

# **Guidelines for Postgraduate Students in the School of Genetics & Microbiology**

**School of Genetics and Microbiology  
UNIVERSITY OF DUBLIN, TRINITY COLLEGE**

*<http://www.genetics-microbiology.tcd.ie/>  
Modified May 2012*

## 1. Introduction

By definition, true research involves working at the very edge of knowledge. For this reason, it is not practical to constrain research activity with a rigid timetable. On the other hand, unless one works within a structure that provides guidance, research runs the risk of being undirected and ultimately fruitless. These notes provide an outline of what an ideal PhD experience in this school should look like. By making comparisons between the ideal and their own situation, students (and supervisors) can acquire some feeling for how they are doing.

The outline is geared to the three-year PhD, which is still the norm in this country from the point of view of funding. However it is now recognized that three years is often insufficient to complete the research and write a thesis and most students register for a fourth year. The purpose of this note is to remind the student of the relentless passage of time and the need to make the very most of the funded time available. The PhD degree represents a substantial reward for a substantial effort. That effort involves a certain willingness to sacrifice things that the general working population in western countries accepts as normal - a five-day, 35 h week with generous holidays. Please do not be misled, nature gives up its secrets grudgingly and we have to work hard to learn them. If this thought is repugnant to you, perhaps you should think again about your chosen vocation.

### 1.1 The research problem

Students wishing to pursue a PhD normally approach a laboratory led by an individual carrying out research in an area which interests them. It is also important that the supervisor is someone with whom one can have a good working relationship. These are essential ingredients for a good project. A third and indispensable ingredient is MONEY. Students are usually aware of the financial costs to themselves of postgraduate work (fees, deferred earning of 'real' salaries, life on a minuscule studentship, etc.) but should appreciate that the research work also must be funded. This involves the buying of consumables and equipment. Raising funds is normally the responsibility of the supervisor and the availability of research money in the lab will often dictate whether a promising project can be pursued.

### 1.2 Problem formulation

The research problem chosen should be formulated so that it lends itself to analysis by a clearly-drafted research programme. Vagueness should be avoided rigorously. For example, a project title such as "To analyse the contribution of the *Salmonella typhimurium* *inv* virulence gene to host cell invasion" is preferable to the hazy formula "To look at the genetics of *Salmonella* virulence".

The programme should contain research goals which serve as milestones during the project. For example, 1) isolate and clone *inv* gene, 2) sequence gene, 3) mutate gene, 4) replace mutant copy of gene on chromosome, 5) observe phenotype of mutant in *in vitro* invasion assay, etc. Without these progress markers, it is difficult to assess how things are going. Once the programme of experiments is underway, it is often necessary to reformulate the problem. Some reformation will keep the problem firmly within the boundaries of the original research problem while others may involve going off completely at a tangent. Thus, the *inv* gene may be found to be more important in host cell attachment rather than invasion and different experiments will have to be planned to follow up this unexpected lead. On the

other hand, it may be discovered that the Inv protein is also a receptor for a bacteriophage. Pursuing this angle will involve a completely novel line of research. Since time rarely permits the student to follow up every potentially interesting lead, a decision will have to be made here to resolve this dilemma. In this case the student may have to drop the phage receptor lead in order to concentrate on the main topic - the role of Inv in virulence.

### **1.3 FEASIBILITY ASSESSMENT**

At the outset, student and supervisor must discuss the feasibility of the proposed work. Can the project be carried out with the resources of the supervisor's laboratory and of the department? Can results be generated quickly or must a crucial breakthrough in a new methodology come first? Projects that depend on such breakthroughs must be classified as 'high risk' because of the possibility that the necessary technical development cannot be accomplished. In such cases a clear 'fall-back' position must be identified so that work can still progress even if attempts at realising the initial aims become frustrated.

At the beginning, the main responsibility for feasibility assessment falls to the supervisor but as progress is made the student should become increasingly involved in the assessment until a point is reached where the student has become the world's expert on the particular research topic. It is a natural and healthy sign if the supervisor slips further and further into an advisory role with the progress of the project. Remember that it is the student and not the supervisor who must write the thesis and defend the work in the oral examination! If the student and supervisor have developed a good research programme, the student has executed it competently and diligently but the outcome is not that originally hoped for, the student's prospects of earning the degree are not necessarily doomed. The thesis is the record of the pursuit of the research goal and is judged as such. Negative results do not in themselves warrant failure.

### **1.3 The thesis committee:**

Every postgraduate student will be assigned a Thesis Committee by the Director of Teaching & Learning (Postgraduate), composed of two members of the faculty not including the student's supervisor. Its function is to support the student throughout their period in the School. It will meet at least three times during the course of the PhD and will participate in progress assessment (see 1.4) and grievance resolution (see 7.6).

### **1.4 Assessment of progress**

Students embarking on postgraduate studies in the School of Genetics and Microbiology either register as MSc students (TRY38, TRY42), or they register directly for the PhD course (TRY40, TRY44). Every PhD student will be assessed at three points during the course of the PhD as detailed below. The assessment at/before 18 months (but strictly before 24 months have elapsed) will be utilized to confirm the student on the PhD register.

**At/Before 9 months:** First Year students write a six page report and present a short talk (about 10-15 minutes) to the thesis committee, department or school as decided by the Head of Discipline. They are interviewed for about 20 min. The objective of this exercise is to ensure that the student has a clear view of his thesis subject, knowledge of the relevant literature and a clear plan of approach. **Students who show no aptitude for research or are deemed by**

**the thesis committee and their supervisor to be unsuited to a research career will be encouraged to reconsider their position.**

**At/Before 18 months:** (midway through Year Two) Students present a research talk to the thesis committee, department or school as decided by the Head of Discipline (approximately 25 to 30 min) and submit a more detailed report to the Committee (about 25 pages, read and signed by the supervisor). This constitutes the exam for confirmation on the PhD register. In consultation with the supervisor, a decision is reached by the thesis committee as to whether the student should progress and be confirmed on the PhD register.

The thesis committee will recommend one of the following courses of action:

- That the student plan to complete an MSc in two years.
- That the student present a revised transfer report for reconsideration within six months at the latest (*ie. strictly* before 24 months).
- That the student be confirmed on the PhD register.
- That the student should leave.

**At approx 36 months:** Students present a thesis plan to their committee. At this meeting the student will discuss the writing up of the thesis and future career plans.

Discovering that one does not have the aptitude or capability to be a professional **research scientist** should not be the end of the world. Not everyone can be a professional athlete or an airline pilot and the same is true of research scientists. It would be very irresponsible indeed, and **absolutely not in the best interests of the student**, to allow someone with little or no aptitude for research to continue in a research career.

## **2. The First Year**

In the first year the student must become familiar with the area of research through reading the literature. It is important to learn how the proposed research project relates to the field, who the other scientists working in the area are and what their interests and contributions are. This task is difficult if taken on in isolation. A research-active supervisor should be familiar with the work of other groups in the field and be able to give advice that will help avoid needless duplication of work already underway elsewhere (or which has already been completed). As in all walks of life, modern science is competitive and it is important to know and appreciate what one's competitors are doing.

The first year is also the time in which the experimental work is initiated. Often this involves a painful period of false starts and setbacks, frequently for technical reasons. Modern molecular biology employs many techniques and these can sometimes prove to be difficult to master. However, there is an art to the successful employment of *any* technique (molecular or otherwise) and the student must acquire competence in these arts if useful data are to be obtained. The easiest course is to choose a research problem that can be solved using the existing technical and intellectual expertise of the supervisor's laboratory. However, if everyone took this approach, methodologies within individual labs would never advance. In order to make progress, it may be necessary to learn methods that are new to the lab. Here it is important for the student to take the initiative and to seek (with the help of the

supervisor) expert advice beyond the home lab, either elsewhere in the School, within the University or even further afield. Constantly repeating a procedure which is not delivering results is ultimately futile and is bad for your morale.

Within the first six months the student should become capable of describing the nature of the research problem, how it relates to the field, and what methods are to be used to address it. Some students may even be producing useful data at this point. Monitoring of progress is crucial in order to identify any problems at this early stage and your Thesis Committee is there to help with this.

### **3. The Second Year**

In Year Two, the bulk of a substantial part of the experimental work should be carried out. The first year is the time for the 'lag-phase' of the learning curve, when the pitfalls of the techniques are encountered and tricks-of-the-trade acquired. By Year Two, the foundation should be laid for a concentrated period of productive work. If the lag-phase extends into Year Two, something is probably going wrong. The project may have been too ambitious, the lab may not provide critical items of technical or intellectual support, the student may not be using the available resources well (perhaps by being too backward in seeking help), there may be difficulties with the supervisor-student relationship which hamper effective communication, the student may be unmotivated or have little aptitude for research.

If all is going well, Year Two should see the student gathering a substantial amount of the material for the results chapters of the thesis. These data must be scrutinised critically by student and supervisor and discussed with as many colleagues as possible. During postgraduate education, the student should develop strong critical faculties where scientific data of all kinds are concerned. This ability comes from engaging in discussion and debate with other professional scientists at every opportunity, both in informal settings (such as the coffee room) and more organised forum such as Departmental seminars, invited lectures by external speakers and journal club. Regular lab meetings provide an opportunity to discuss results and any technical difficulties with the other members of the group in the supervisor's presence. Students should aim to participate fully in these meetings - they should not simply be a means of bringing a busy supervisor 'up-to-date' with the development of the project.

If critical and analytical skills are not learnt at this period of the postgraduate experience, their absence will tell during the *viva voce* examination in which the student will be called upon to defend the thesis. An absence of these critical skills in reasoning and deduction will also hamper the student in later phases of life, such as during postdoctoral research. It is unlikely that such a person will make an independent and effective scientist, although they may be capable of being trained to carry out the directives of others. A PhD degree in Genetics or Microbiology from Trinity College should tell a potential employer immediately that the holder is both an independent thinker (i.e. a Doctor of Philosophy) and an effective experimentalist.

During this very busy second year, the student must not neglect developments elsewhere in the field, or in science in general. Keeping up with the literature is essential and requires self-discipline. The "Pubcrawler" website operated by the Genetics Department can be used to provide regular updates of the most recently published papers determined by your personal profile of key words used to search the National Library of Medicine database PubMed. The student should be encouraged to participate in scientific conferences by presenting a poster or a short lecture. Attendance at such meetings allows the student to meet and talk to a wider range of scientists and may help to give the student some ideas about future employment choices.

## **4. The Third Year**

Ideally, in Year Three, the experimental work should draw to a close and the writing of the thesis should begin. Writing always takes longer than many students imagine so it is important to get the task underway as early as possible. One of the worst situations to find oneself in is to have left the Department with the thesis unwritten. The demands of a new job, possibly in a foreign country (and perhaps with a new language to learn) will erode rapidly any spare energy which the student had hoped to devote to writing in the evenings. It is these of this type which run the risk of never being completed. There may also be a financial penalty to be paid for not finishing the thesis: most funding organisations refuse to pay 'postdocs' on a postdoctoral salary scale until they have submitted the thesis.

There may be differences of opinion between students and supervisors about when the bench work should stop. The student should remember that the PhD Thesis Committee members are available to help resolve these issues.

## **5. The Fourth Year**

University regulations have changed recently. A student can remain on the PhD register for no longer than four years. One extra month (*e.g.* the October following the third year or fourth year if a student registered in October) called "Dean's Grace" can be requested from the Dean of Graduate Studies in order to submit the thesis without financial penalty

Some funding agencies provide a stipend and fees for three years. However it is now recognized that it is often difficult to complete a PhD in this time. Indeed the Health Research Board is experimenting with a four year PhD programme in two institutes in Trinity College (Molecular Medicine and Neurosciences) involving coursework and lab rotations in the first year.

Many postgraduate students prefer to extend their stay in the department for another 6-12 months. It is often possible for the supervisor to provide support for this. There are limited funds available from the university to support some students in the fourth year. The extra time is beneficial because it often allows the student to bring projects to completion and to write and submit papers for publication. The thesis will undoubtedly be of a higher standard.

## **6. Finishing Off**

### **6.1 Preparing the thesis**

It is normal practice for the supervisor to read and comment on completed chapters of the thesis. Obviously, writing the thesis is the responsibility of the student and the supervisor may only give advice and guidance on the writing. Reading a thesis is often a demanding task and the student should negotiate with the supervisor to find times when it is mutually convenient for this to be done. It is unfair of the student to expect the supervisor to drop everything and read the thesis without prior notice. It is also unfair if, having agreed to undertake the job at a particular time, the supervisor then delays unreasonably the returning of the (read) thesis. Your Thesis Committee is there to assist you with problems of this type.

The student should make every effort to present the thesis free from errors in English (spelling mistakes, grammatical errors, poor syntax). These are completely avoidable and most external examiners are diligent in picking them out. Much correcting can be avoided by a simple process of rigorous proof reading.

The Graduate Studies Office will supply their latest rules and regulations about thesis format, print quality etc. Trinity College requires two bound copies of the thesis. One will eventually go to the College Library and one is kept in the Departmental Library. It is normal for the student to want to keep a copy too. Thus, the minimum number of copies is three. However, the supervisor should also be presented with a copy, not least as a way of saying ‘thank you’ for the supervision and support given.

## **6.2 Seminar to the Department**

Students are expected to present a research seminar to the department in their final year. Current practice is for the student to present a special lecture immediately before the *viva voce* examination in the presence of the internal and external examiners.

## **6.3 Examination of the Thesis**

Once the thesis has been submitted to the Graduate Studies Office, the supervisor is asked to nominate the external and internal examiners. The internal examiner is usually an academic staff member of Trinity College and the external examiner is from another institution, often a UK University or Research Institute. Scientists from other European countries are sometimes appointed as external examiners.

The Dean invites the examiners to accept the thesis for examination. Only when acceptance is received will the thesis be sent. It will normally take at least six weeks for the external examiner to read the thesis and for the *viva voce* examination to be arranged.

The thesis is judged under three categories.

- Does it contain adequate reference to the published work in the field?
- Does it contain original observations (i.e. not published previously) which are worthy of publication in the scientific literature?
- Is it presented in acceptable literary style?

The examiners judge the thesis in advance and then assess the candidate’s performance at the oral examination. They then make one of the following recommendations:

- (i) the degree be awarded for the thesis as it stands,
- (ii) the degree be awarded for the thesis subject to minor corrections, for which two months are allowed from the time of notification,
- (iii) the thesis be referred for major revision and subsequent re-examination, for which six months are normally allowed from the time of notification,
- (iv) a lower degree be awarded, if necessary following minor corrections to the thesis
- (v) the thesis be failed. When failure, referral of a thesis or the award of a lower degree is contemplated the candidate should be informed of this possibility in advance of the *viva voce*. A thesis may only be referred for major revision once: in other words, option (iii) above is not available to examiners on re-submission.

Further details of regulations and procedures can be found in the postgraduate studies supplement to the College Calendar

## **6.4 The viva voce examination**

Oral examinations are mandatory for PhD degrees. Most of the examination is conducted by the external examiner with some contributions from the internal examiner.

It is usual practice in the School of Genetics and Microbiology that the PhD candidate will present his research in the form of a public seminar (usually ~45 minutes) as part of the examination. The internal and external examiners will be present, but will not ask questions during or after the seminar. The seminar will be followed by the *viva voce* with the external and internal examiners. External examiners decide on the format of the examination. It is usual for the majority of time to be spent on the subject of the thesis. However, other, more general matters may also be covered. Topics that will certainly be discussed include:

- The rationale of the project
- The methods used: their advantages, limitations etc.
- The presentation and interpretation of the results. Are the conclusions drawn reasonable and accurate, are other interpretations possible?
- The relationship of the work to the field.

General matters of scientific interest may also be raised. For example, the candidate may be asked:

- questions about recent advances in microbiology/genetics, molecular biology etc.
- to speculate on the identity of future Nobel Prize winners in Medicine or Physiology.
- for opinions on well-published controversies in science (such as the release of genetically-engineered microorganisms in the environment, or how best to combat the problem of scientific fraud).

and other issues which probe the candidate's knowledge of the wider reaches of biology.

Students who have grown used to analysing and criticising data during their postgraduate career by debating with other scientists in lab meetings, seminars, journal club or conferences will be best prepared for the tests inherent in the oral examination. They will already have training in 'thinking on their feet' and have rehearsed many of the answers to the questions the examiners will raise about their work. In addition, one should never forget that no one else (including the supervisor) knows the subject of the thesis as intimately as the student.

The examiners reach a decision in closed session after the end of the examination. The student is then informed of the result. Formal notification requires the approval of the University Council. The Dean of Graduate studies will submit the recommendation to council once written reports from the examiners have been received and the student has submitted bound copies to the Graduate Studies Office.



## **7. Other matters**

### **7.1 Publication**

It is wise to discuss with the supervisor the probability of publishing as much material as possible from the thesis in good quality journals. The student should have learnt quickly that not all scientific journals are equal and the higher the impact factor of the journal in which the work appears, the better for the student's career (and that of the supervisor!). Publishing two or three papers from a thesis in good peer-reviewed journals is indicative of a successful project. If the papers are accepted for publication before the thesis is examined, the criteria of originality and publication-worthiness of the thesis material are largely met.

### **7.2 Seminars**

The School puts on a seminar programme and postgraduate students are expected to attend these lectures. Students should note that other departments in College also run seminars which are of interest to members of our School. Direct relevance to one's research topic should never be the only factor influencing attendance at a scientific lecture. Often, useful ideas can come from talks on topics which are quite far removed from the student's area of immediate interest.

### **7.3. Scientific societies and conferences**

For microbiology students working in Ireland, the Society for General Microbiology remains the most relevant scientific society (although with the erosion of traditional barriers between the branches of biology, other societies offer good value for their membership fee). Student (associate) membership of the SGM currently costs Stg£25 per annum and offers valuable rewards, including grants to attend and present a paper at society meetings. The SGM also provides small grants to assist postgraduate student members to attend other conferences. Students should discuss with their supervisor the possibility of presenting some work at a conference and should aim to attend at least one national and one overseas conference during the period of postgraduate studies.

### **7.4 Demonstrating and supervision**

Postgraduate students may be REQUIRED to act as demonstrators in undergraduate laboratory practical classes held in the School and in the Biology Teaching Laboratory. Without the assistance of postgraduate demonstrators undergraduate practical teaching would not be possible. Also, to learn how to be an instructor is an important part of a postgraduate student's training. The maximum amount of time should not exceed 6 hours per week – more than this would be too disruptive to the students' research.

Supervising a final year undergraduate student's research project and/or a visiting student also provides an invaluable experience. A postgraduate student might be asked to help supervise a project when they are in the second or third year of their postgraduate career.

## **7.5 The roles and responsibilities of students and supervisors**

The supervisor's role is as an academic guide and mentor. In the ideal situation, a strong working relationship will develop between supervisor and student that will extend beyond the PhD study period and be a lasting career benefit. Such a relationship must be based on mutual respect and generating it will require significant effort by both parties. Regular communication is the essential ingredient to developing a strong working relationship - grievances should not be allowed to fester. Problem issues should be brought **explicitly** to the attention of the other party – do not assume the other party is aware that a problem exists. Together, the supervisor and student should work to achieve the academic and intellectual independence of the student. The supervisor's role is most important at the beginning of a PhD when the project is being formulated and the student is learning new techniques. As the work progresses the student should become more independent and should not rely on the supervisor for detailed instructions as to what to do. However it is important to recognize that supervisors have substantial research experience in the field and students should be continually cognisant of their guidance in mastering the many skills that are required to achieve a PhD, including: the choice of scientific problem, experimental design, technical approaches, scientific best practice, critical evaluation of data, critical evaluation of the literature, data presentation, career planning and many other issues. Your supervisor should also play a major role in helping you to track the progress of your work and how to develop good project management skills.

Students should make themselves familiar with the document on good research practice and supervision guidelines available from the Graduate Studies Office webpage: [https://www.tcd.ie/Graduate\\_Studies/currentstudents/supervision](https://www.tcd.ie/Graduate_Studies/currentstudents/supervision)

In summary:

A student can expect their supervisor to:

- meet with them at mutually convenient times on a regular basis
- advise on experimental or research strategies
- assist in interpretation of data and results
- work with the student to prepare work for publication

A supervisor can expect a student to:

- conduct their work with integrity and diligence
- diligently avoid plagiarism and all other forms of academic misconduct
- keep a detailed lab notebook
- report the status of their work at regular lab meetings
- write the first draft of manuscripts arising from the student's work
- prepare and deliver seminars within the School as well as at international conferences
- communicate any difficulties to the supervisor as soon as they arise

## 7.6 Grievance resolution

If a problem arises the best solution is resolution with the supervisor directly – thus, good communication and mutual respect between supervisor and student is essential. In the event that the problem cannot be resolved in this way, then it is recommended that the problem be addressed through discussion with the following people, preferably *in this order*:

Members of the thesis committee.

Director of postgraduate teaching and learning.

Head of Discipline.

If the problem remains unresolved, the student should contact the Head of School for advice. All discussions will be held *in the strictest confidence*.

College also provides a Postgraduate Advisory Service and students may refer to this service for advice and assistance. However we ***strongly recommend*** that a resolution is sought within the School before seeking external assistance.

## 7.7 The structured PhD programme

The following statements summarize the university's new regulations governing the structured PhD

“All new entrants to the research register are considered to be on a structured PhD programme.

Students can avail of skills training and advanced disciplinary modules during the course of their degree, up to 30 ECTS in the first 18 months prior to confirmation or transfer.

The degree of structure varies between, or even within, schools. By devolving the design and management of programmes to the schools, while offering guidance and stability from the centre, we aim to achieve the ideal balance between structure and flexibility.”

The following structured elements are available within the school and university:

1. Innovation Academy Courses:

[http://www.tcd.ie/Graduate\\_Studies/InnovationAcademy/index.php](http://www.tcd.ie/Graduate_Studies/InnovationAcademy/index.php)

Postgraduate training in this School provides all of the benefits of a formal structured PhD programme

1. Thesis committee meetings
2. Students have several opportunities to give oral presentations. Apart from informal presentations during lab meetings students give formal public presentations at 6 months, at the time of transfer/confirmation and as a prelude to the *viva voce* examination.

3. Students get training in writing short reports and a 25 page interim project report prior to writing the PhD thesis. Most students will have collaborated with their supervisor in writing at least one paper for a peer-reviewed journal.
4. Analysis of scientific papers. Each research group has a “journal club” where 3-4 times a year a student will present a critical evaluation of a current paper.
5. Seminars. The School supports a vibrant weekly seminar programme with external speakers. Postgraduate students are expected to attend all seminars.
6. Courses. Postgraduate students are encouraged to register for the Diploma in Statistics. The optional courses offered to final year undergraduate students are advanced tutorial-type courses. They are open to postgraduate students. Each course is 10 contact hours and involves advance preparation to read the paper(s) to be reviewed/discussed. Postgraduate students are also encouraged to register for appropriate Innovation Academy courses  
[http://www.tcd.ie/Graduate\\_Studies/InnovationAcademy/](http://www.tcd.ie/Graduate_Studies/InnovationAcademy/)
7. The Society for General Microbiology. If appropriate to their discipline/subject students are strongly advised to join the Society and to participate in its conferences in the UK and Ireland.
8. Teaching. Postgraduate students develop teaching skills by acting as demonstrators in undergraduate practicals and in supervising projects (undergraduate, summer students).