

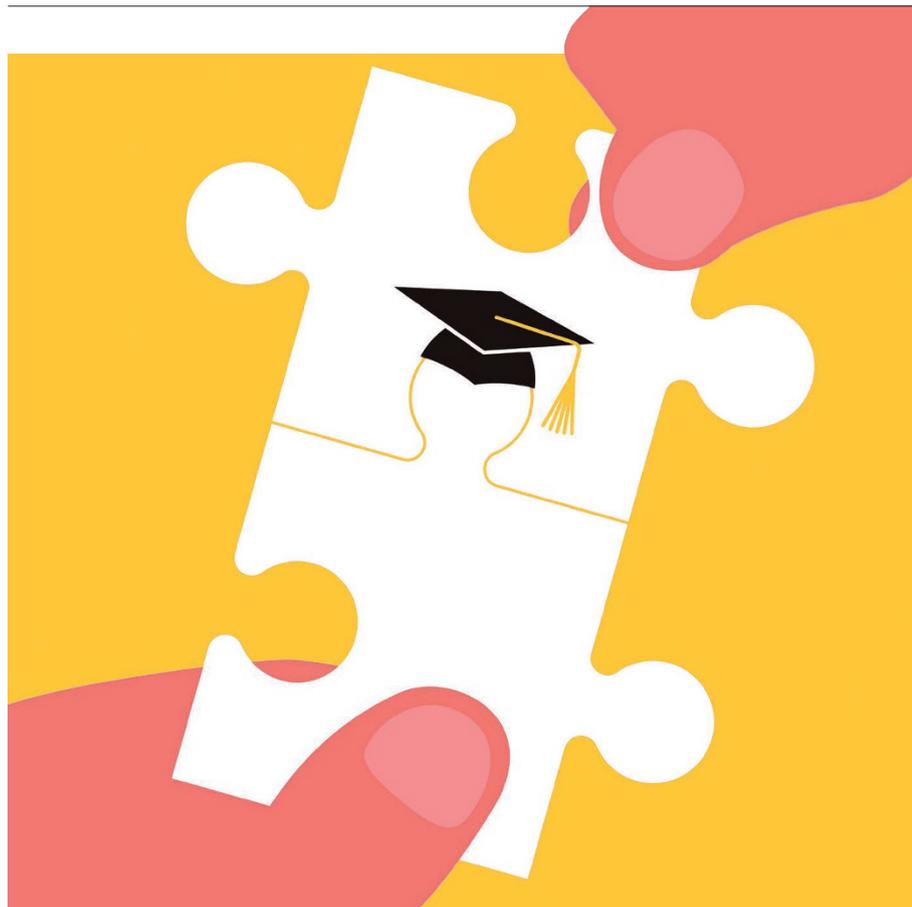
CAREERS

GENDER Fear of bias pushes women from STEM fields **p.129**

DRUGMAKERS Research jobs cut in the United Kingdom **p.129**

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POSTGRADUATE STUDIES

Find the best fit

Choices for doctoral programmes can seem endless, so look for one that matches your interests and personality.

BY KENDALL POWELL

There's much to consider when you're trying to choose the university and programme for your science PhD. But the main reason for your selection must be that it suits you — not that you don't know what else to do, not the institution's or department's reputation, not that a star researcher in your field is a faculty member there. Getting a PhD is hard enough, says Bruce Horazdovsky, associate dean for the Mayo Graduate School in Rochester, Minnesota. You don't want to make it harder by being

“miserable while you're doing it”, he says. “You have to be engaged and like what you are doing. The best programme in the country is the one that best fits you.”

How do you find that best fit? Prospective doctoral students will need to consider several factors and compare programmes and schools. Deciding which universities to apply to means identifying programmes that match your research interests and personality. You will need to evaluate how the school approaches career and professional development for its graduate students, and how its alumni fare after achieving their PhDs.

Ultimately, the school you select will be the launch pad for your scientific career.

Before you look at schools, you should have a clear idea of your chosen subfield of study. “Even at this stage, students ought to be thinking about what sort of specialization they want to do,” says David Bogle, pro-vice-provost of the doctoral school at University College London. He notes that a physics programme, for instance, could be great for astrophysics and string-theory research but offer nothing on materials science.

Although it's not necessary to narrow down fields too specifically, it is imperative to find a programme that has at least several faculty members who are doing research that excites you, says Bogle, who chairs the League of European Research Universities' doctoral studies community in Leuven, Belgium. He advises students to look, not for a single high-profile researcher, but rather for a strong research environment with several professors working in similar areas.

To get started, applicants can generally find descriptions of a school's research programmes and faculty members on the institution's website. Sometimes, more information is available: the European School of Molecular Medicine (SEMM), a graduate programme shared between two universities and three research centres in Milan and Naples, Italy, publishes an annual list of faculty members who are taking new students in the coming year. Other institutions may publish similar material.

Group websites can also give applicants a feel for the size and culture of a laboratory. Look for photos of lab outings or celebrations, for announcements of student achievements and publications, and for other evidence that graduate students drive much of the research in the group. Applicants should also look up a lab group's latest research publications to get an idea of its members' current interests and to see how well and how often students in the lab are publishing papers. “If the publications coming out of a lab are numerous and high quality, you can be pretty sure that you will get published by the end of your PhD” — which is essential for success after graduation, says Francesca Fiore, coordinator of the SEMM graduate office in Milan.

Applicants should also seek advice and guidance from their undergraduate or master's advisers to generate a shortlist of potential programmes. “Come talk to me,” says Andreas Berlind, an astrophysicist at Vanderbilt ▶

► University in Nashville, Tennessee. “Let me help you make that initial list — it will save you a lot of time.” Advisers, he says, have enough deep knowledge of their field and its subfields to know which programmes tie in with the subjects a student is passionate about; they should also know where other researchers in that subfield are doing good work. For extra connections with the research world, applicants should try to attend large scientific conferences in their subfield; these often have travel fellowships so that undergraduates can attend.

Students should also check online resources such as the US National Research Mentoring Network (nrmnet.net) and Facebook sites such as Equity Einstein, a group dedicated to making physics and astronomy more inclusive. Such resources will help students to connect with established researchers who can offer advice on training. They should also contact current graduate students in their subfield to learn about programmes’ reputations. Applicants should not be shy about doing this, says Berling, who is also Vanderbilt’s director of graduate studies in astrophysics. It is the best way to get honest answers about the culture and atmosphere in a programme, he adds (see ‘The value of hindsight’). Fiore also encourages correspondence with current students, especially for applicants who are pondering studying abroad. “Find someone from your home country,” if possible, she says, so that you can discuss their experience in your native language.

Prospective students should never pin their hopes on working with one particular professor, because that person may not be taking students, may move away or might

be a terrible fit as a mentor. If several faculty members are working in a similar area, the student has a better chance of landing a spot in one of those labs. Identify and contact at least two researchers, and ideally more, whom you’d like to do a PhD with, counsels Pamela McLean, director of neurobiology at Mayo Graduate School in Jacksonville, Florida. When you e-mail them, you can let them know of your interest in their work and find out whether they are taking on doctoral students in the next year. “A lot of times it will also strengthen your application,” she says. “Those names are often forwarded to admissions directors, and someone who has taken the initiative gets bonus points.”

SHOW ME THE DATA

More programmes are publishing data on their websites about their graduate students, including the average time taken to achieve a PhD. Students should pay particular attention to this: anything much more than five years for US programmes or three for UK programmes can indicate that students are languishing in labs as labourers. Some institutions provide data on their graduates’ career choices — the University of California, San Francisco, posts outcome data for most of its graduate-division programmes (go.nature.com/2dnyy89). It’s unusual for these data to be long-term enough to give a realistic picture of what all PhD holders are doing ten years after earning their degree, but it is still useful to scan such listings to see if doctoral graduates are ending up in careers that applicants consider desirable. “If they’re not there, that’s a bad sign that the department doesn’t see it as a priority to advertise

how well students are doing,” says Berling.

Applicants should also determine whether they want to work on fundamental questions or do applied research. Students interested in the latter should seek programmes with strong ties to high-tech companies, the aerospace industry or hospitals, if their passion lies in those areas. For example, the Mayo Graduate School is spread across three large medical campuses in Minnesota, Florida and Arizona.

Students should also give some thought to the overall structure and organization of graduate programmes; these can be small and based in single departments or wide-ranging and interdisciplinary. Umbrella programmes (sometimes called structured programmes in the United Kingdom) pull in faculty members across several departments or campuses. These are in contrast to more conventional, single-department programmes, and in many cases they offer numerous labs and more options for cross-disciplinary studies. But what they make up for in quantity, they may lose in the quality of training or mentoring. Departmental programmes often produce more close-knit communities, with seminars, journal clubs or other events geared specifically to their graduate students.

Another structure is the bridge programme, which offers US students the chance to apply to a master’s programme that filters directly into a PhD programme on the same or a nearby campus. (The master’s-to-PhD route is common in the United Kingdom.) Such programmes are often a sound choice for those who feel that they need more preparation for doctoral studies. LaNell Williams, a second-year biophysics student, found that the Fisk–Vanderbilt Bridge Program run by Fisk and Vanderbilt universities

THE VALUE OF HINDSIGHT

What didn’t work for graduate-school applicants

PhD students who applied to programmes in the past several years share the wisdom and insights they’ve acquired from their own experiences, and offer words of warning.

Joseph Rodriguez, a postdoc at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, warns students to be aware of the specialized, standardized tests required for admission to certain programmes — and to prepare for them well in advance. He signed up at the last minute to take the physics Graduate Record Examination (required for most US physics PhD programmes), scored poorly and wound up in a programme in which no one was working on extrasolar planets, his research interest. After treading water for many months, he transferred to Vanderbilt University, all of which cost valuable time.

Priyanka Kothari, a third-year PhD student

in biochemistry, cellular and molecular biology at Johns Hopkins University in Baltimore, Maryland, counsels applicants to keep a close eye on their prospective department’s culture and make-up when they are on campus. During an interview visit at one university, she noticed graduate students introducing themselves to one another — a clear warning that the department had not fostered a sense of community and mutual support. “I want to do great science, but I also want a relationship with other faculty members and other students in the department,” says Kothari. “That networking is so critical for becoming the best scientist.” She was dismayed during another interview when she noticed that the programme’s faculty members were mostly white men. “Either the department doesn’t care enough to change

that or it doesn’t see it — both of which are red flags,” she says.

Allatah Mekile, a second-year PhD student at Johns Hopkins University in Baltimore, Maryland, says that location played a part in her decision as she weighed up whether she would feel comfortable living near the university. Considerations included how far she’d have to travel to get groceries, whether she’d feel safe leaving campus late at night and whether she could easily bring her car with her.

Rodriguez explains why students should think carefully when choosing programmes. “Graduate school is not just 5–6 years, but also working 50–60 hours per week and taking the hardest courses you’ve ever taken in your life,” he says. “You’re going to burn yourself out if you don’t really like what you are doing.” **K.P.**

GENDER BALANCE

Culture clash

Scientific disciplines that have a 'masculine culture' tend to deter women from pursuing those fields, a study finds (S. Cheryan *et al. Psychol. Bull.* <http://dx.doi.org/10.1037/bul0000052>; 2016). The study analysed 1,200 publications looking at women's participation in science, technology, engineering and mathematics to learn why women are well represented in biology but not in physics, computer science and engineering. The authors found that the presence of negative stereotypes about women's abilities and the lack of female role models were major factors in deterring women. But they also found that women who feared gender bias and discrimination might be more likely to avoid certain fields. Predictors of decreased participation included a lack of pre-university experience in the field and a lack of confidence. The low numbers are also linked more to a failure to recruit female students into the fields than in retaining them, suggest the authors. Creating a more inclusive culture is the best way to boost female participation, the authors say.

BIG PHARMA

UK drugs outsourced

Biopharmaceutical companies in the United Kingdom have cut research positions in drug discovery, according to a report released by the Association of the British Pharmaceutical Industry on 17 October, entitled *The Changing UK Drug Discovery Landscape*. In the past decade, almost all large UK drugmakers slashed in-house research jobs in discovery, the earliest stage of drug development, when researchers usually test hundreds of thousands of compounds to find one that could move into the next stage. Overall, there has been a net loss of several hundred positions. At the same time, however, large companies have increased their investment in drug discovery through outsourcing and collaborations. A number of UK contract research organizations (CROs) reported growth in partnerships with academic drug-discovery centres. Some CROs reported more drug-discovery employees, and about one-quarter of those reported staff increases of more than 25%. Yet some of the rise in CRO research jobs is also due to an increase in the number of contracts made with companies outside the United Kingdom, particularly in North America and the European Union, the report says. The UK biopharmaceutical industry employs more than 70,000 people.



The Fisk–Vanderbilt Bridge Program links up students and mentors.

FISK UNIV. in Nashville, Tennessee, let her meet up with other students who were from groups that are under-represented in science. In contrast to her experience as the only woman of colour in her undergraduate physics studies, Williams says that after a year in the Fisk–Vanderbilt programme, she feels comfortable and has formed a community with fellow students. “I have been able to thrive,” she says, “and see myself as a physicist.”

The doctoral application process is not too early to think about ultimate career goals, says Horazdovsky. “Those can change,” he says. “However, you need to make sure you will have tools or experiences to achieve your goal by the end of graduate school.” For example, students who think they want to work at a mainly undergraduate institution will want significant teaching experience. Students who aim for industry will need exposure to business, companies and the jobs that PhD holders occupy. Students should also find out whether their programme of choice hosts, or at least encourages students to attend, conferences and workshops that help them to build teaching, networking and communications skills.

Many programmes include career-development components that give students real-world exposure to career tracks. These can be extremely helpful for students who are not aiming for an academic research position and can include university internships, external internships and other options.

TRUE GRIT

Students at the application stage need to stand out from the crowd to get accepted by their school of choice. David Charbonneau, director of graduate admissions for Harvard University's department of astronomy in Cambridge, Massachusetts, looks for students who have persevered in the face of obstacles. “Most of what we do in science leads to dead ends,” he says. He seeks students who are passionate and hard-working, and who have demonstrated new ways of tackling

problems — for example, by working through solutions to an ambitious research problem for several years. These attributes should come across through concrete examples in their letters of recommendation, he says. McLean says applicants should personalize their application statements by including a paragraph explaining which faculty members within a programme they would like to work with, and why.

If prospective PhD students are unsure whether graduate school is the right decision, they should take a year or two to work as a research assistant in an academic or industry lab before making the hefty commitment to doctoral studies. Taking that time is no longer viewed as a negative, says McLean, but instead shows that applicants have realistic expectations and are aware of what's ahead. Allatah Mekile was uncertain of her next steps after finishing college at East Stroudsburg University of Pennsylvania, so she moved home and took an entry-level position as a research associate at a supplier of nutritional products. There, she worked for two years on a metabolic-engineering project before applying to graduate programmes; she is now a second-year doctoral student in biochemistry, cellular and molecular biology at Johns Hopkins University in Baltimore, Maryland. She says that her experience in industry also helped her to explain in her application letter why and how certain programmes aligned with her career goals.

By eschewing the conventional path of going immediately into a doctoral programme after earning a bachelor's degree, and gambling that she'd be better prepared, Mekile showed that she was ready for graduate studies, says Bogle. “The whole point of going to graduate school is to take a bit of a risk. If you want to play it safe all the way through, then maybe graduate school — or research — isn't for you.” ■

Kendall Powell is a freelance science journalist based in Lafayette, Colorado.