement. Celebrations ranged from cocktail parties, lunches, dinners at the supervisor's home or simply a cake at morning coffee time. One laboratory even had a special ritual of 'weighing the thesis' when a student was handing in the final tome. The crowding around for this special ceremony was described as marking a very special time for the student. Ritual is what we want. Special moments of discovery are special events that need acknowledgement. How often are there celebrations in your lab? Another outcome of ritual celebrations is that they bring everyone together and contribute to the building of a community referred to below.

Building a community

One of the major lessons I learnt as head of a school of microbiology and immunology or PVC (Education and Quality Improvement) was the importance of building communities. Thus it was not surprising that building the research team as a scientific and social community was another attribute of great mentors put forward for the *Nature* awards. This does not just happen; special strategies need to be devised to deliberately build the communities and nurture them. The demise of communal lunches or coffee breaks in many schools is a great shame and potentially leads to isolation of groups and individuals just at a time when we are being encouraged to be interdisciplinary.

The scientific community

Weekly group meetings, seminar series, journal clubs and so on are all well-tested vehicles for building a community of scientists. However, the leader needs to put much thought into the processes used, to ensure that all feel valued and heard and they are not just a platform for the usual suspects to expound their views. Examples described included going round the group in a journal club with each participant speaking for 3 minutes. This allowed all who may have been too shy to talk to contribute and restrained the talkative. Some hold all-day meetings each 6 months where everyone, including the supervisor, prepared a single page, listing things they are planning to achieve or complete over the next 6 months. They also write brief comments on achievement against the targets they set at the previous meeting. In another group, all new honours students were assigned to a PhD student who acted as a lab mentor. This contributed to the collegial environment of the lab and was a great practical experience in mentoring for the graduate students. Others put teams together to write drafts of papers or a review

Social

We are not all social animals and to suggest that we all entertain our groups, go on picnics together or climb mountains is not appropriate. However, amongst the *Nature* mentee reports were many fond references to 'Shakespeare under the stars', ethnic dinners, birdwatching days, a jazz band, picnics, video nights, even cake baking. My strategy in community building was to have wine tastings with great wines, good food and soft drink for those who preferred it. The best tastings ever were eventually run by the graduate students!

Create networks

One of the best things we can do for our PhD students is create and share our networks for the benefit of their careers. Again this was a universal characteristic of all the great mentors, using their contacts to promote their students and young staff. My PhD supervisor Geoff Cooper, travelled to New York on sabbatical, talked to the great René Dubos about me and so off I went to the Rockefeller University to begin a lifetime immersed in the gut flora, an area I had never worked on. Other tips referred to were to insist that our students get time to travel to overseas labs and conferences and link in with our networks. Universities need to put many more resources into allowing their graduate students to travel. This not only leads to better outcomes for the student, but has immense reputational benefit for the institution. Another behaviour of a good supervisor is that when a distinguished scientist comes to visit the school they not only introduce them, but also give them an opportunity to present or discuss their work. Often this is more valuable than having the students simply listen to a seminar by the great woman or man.

Question and listen

Questioning is a skill that can be developed and listening is something we should force ourselves to do more. We may know the answers but our job is to get the students to work it out for themselves. This for me was best described in the following quote:

> *There is always another question to ask. The questions seem innocuous but nothing is as it seems to be; there are more insights to be gained by probing away ... also never imposes his/her will, but he/she persistently keeps the questions flowing to help the answer come along.*

If you have not done this before, in your next discussion with some students, ask three more questions than you normally would. Also listen and paraphrase back to the student what you think you have heard her or him say.

We learn about 'active listening' when we attend parent effectiveness training but don't always practise it in our laboratories. We are all so busy that it is much easier to simply give them the answer and the solution we already know.

Enhance skills

Being a scientist requires skills in critical thinking, writing and oral presentation. Often we expect this to happen by osmosis during our student's candidature. It does not; it has to be planned for. A continuing theme of this article is that we have to have a personal strategy that suits our personality such that we create the optimal learning experience for the young scientists under our care. A limited number of examples or thoughts from the *Nature* mentors and mentees are given below.

Criticism

From the beginning of their candidature we should be building on the skills of scientific criticism we hope they have picked up in their honours year. This should continue, with them taking an increasingly important role in the critique. A journal club is one strategy: students should not only participate in the critique of key papers but they should regularly take the lead by selecting, reviewing and critiquing papers themselves. Students should be involved from the beginning in the team's grant applications. They should also be put in the position of interviewers in mock interviews. They should take the position of journal referee of papers submitted from the group and be encouraged to make a decision regarding acceptance, resubmission or rejection. The actual reviews that come back then provide the basis for a very rich discussion. In summary, we should create a situation where our students practise all the things we do that make us a scientist.

Writing

All too often we start training our young scientist how to write scientifically too late. The major writing activity is when they start to write their thesis. In reality, they should be so practised by then that writing becomes second nature to them. Early on, groups of students could be given the task of writing a review. A good strategy, which also enhances critical ability, is to present them with a manuscript they have not seen with either the abstract, introduction or discussion omitted and getting them to write their version which can then be compared with the original. With respect to papers, the student should always write the first draft no matter how much we want to get their great results published. Use of track changes in Microsoft Word makes our suggestions very informative. The more writing we give students to do the more we burden ourselves but that is part of the contract. A positive comment on all the mentors was that they gave feedback on written work very quickly. Hard to do but essential.

Presentation

From the beginning, possibly due to my interest in good teaching, I insisted that much effort went into training for oral presentations. Good readable slides, logical presentation and clear speaking. Our honours course had sessions on how to present. This was often embarrassing in that the standard of honours seminars and graduate student presentation was way better than the presentations of senior staff members the students experienced at ASM meetings and other conferences.

Teaching

It is interesting how many of the *Nature* mentors were referred to as great undergraduates teachers. This is important to me, as one reason I took on the PVC (Education) role was the conviction that great scientists can also be great teachers. Many of the mentors put forward for the *Nature* award were indeed outstanding researchers. Relevant to the theme of mentoring is my belief that supervisors should encourage their charges to take on a teaching role, for example, demonstrating to undergraduates and to do it well. As a resource for them you are referred to a website called *Guidelines on learning that inform teaching* that I have created to help academics teach well [3]. Inspire your undergraduate students and they will come to you as a future supervisor.

Seek feedback

However comfortable we are with our supervisory or mentoring abilities, we should always aspire to do better. Thus we need to reflect and ask for feedback on our performance. At the end of the *Nature* paper there is a self-assessment entitled *How good a mentor are you?* You are invited to complete this. The article is available online [3]. In the assessment you are asked to write down examples of how you tackle many of the issues described above and to reflect on what you could do better. For an optimal chance of improvement you could again ask all your team to anonymously complete the form and return it to you. Then you can have one of the social team-building activities referred to above catalysed with a very good shiraz!

For the students among you

This article has been written for the supervisor not the student. For those aspiring to be an academic, good luck. Hopefully you might find this useful in the future. For those of you who are still undergraduates and are contemplating a postgraduate degree, go for it, as it is a very special stage of life for anyone interested in science. But one word of advice, put as much effort into selecting your supervisor and the field you will work in as you did or are putting into your honours year. Be brave and stretch yourselves. Unlike in the USA, we tend to simply complete our honours year and progress to a PhD on the same topic with the same supervisor at the same institution. That's what I did. However, even if you are totally happy with your honours supervisor, look around and look for alternatives. Consider another university,

consider another country, consider another field. Find groups of outstanding calibre you have read about and who may be willing to take you on. Question others about your possible supervisor. Do they have the track record and attributes referred to above? This is one of the most important decisions in your life. Take your time and investigate thoroughly. Good luck and if I can hang on a few more years, I may see you being nominated for a *Nature* award!

Conclusion

There is much more that could be said. The most common words coming through those many reports from the *Nature* mentees supporting their mentors were **passion, enthusiasm and love of science**. There are no tips that can be given to help the development of these characteristics other than if you feel you don't have them, maybe mentoring is not for you. However, my guess is that many reading this article have these traits in abundance and are doing a great job supervising already. I hope the words of the very successful mentees and mentors who participated in the *Nature* venture have been helpful. I conclude with two great quotes which sum up key issues for me.

> *Often, ... would leave the latest, hottest paper on my desk, with an enthusiastic note attached that not only conveyed his/her own excitement about the field, but also piqued my interest. His/her door was always open to discuss not only my latest results, but also the latest paper.*
>
> *… has an optimistic outlook is willing to push the boundaries. Going to …'s office with your head down, armed with a plot or calculation showing that the project appeared to be going nowhere, you will leave believing that you've solved the mysteries of Universe.*

Guidelinesonmentoring.com

This mentoring project has continued in my retirement and has resulted in the construction of another website in which appear many of the thoughts written above [4]. You are invited to look at it but more importantly send me more examples, tips and strategies that you think could be usefully included.

References

1. *Nature* Awards for Mentoring in Science. At: http://www.nature.com/nature/awards/mentorship/index.html
2. Lee, A. *et al.* (2007) *Nature*'s guide for mentors. *Nature* 447, 791-797 and at: http://www.nature.com/nature/journal/v447/n7146/full/44779la.html
3. Lee, A. (2009) *Guidelines on learning that inform teaching.* At: http://www.guidelinesonlearning.com
4. Lee, A. & Hulbert, K. (2009) *Guidelines on research mentoring.* At: http://guidelinesonresearchmentoring.com

Biography

Adrian Lee did his BSc and PhD at the University of Melbourne and a postdoc at the Rockefeller University in New York. In 1968, he took up a lecturing position at the University of New South Wales progressing to Professor of Medical Microbiology and Head of the School of Microbiology and Immunology. He was an active researcher investigating the spiral bacteria of the gut including Helicobacter species and held NHMRC grants continuously from 1972-2003. He became Pro Vice Chancellor (Education and Quality Improvement) at UNSW from 2000-2006 due to his interest in teaching. Adrian has had a long relationship with ASM, chairing the organising committee for the annual meetings in Sydney in 1972 and 1978 and sat on the National Council for many years. He was awarded the inaugural ASM Distinguished Teaching Award in 1989, the ASM Distinguished Service Award, was the 2002 Rubbo orator and became an Honorary Member of ASM in 2004. Now Emeritus Professor, Adrian continues to support quality teaching and research mentoring. In 2008, he was awarded a Career Achievement Award from the Australian Learning and Teaching Council.