
CONTRIBUTIONS

Advice on Applying to Graduate School in Ecology and Evolutionary Biology: How to Prepare and a Step-By-Step Guide

Walter P. Carson, Sara E. Kuebbing, Tiffany L. Betras, Amoi S. Campbell, Eden W. McQueen, Cheyenne L. Moore, Castilleja F. Olmsted, Laurel B. Roberts, and NyJae N. Washington
Department of Biological Sciences, University of Pittsburgh, A234 Langley Hall, 4249 5th Avenue, Pittsburgh, Pennsylvania 15260 USA

We provide an introduction to the process of applying to graduate school in ecology and evolutionary biology with information on how to prepare for graduate school, how to choose a program, how to gain admission, and how to find and select an advisor. We provide a basic step-by-step guide for the application process and for the prelude to that process. This is a much revised and updated version (Carson 1999) containing additional information on parenting during graduate school and information for underrepresented groups in ecology and evolutionary biology and first-generation college students. We hope that this guide will help students, and others get started down the right track and help them to ask more refined questions of their mentors about the whole application process. This guide applies primarily to graduate programs in ecology, evolution, and behavior, as well as other areas of organismal biology, particularly those where the prospective student will be directly admitted into a specific professor's laboratory. It may also be useful for those applying to graduate programs in other subfields of biology such as molecular, cellular, or developmental biology. In general, students should understand at the outset that applying to graduate school in these disciplines is much different than applying to undergraduate programs or applying to professional graduate degree programs such as medical or law school. Graduate schools will often use some combination of up to five primary criteria or metrics to evaluate applicants: these are grades, your scores on the Graduate Record Exam (GRE), your research experience, your letters of recommendations, and your personal statement or essay. We discuss each of these below.

Carson, W. P., S. E. Kuebbing, T. L. Betras, A. S. Campbell, E. W. McQueen, C. L. Moore, C. F. Olmsted, L. B. Roberts, and N. N. Washington. 2021. Advice on Applying to Graduate School in Ecology and Evolutionary Biology: How to Prepare and a Step-By-Step Guide. *Bull Ecol Soc Am* 00(00):e01917. <https://doi.org/10.1002/bes2.1917>

While it is never too early to start thinking about graduate school, before applying, you should be pretty confident that graduate school and research are right for you. It can be a long haul (typically 5–6 years for a Ph.D.), and a serious commitment is required for success. If you are not certain, or if you feel “burned out” from school, take a year or two off, gain some additional research experience through postbaccalaureate research programs, seasonal fieldwork, laboratory technician positions, or get a job and bank some money, and then carefully consider postgraduate education. Delaying entry into graduate school will rarely hurt your chances of admission later and will improve them if you garner relevant research or life experience. Perhaps more importantly, it may reinforce your decision that graduate school is the right place for you.

Prelude I: Grades and the Graduate Record Exam (GRE)

The use of the GRE by universities is waning, at least partly because of the mounting evidence that the examination only weakly predicts student success (Moneta-Koehler et al. 2017, Peterson et al. 2018) and often fails to predict the success of students, particularly minority students (Miller et al. 2019). Whether the GRE is required can vary by departments even within institutions, check to be sure. Although your grade point average (GPA) and your GRE scores are not always good predictors of success in graduate school, universities will use these metrics as one way to compare and evaluate applicants. Here is some advice:

Try to graduate with at least a 3.0 GPA

Many graduate schools have a 3.0 as a standard cutoff and the most competitive programs will look for GPAs that are much higher. However, if you have a low GPA, do not lose hope because there are a few things you can do. For example, make it clear in your personal statement (see Applying) if your grades improved steadily over time. Some programs will emphasize your GPA in the last two years of your degree program, or within your major; if your GPA is higher in these respects, emphasize this in your application. Also, if you had a semester or year when your GPA plunged relative to other years, explain why this may have occurred in your personal statement. These reasons, however, should be compelling and may include illness, caregiving, holding down a part-time job, or participation in scholarship athletics, but only you can provide relevant context for your GPA to an admission’s committee.

Try to score well on the GRE

The GRE attempts to evaluate your quantitative, verbal, and analytical abilities. While the use of the GRE as a performance metric is declining, if you score well (~75 percentile or above), this can make up for a low GPA. Thus, even if an institution does not require GRE scores, if you do well, you can still pass on the scores when applying or contacting a prospective advisor (see Selecting a potential advisor). A high score on the GRE can make up for a low GPA (or vice versa). If you decide to take the GRE, you should consult one of the many available preparation and study guides. Educational Testing Services, which administers the GRE, has low-cost tools to help you, including two free practice examinations (https://www.ets.org/gre/revisted_general/prepare/). Practice taking the test under the actual conditions of the examination until you feel comfortable with the format and length of the test. In addition, see if your undergraduate institution offers free help and instruction through the library or career services center. Students can also request disability or health-related accommodations from Educational Testing

Services (https://www.ets.org/gre/revised_general/register/disabilities). Note that some universities may require that you also take the GRE Biology Subject Exam. Regardless of all of this, we predict, and welcome, a continued decline in the use of GRE scores as a metric to vet applicants. One way to avoid the stress and cost associated with taking the GRE is to avoid applying to those places that still require it.

Hang in there

There are many outstanding master's programs out there. Thus, if your grades or GRE scores or both are relatively low, but your ultimate goal is a Ph.D., do not despair. Consider trying to find a master's program (see Should you do a master's degree first?) that emphasizes research, where your chance for admission might be higher. In a master's program, you can conduct interesting research and produce publications in peer-reviewed journals derived from that research. Along with enthusiastic letters of recommendation, this effort can more than make up for a modest GPA.

Prelude 2: Gaining Experience

Start doing or participating in actual scientific research early

Know that classes are only one part of your education. You should begin to obtain real hands-on research experience as early as your first year as an undergraduate. *Research is the most important thing you can do to prepare yourself for graduate school.* This is because it will teach you not only how to conduct research, but also whether you like research, and if so, what areas of research you enjoy the most. You can gain research experience working with professors, graduate students, and with scientists at nearby natural history museums, zoos, or botanical gardens. The vast majority of scientists have personal web pages or information about their research programs on their departmental website. On these sites, you can learn much about the professor, their graduate students, their research, and their scientific publications. There are a variety of ways to gain research experience including volunteering to help, working as a paid assistant, signing up for research credit, conducting independent research, or doing an independent study (library project that will require reading in the primary journal literature). Graduate students almost always need help with their research, and they are often short of funds, so seek them out if you are willing to volunteer time; they will be grateful, and you will learn a lot. Unfortunately, many undergraduate research opportunities are unpaid, which is inequitable because students who cannot afford to work without pay will have a harder time gaining research experience than their peers who have the financial support to volunteer their time (Fournier and Bond 2015). Students who seek research experience but cannot afford to volunteer may be able to apply for federal work-study funds to work in research laboratories or look for funding through university undergraduate research offices.

There are also opportunities for undergraduates at universities across the United States and at field stations that offer well-paid summer immersion programs in research. Many of these are funded by the U.S. National Science Foundation (NSF), but others are funded separately by the host institution. If your university has an Office of Undergraduate Research, they also likely offer grants or fellowships to promote research or have additional information on how to find and apply for paid undergraduate research opportunities. These opportunities are a terrific way to get paid to do research. If you are unsure about how to begin the process of selecting an undergraduate research mentor or applying to an

undergraduate research program, McGill et al. (2021) have produced a useful guide. A current listing of NSF funded Research Experience for Undergraduates can be found at https://www.nsf.gov/crssprgm/reu/list_result.jsp?unitid=5047. There are other resources for finding opportunities to conduct research. Texas A&M has a fairly comprehensive Job Board in ecology and wildlife biology (<https://wfscjobs.tamu.edu/job-board/>) as does the Ecological Society of America (<https://www.esa.org/nextgencareers/resources/job-sites>).

Participate in a scientific meeting

After gaining experience by one of the above means, try to attend a scientific conference or research fair, and if possible, give an oral presentation or poster on your research. Presentations are short talks (12–15 minutes) on your research, while a poster displays your research with text and figures. Conferences can also be a great place to meet and visit with potential advisors or graduate students at institutions where you are considering applying for graduate school. Conferences also frequently have professional development workshops and panels that you could attend to learn about future career options, how to develop a CV, and even how to apply to graduate school. However, to make the most of a conference, you may want to reach out to schedule times to meet with scientists prior to the start of the meeting. Most meetings publish their conference programs online where they list those who are presenting. Many universities have research fairs specifically designed to allow undergraduates to present their work, although graduate admission's committees weigh regional or national meeting participation more highly than research fairs at your home institution. Larger national meetings occur in most years and are hosted by scientific organizations such as the Society for the Study of Evolution (SSE) and the Ecological Society of America (ESA). Ask graduate students and professors for advice on attending meetings and work with your research mentors to polish your presentation or poster. A growing number of scientific societies offer funding for undergraduates to attend meetings; these include ESA's SEEDS program (Strategies for Education in Ecology, Diversity, and Sustainability) and funding offered by SSE (<http://evolutionsociety.org/content/society-awards-and-prizes/travel-awards.html>). These societies, and others, often have dedicated travel awards to promote participation by underrepresented groups. Sometimes universities or individual scientists will have funds to defray the cost of attending a meeting. See if your institution has an Office for Undergraduate Research, which may provide travel funds. Even if you do not have independent research to present, you should still try to attend a conference or research fair. These gatherings will give you a glimpse of the diverse array of research that is out there, give you a chance to meet prospective advisors, and probably convince you that you can do interesting science.

Publish a scientific paper

This could result from your independent research, a project you began in a class, or an independent library project; it will require the help of a professor, postdoctoral researcher, or graduate student. Do not think that this is beyond your ability but know that it will require dedication and perseverance. It is essential to plan ahead, because getting the research to a publishable level will be more time-consuming than you expect. Nothing impresses a prospective advisor or graduate school like a publication in a refereed scientific journal! This will no doubt help you get into a top program or is an excellent way to get past a modest GPA. If you are working on a publication, but it is still in the works after your application was due, make this clear when you apply. Finally, some applicants have earned co-

authorship on publications; this also demonstrates commitment and achievement. And of course, many applicants are not authors on papers, and this does not preclude you from gaining entry to an excellent graduate program. The research experience itself will have been essential to prepare you for graduate school.

Find a mentor and get to know your professors

A mentor is someone you can talk to about careers in science, ask for guidance, request letters of recommendation, and someone you can keep in touch with throughout your journey in academics or subsequent career. The earlier you find a mentor or even multiple mentors the better; however, there is no deadline. If you are a first-generation student, this is a great way to start researching possible career pathways with someone who has already navigated them. Your mentor does not necessarily have to be a professor, but could also be a graduate student, a postdoctoral researcher, or someone from the advising office. The most important thing you want in a mentor is someone who you feel comfortable meeting with and talking about your professional goals.

It is important to know that recommendations that only include your performance in class will be considerably less influential than recommendations that evaluate your performance outside of class conducting independent research or completing an independent study. Recommendations are extremely important. Your professors are likely to be friends or colleagues of the professors that you are applying to work with. Potential graduate advisors will often trust the recommendation of a close colleague or scientific peer more than a GPA or GRE score.

Participate in departmental activities

Participation in departmental events will contribute to immersing you into the culture of science. Examples of departmental organizations include biology or ecology clubs. Consider taking on a leadership role (e.g., president) or starting a relevant science club if one does not exist; doing this can help you learn important leadership and organizational skills. Perhaps most importantly, if your department has a weekly seminar series or journal club or both, make time to attend at least some of these gatherings. A journal club is an informal weekly meeting of scientists to discuss recent scientific papers. Seminars are hour-long presentations on current research by scientists from both within the institution, and more often, by those outside the department or university. Undergraduates are almost always welcome at these events; however, you may need special permission to attend a journal club. Just ask a grad student or professor to be sure. It is certainly possible that you could meet a future advisor (see Selecting a potential advisor) at one of these events.

Enroll in graduate-level courses or seminars

Graduate-level courses provide a window into the graduate school experience. They can expose you to the flavor and tone of graduate school and will allow you to interact on a regular basis with graduate students. Do not think these courses will be over your head; often, they are no more difficult than undergraduate classes. Primarily undergraduate institutions may not offer graduate courses; if so, talk with your professors about acquiring skills that will help you prepare for graduate school, such as analyzing data in R, learning ArcGIS, or reading and discussing scientific papers with a

group. Consider organizing a group of students with similar goals to work on these activities together, and at some colleges, you can register these groups as student-led courses for credit.

Applying

Should you do a master's degree first?

Graduate students at research universities typically plunge right into a Ph.D. program. Consider completing a master's degree if you are unsure whether you want to commit to a lengthy Ph.D. program, if you are really unclear about your research interests, or if you are not sure that research is definitely for you. You will get additional experience and will be able to choose a Ph.D. program with much greater insight and clarity. Alternatively, there are often opportunities to become a full-time paid research technician where you can acquire important research experience (see the Job Boards mentioned above).

Application deadlines and help with applying

Start the application process well before applications are due, which is typically from early December to early February for programs that begin the following Fall. A spreadsheet might be helpful with entries such as application deadlines, whether the GRE is required, whether there are internal fellowship opportunities at the institution, and whether there is an application fee. Note that only a small number of programs accept graduate students in the middle of the year; thus, it is a once-a-year process! You should ask your mentors to help with your application. Your university's career center may also be helpful in helping you find fellowships, connect you to alumni who have pursued graduate school, and write your application statements. There are also experienced mentors from around the country that are willing to help anyone with the application process; we encourage you to seek out this help (see <https://dynamicceology.wordpress.com/2018/08/21/call-for-mentors-and-mentees-for-eebmentormatch/>).

Recommendations

You will need to secure at least three letters of recommendation for your application. These recommendations should come primarily from faculty, but one may also come from a senior graduate student or job supervisor. Choose people who know your abilities well. It is fine to email professors to request a letter of recommendation and to ask them if they are willing to write you a positive letter. Attach your résumé and offer to provide the professor a list of bullet points that highlight your accomplishments that might not be obvious on your résumé. These could include fluency in a second language, how you overcame significant hardships, lead guitarist in a rock band, or anything else that would help the professor compose a more compelling letter. Make sure you give the professor at least a three-week window, if not more, to submit your letter on time. Most programs will have you provide the email address of each person who has agreed to provide a letter of support. These programs will often automatically send emails to those faculty requesting that they submit a letter by a specific date. Faculty can be notoriously bad about getting recommendations in on time. It is your job to ensure that individuals who are writing your recommendations actually send them in. *Double-check* this and if the letters have not arrived by close to the due date, contact the faculty member and request politely that they send the letter ASAP.

Choosing an area of research

Identify the general area of research you would like to pursue. It should be more specific than just ecology or plant ecology, but it should not be so narrow as to exclude relevant options. Seek advice from your mentors. Although it may be difficult, it is important to try to narrow your interests. This underscores the benefit of gaining exposure to different research areas as an undergraduate so that you can *begin* to narrow your interests. One way to gain further insight is to explore job opportunities in research after you graduate but before starting grad school. This may help you hone in on an area of research that you really enjoy (see the job boards mentioned above).

Selecting a department and institution

Select a range of institutions from major research universities to smaller Ph.D. granting institutions. You should choose at least one university where you are fairly certain of being admitted. It is sometimes the case that large research universities may be less likely to accept master's students, or that these applicants are given lower priority or less funding than students applying to doctoral programs. This varies by department and discipline, so do your research or ask to be sure.

Different departments and institutions can have different expectations for graduate students and departments will vary in how they approach issues of “work-life balance.” You can learn about the different cultures and expectations by talking with people in the department about what day-to-day life is like for graduate students. Note, this will vary a lot from laboratory to laboratory even within a single program. Finally, ascertaining whether a university or department is family-friendly and progressive and proactive in terms of diversity, equity, and inclusion is also critical, and for many, these factors may play a deciding role in which program to apply to and ultimately attend. We provide numerous and important insights into finding these departments and universities (Boxes 1, 2). In addition, we provide the lived experience of a current professor who entered the academy nearly 40 years ago; her story illustrates how far we have to go when it comes to diversity and inclusion (Box 3).

Another important consideration in choosing a program is whether there are opportunities to acquire career training beyond research and traditional coursework. Not all students want to pursue the prototypical track of obtaining their doctorate, moving on to a postdoctoral position, and then accepting a professorship at a Ph.D. granting institution. These tenure-stream professorships tend to be scarce and fairly competitive. Fortunately, there are a wide array of other employment opportunities once you complete your degree, including science communication, working in the private sector (e.g., ecological consulting, natural history museums), teaching at a primarily undergraduate institution, and state and federal positions (e.g., U.S. Forest Service, policy advising). Does the university or the department you are considering offer courses, certificates, or training in pedagogy, statistics, GIS, or science communication that will allow you to expand your skill set in a way that would be attractive to employers? Does the department have affiliations with researchers or adjunct or affiliated faculty who work in these other sectors that could provide career advice? The ESA journal *Frontiers in Ecology and Environment* has an Exploring Ecological Careers section where more than a dozen articles explore career options outside of academia ([https://esajournals.onlinelibrary.wiley.com/doi/toc/10.1002/\(ISSN\)1540-9309.Exploring-Ecological-Careers](https://esajournals.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1540-9309.Exploring-Ecological-Careers)).

Box 1: A Guide to Finding a Family-Friendly Graduate Program.

Attending graduate school while caregiving is challenging. Graduate school is demanding, requires a *high* level of commitment, and does not pay well, but it can be tremendously rewarding. You can succeed in graduate school while caregiving, especially when you find a department with supportive and well-established programs that are already in place. Here, we offer insight and advice to those who have children or plan to have children during graduate school. Some of our recommendations are likely specific to graduate schools in the United States, where federal and institutional support for families is limited relative to many other countries. We divided considerations into four categories: **Location**, **Institutional Support**, **Departmental Culture**, and **Laboratory Culture**. We note that similar challenges may apply to students with adult dependents.

Location: Cost of living and community resources. The cost of living and available community resources are critical considerations for those with dependents, particularly if the student's salary will be the primary income for a family. Below are points to consider.

- **Cost of Living and Support Network:** How does the cost of living in the area match up with your predicted income? Do you have friends or family nearby for support? For many with dependents, this may well be the key determinant of where you enroll.
- **Childcare:** If you are starting graduate school with young children or planning to have children while in graduate school, finding childcare that is *affordable*, *accessible*, and *reliable* will be key. Demand for childcare is usually higher than supply near universities, so start planning early and get onto waiting lists ahead of time. Do you want a day care center, in-home childcare, or a childcare provider that comes to your home? The U.S. Administration for Children & Families website (<https://childcare.gov>) can link you to relevant information on licensed centers and in-home facilities. Determine where current members of the department send their kids and ask if anyone has compiled information on local childcare options. One sign that a program supports parents is whether such information is readily available.
- **Local Schools:** If you are starting a graduate program with school-aged children, do you want your kids to go to private or public schools? If you want to send your kids to a public school, consider choosing where you live based on the local school district that meets your needs. You can call or visit schools to see their facilities and to inquire whether they offer additional resources such as affordable after-school care, tutoring services, or special educational programming.
- **Medical Care and Facilities:** What are your family's medical needs and are there relevant healthcare facilities nearby? For family members with chronic health conditions (e.g., diabetes and asthma) this may determine where you matriculate. If you anticipate having a child while in graduate school, are there nearby obstetrics facilities or birthing centers?
- **Local Amenities for Kids:** Some locations may have a wider variety of family-friendly amenities than others. Is the university in a city where you want to raise children? Are there nearby parks, playgrounds, museums, or libraries?

- **Proximity to Campus and Transportation:** Finding affordable housing on a limited income is tough and trade-offs may occur between a short commute vs. a longer one where important amenities exist (e.g., a yard). Owning a car is expensive so consider the cost, reliability, and accessibility of public transportation. Can public transit get you to your child's school or to your laboratory? Does the institution cover costs for public transportation and is parking near your laboratory affordable?
- **Government Assistance:** Government assistance to support families on a limited income vary by state, and even by city or county. If so, what programs are available, and what hurdles are required to obtain assistance? Does the university have resources to help you?

Institution: Resources and support. Institutional support for graduate student parents varies substantially. Below are some questions to consider.

- **Health Insurance:** *This is important.* Is health insurance covered, how expensive is it, and what will it cost to insure your family? Will you have to pay more for health insurance if you shift from one form of support to another (teaching assistantship vs. research fellowship)? Many states provide low-cost health insurance for children; check out your state's Children's Health Insurance Program (<https://www.benefits.gov/benefit/607>) for more information.
- **Student Health Services:** Larger universities (especially those with medical schools or hospitals) may have student-focused health centers that are more affordable than other options. Do these resources have a dedicated obstetric staff and do they provide pediatric care?
- **Childcare and Family Leave:** Does the institution offer childcare and, if so, is it affordable? Are there any programs or resources which allow you to bring your child to campus if your child needs to miss school? Are there family leave policies and do they give extensions for your graduate program timeline? Are those extensions paid or unpaid?
- **Nursing Parent Resources:** Are lactation rooms nearby, adequate in number, and well equipped (at a minimum, a chair, a table, a sink, and a fridge)? Where will you store your milk or clean your pumping equipment? Can you sign-up ahead of time to use these rooms?
- **Unions:** Are graduate students unionized? If not, what institutional organizations advocate for graduate students? Unions routinely fight for resources for parents.
- **Field Stations:** If you will be working at a field station, is it family-friendly?

Department: Culture and support. Does the department have a family-friendly atmosphere? During interviews, talk with graduate students, postdocs, and faculty members who have children about their experiences in the department. Some indicators of departmental attitudes toward caregiving might be:

- **Children in the Department:** Do other graduate students have children in the department and are children welcome and present at departmental events? Are there parent support groups?

- **Work Expectations:** Do the graduate students convey directly or indirectly that their advisors expect them to work long hours at the expense of their family (e.g., working on weekends or late nights)?
- **Parental Resources:** During your interview, does anyone offer information about parental resources or direct you to where such information is available? Will you have to seek out these resources on your own? Are there child-safe workspaces in case you need to bring your child to work with you? *If you have to take classes, will you be able to attend class remotely, if necessary?*
- **Childcare Foreboding:** Do you get the sense, or is it even said directly, that you should not mention or ask questions about childcare during your interview? That is a big warning sign that the department may be unsupportive.
- **Teaching Flexibility:** If your support requires teaching, are there policies in place to get a substitute if you cannot come in? Do you have a say in when you teach? If not, you may have to teach at 8:00 am, even though your child gets on the bus at 8:20!

Laboratory: Culture and support. Regardless of institutional or departmental support, if your advisor is unsupportive graduate school could become difficult or unpleasant. *Laboratory culture and support is one of the most important factors to consider!* Below are some points to keep in mind:

- **Work Expectations:** Talk to the graduate students and postdocs in the laboratory. What hours do they work? Is it easy for them to take personal time away without fear of repercussions? If everyone is working non-stop on their research, your caregiving responsibilities could become a source of conflict.
- **Flexibility:** It is possible that you could be the first graduate student with dependents for a prospective advisor; thus, talk to them. Are they flexible about the hours you would need to work? Do they understand that raising children may limit your flexibility and the amount of time you are able spend in the laboratory or field?
- **Scheduling Meetings:** When does the prospective advisor hold laboratory meetings? If it is late in the day or early in the morning or, even worse, on weekends, this is a red flag that either they are unaware or not accommodating to caregivers.
- **Navigating caregiver and research logistics:** Will you be permitted to do research that is feasible given the logistics of caregiving? Conducting experiments that require weeks without any unexpected changes to your schedule can be demoralizing if you are interrupted (SURPRISE! It's a snow day!) forcing you to restart your experiments.
- **Lab esprit de corps:** Is there a collaborative and positive vibe in the laboratory? Knowing that your laboratory mates have your back in a pinch is critical (like helping with an experiment during snow days).

Some final thoughts and advice.—Recognize the difference between “**accommodation**” and “**support**.” An advisor insisting that they are “flexible” is **accommodation**; a department offering paid parental leave is **support**. When deciding on a program, be careful not to make too many compromises that could put an unmanageable burden on yourself. It may be a cliché, but graduate school is a marathon, not a sprint. When you have children, that marathon maybe even longer and steeper, but it can also be enormously rewarding. For the sake of yourself and your family, choose a program that provides tangible support for parents at multiple levels. Do not worry about asking too many questions. Asking questions will allow you to identify programs that are a good fit for you; showing initiative will also reflect well on you to prospective recruiters. Being assertive demonstrates that you understand the challenges and that you are ready to take on the challenging but rewarding path ahead of you.

Box 2: A Guide to Finding an Equitable, Inclusive, and Welcoming Graduate Program.

For quite some time, universities and departments have been promoting diversity initiatives to support minoritized students and to combat tokenization of students from underrepresented groups; these initiatives gained significant additional momentum in 2020. While it is great to see this goal on institutional websites, you should evaluate the degree to which these initiatives are primarily publicity statements rather than actual commitments to diversity. Ask yourself: Are universities truly changing current policies and what actions have institutions and departments taken to make their programs more inclusive and welcoming? Here, we offer insight and advice to assist in identifying programs that are working toward solving the many serious inequities in ecology and evolutionary biology (Graves 2019, Tseng et al. 2020). There are many dimensions of diversity including race, gender, religion, sexual orientation, among others. To help minoritized individuals identify an outstanding program, we divide this box into four considerations: **Location, Institutional Support, Departmental Culture, and Laboratory Culture**.

Location: Safe and Welcoming. Choose a location where you can thrive—you will be there for five or more years. For minoritized students looking at predominantly white institutions (PWIs), the attributes that make a community safe and welcoming may be difficult to discern during a short visit, so ask questions and do some research. Are there safe, attractive, and affordable neighborhoods within a reasonable commute to campus? Important considerations include:

- **Social and Cultural Support:** Minority students at a PWI or moving to a region that lacks racial and ethnic diversity may need moral and emotional support during events of racial injustice or after experiencing microaggressions and prejudices. Building support networks takes time, and you may want to consider attending a university closer to family, friends, or those who can provide meaningful solidarity. If there is an emergency, who would you contact for help? If you needed to return home, how long would it take and at what cost?
- **Safety:** Understanding local demographics is important. Is there high-quality and affordable health care for underrepresented groups? Have hate crimes occurred on campus? Are local

police departments trained in and favor de-escalation rather than confrontation? Do local police departments have a history of or a reputation for targeting minorities? What is the relationship between the local police and the student body? Check local news sources or social media to see if you can discern a pattern of police violence, profiling, or harassment. If you conduct field research, will you have access to a field station or field sites where you can do research safely and without harassment? This may be particularly relevant in rural settings where diversity tends to be lower.

- **Belonging:** Will the city or neighborhood where you choose to live welcome you and accept your cultural identity? Are there nearby grocery stores and restaurants that provide appealing and culturally diverse variety of foods? Are there activities that you can do outside the university that may promote a sense of belonging?

Institution: Resources and Support. An institution committed to supporting minoritized students and to equity and inclusion will have funding streams for these initiatives and services. Are these programs readily available and transparent?

- **Diversity and Inclusion Fellowships:** Does the institution offer fellowships or financial support for minoritized students? How receptive is the university leadership to requests or concerns from students of color?
- **Institutional Services:** Does the university provide free and accessible mental health services? Does the university provide services or programs for international students for navigating paperwork (visas and taxes), improving teaching, developing written and spoken English skills, or providing professional development?
- **Cultural Programs, Social Justice Advocacy, and Campus Climate:** Does the university support student groups or cultural clubs that could provide important social networks for minoritized students or first-generation students? Is the student body actively engaged in social justice movements? Does local or institutional media report on social justice climate or events on campus?
- **Community Outreach:** How does the institution interact with the local community? Is campus walled-off, or integrated and engaged with neighboring businesses and residential areas? Do they partner with local neighborhoods, particularly communities of color, environmental justice communities, or lower-income neighborhoods?
- **Housing:** Is there affordable on-campus housing available to graduate students? If you are moving from far away, how expensive or easy is it to find housing before you enroll. If you are moving with a partner, are there resources to help them find work?
- **Health Insurance:** Institutions vary widely in the quality and cost of health insurance. Do you have to pay for health insurance, or will it be covered in your stipend? Get the facts,

because if you need access to specialists who are not covered by your institution's insurance, it can be expensive. Are current grad students satisfied with their health insurance? Find out who to contact if you have questions about coverage. Are there co-pays and does medical insurance cover vision, dental, or mental health? Will your funding source change during your degree program and will that affect your health insurance? What are medical leave policies, if any?

Department: Culture and Support. The majority of your interactions will be with faculty and students in your home department. You must self-assess what you need from your mentors and peers so that you can develop a sense of belonging and well-being. How inclusive are the faculty and grad students? The following are some indicators of the department's "temperature" toward inclusion and equity:

- **Belonging:** Check out the department's website. Does it or the student handbook discuss inclusion and equity? Are the faculty and students diverse—how many are people of color or other underrepresented groups? Will the community be able to relate to your experiences as a minoritized student? Are there programs specific to minoritized students and does the department signal a welcoming and inclusive environment? During your interview, find out what graduate students think about equity and inclusion. Did you get to spend enough time with current grad students to gauge their views?
- **Finances:** Socioeconomic diversity is rarely discussed in academic settings, but financial constraints can present real barriers. Does the department provide a livable stipend to students? Do you get paid during the summer, or just during the fall and spring terms? Are there opportunities for additional funding during the summer term? Can you afford to move to your institution and are funds provided to offset moving expenses? How often do you get paid (weekly, monthly)? Will taxes be withheld from your paycheck? How much are student fees? When will you receive your first paycheck?

Laboratory: Culture and Support. When you select your research advisor, either prior to enrolling or after laboratory rotations, consider the following to ensure your advisor will be supportive:

- **Diversity statements and trainings:** Does the advisor have a diversity statement on their website? Do they have a laboratory expectations manual that discusses the laboratory environment? Do laboratory group members and the advisor participate in diversity trainings?
- **Laboratory group members:** Your closest colleagues will be members of your laboratory. Your advisor should put you in touch with current students and postdocs and let you talk one on one without the advisor present. Try to get a sense of the laboratory culture. Is it casual or more formal? Does everyone use first names or professional titles? Are people warm and friendly, or more reserved and distant? Would you feel comfortable hanging out, collaborating, or traveling with current laboratory members? Do people socialize outside the laboratory? If you will be the only student of color or other URM, can your advisor connect you to other mentors or students that you might more readily identify with?

- **Support networks:** If you choose to attend a university far from home, consider how often you want to travel home and the degree to which your advisor will be supportive of these visits. Will you feel comfortable asking for time away? Will anyone be able to maintain your research in your absence?

Final thoughts and advice.—You should strive to find a supportive program where you will thrive and be accepted for who you are. Seek out programs that genuinely invest in inclusion and equity and provide real support rather than mere accommodation. Find an institution that welcomes you, one that invests in programs that provide marginalized students with critical social, cultural, and mental health support. Departments that provide a one-time fee waiver for your application are accommodating, but a department that provides a livable wage to live in a safe and welcoming neighborhood is supportive. Choose well and wisely.

Box 3: Tales of a Young Black Woman in the Academy in the 1980s by Laurel Roberts.

I was used to being an outlier, smoothing my rough edges, moderating my responses to trend to the mean. Attending schools where I was often one of two black kids in a class of 25 was the norm. Being a black girl who thought animals were fascinating required another layer of adjustment as well.

My history in ecology began as an undergrad. I was at the University of Pennsylvania and all of my profs in biology were white men, the grad TA's were mostly white men, with 1 or 2 white females for leavening. I took several courses that fascinated me, particularly Ecology with Dan Janzen and a behavioral ecology field course with W. John Smith.

Although I was deeply interested in behavioral ecology, I had no model for how to pursue it. I grew up in the inner city, raised by parents whose career aspirations had been stifled by the lack of opportunities for smart, young black people. Upon graduating, I worked a few years in medical research and then decided to pursue a master's degree, mostly in hopes of getting a better job. Because my transcript best matched the Ecology and Evolution program at the University of Pittsburgh, that is where I landed.

It was like being in a foreign country. None of my family had ever held a non-clinical degree; I was not raised to think about graduate school, unlike nearly all of my fellow students and mentors. I still remember taking my comprehensive examination at the end of my first year. I spent 2 hours sequestered in a conference room with half a dozen white middle-aged men, desperately trying to figure out what they expected of me. I knew that they were (mostly) only interested in helping me, but I could not comprehend the nuances of their questions. I finally excused myself to get a drink and let the cool water from the fountain bathe my eyes as I cried.

They took pity on me and I continued in the program. Fieldwork was *traumatic*; aside from a few weeks at summer camp, I had not spent time in the field and had certainly never contemplated standing alone in a marsh in hip waders on a cold April day while hunters unleashed shotgun blasts nearby!

My academic career as a graduate student in ecology was like my undergrad experience. I became so accustomed to being the only female and only person of color in the room that I stopped noticing. I could not even let myself imagine that being denied a fellowship, a cushy TA assignment, funding, etc. could have anything to do with my color or gender; that way lay despair.

Although falling in love with teaching was my impetus to finish my Ph.D., I never intended to join the tenure stream. When I look back on it now, I am sure that the alienation I felt was a major (if silent) contributor to that choice. How far have we come since those days nearly 40 years ago? In my department, we have ~60 faculty (tenure and appointment stream). For the last 25 years, I have been the only self-identified minority faculty member, but now we have two. Our department, like our university and academia in general, is starting to shift. Like the first hints of dawn after a long, cold night, hope is on the horizon. But, we still have a long way to go.

Selecting a potential advisor

Your selection of an advisor is *the most important decision* you will make with regard to your graduate degree. Identify 5–10 professors who might serve as your potential advisor in graduate school. Find their laboratory webpage or Google Scholar page to understand more about their research. These professors should be conducting research in an area you are interested in, and at universities, you are interested in attending. Some universities that you are interested in attending may not have faculty that work in your area of interest, while some faculty with strong research overlaps may not be at an institution you would consider attending. The faculty member is almost always more important than the specific university (Fox 2020) and narrowing your scope of institutions may also limit your chances of finding the right faculty advisor. Do not go into this without careful thought. Ask mentors for advice on appropriate advisors. Although it may be possible to switch advisors once you enroll, switching advisors can sometimes become awkward and politically difficult, and there may not be another professor who has an opening for a student or one who matches your research interests. Thus, choose your advisor as wisely as possible in the first place (for some advice, see The Interview below). Finally, the degree that a potential advisor is progressive in terms of diversity and inclusion or is family-friendly or both may be of central importance for many applicants (Boxes 1, 2 offer advice).

Do your homework

You should read the most recent scientific papers authored by the faculty member you are interested in working with and find out whatever you can about these professors. You will not necessarily be expected to fully comprehend these papers. Still, you should obtain a reasonable understanding of the research being conducted because it will allow you to ask better questions during an interview (see The virtual or in-person interview), make you much better informed and a stronger applicant overall. *Do not forget to do this!* The strongest applicants will be those who can discuss issues in their field of interest; these candidates will stand above the rest. You should use the professor's webpage or Google Scholar page to gain insight into their most recent work, the research of members in their laboratory, their favorite journals, and the topics they publish on the most.

The inquiry email and résumé

Send an email to each faculty member with whom you are interested in working; be formal and respectful. This email should go out well ahead of the application deadline meaning no later than September to early October. In the email, you should say briefly who you are, why you want to work with that person, and your background and research experience. You should make it clear in the email that you are familiar with the research and publications done in that professor's laboratory. *Do not send a generic email*; rather tailor it to the specific laboratory and faculty member with whom you want to work. Find someone to read and edit your email, preferably a graduate student or faculty member. In this email, focus first on your interest in their research, then on your research experience, and then on your academic performance. If you have research experience, give the name of the professor(s) with whom you have worked. Ask specifically whether the prospective faculty advisor will be taking on any students in the next academic year. Faculty may not be recruiting students into their laboratories because they are taking a sabbatical leave, are close to retirement, or do not have funding to support a new student. It is not a reflection of your strengths if a faculty member responds that they are not recruiting students that year. The email you send should be limited to about one page and attach a résumé or curriculum vitae (a long résumé used in academia). If you can, obtain examples of résumés from peers, mentors, or online. Ask graduate students or faculty advice on constructing a résumé and ask them to critique yours. Keep your résumé up to date as you go through school; it will save you a lot of time. For more advice on the inquiry email, see <https://contemplativemaammoth.com/2013/04/08/so-you-want-to-go-to-grad-school-nail-the-inquiry-email/>.

The follow-up email

When you hear back from your initial emails, follow whatever recommendations or advice they provide. If you do not hear anything, follow up your inquiry about 2–3 weeks later with a short and polite email asking if they received your initial inquiry, and if so, whether they would consider you as a prospective graduate student. Faculty are often busy or out of town for extended periods; thus, a second email may be necessary. A missed email does not necessarily signal that a faculty member is not enthusiastic about your application; it likely signals that their email inbox is out of control!

The application and personal statement

The application will be online; fill it out completely and make sure you submit it on time. You may be asked to complete multiple sections such as a Research Statement, Personal Statement, and in some cases a Diversity Statement. These statements should be tailored to each program; they need to be compelling so start writing them early and get them critiqued. Consider your goals carefully and remember that most faculty are looking for committed, mature students, *who will make research their priority*. Generally, the more specific you can be in the essay the better. It is important to demonstrate that you have knowledge in the research area you hope to pursue and that you are aware of what a research-based degree requires. The personal statement is also an opportunity where you can provide context for weaker areas of your application, such as a low GPA or limited research experience, that may not be obvious from your transcript or letters of recommendation. Did you have to seek research experience outside your institution because of limited opportunity? Did you have to overcome any obstacles academically or economically? If you are a first-generation college student or a member of an underrepresented group, say so if you feel comfortable conveying

this information. Graduate admission committees are becoming more cognizant that implicit biases create inequities in access and inclusion in academics; sharing personal obstacles that you have overcome provides evidence of your perseverance and determination to pursue graduate studies despite societal or academic barriers. Overall, it takes perseverance and hard work to complete a doctorate; explain why you have what it takes.

The virtual or in-person interview

Hopefully, some of the professors you contacted will be interested in working with you or discussing a position further. The first step could will be either a formal or an informal virtual interview (e.g., Zoom) or phone conversation. These initial contacts will allow you to scope out the professor and vice versa, and as a prelude to, or in lieu of, an on-campus interview. Nonetheless, many universities will have funding to pay the travel for prospective candidates for an on-campus interview. If you are invited to an interview, you have to navigate the very large gray area of neither over- nor under-dressing. This is challenging, and more so for some applicants where implicit biases can lead to differential judgements about attire. You can seek advice on appropriate attire by asking trusted mentors on what to wear; generally, suits or formal business attire are not standard and may be deemed “over-dressing.” We advise to sticking with business casual. If you have attended professional conferences, you will have a better sense of the way ecologists and evolutionary biologist dress for their profession.

Overall, to get into many programs, and for you to evaluate the program, *an in-person interview or informal visit is extremely important*. This visit or interview will:

1. Let you know if you want to work with this person. Major personality differences between a student and an advisor can become a disaster. Ask yourself what you want in an advisor. While at the interview, ask yourself the following questions: Can I get along and work comfortably with this person? How does this person interact with their current students (regular laboratory meetings, daily guidance, moderate guidance, or total independence)? Have past students done well? How much leeway will I have to develop my own research independently from my advisor? Did past students publish their research in good journals? Are students finding good jobs on completion of their degree? Will the advisor be supportive if I choose to broaden my skill set by taking additional courses, volunteering for science communication and outreach initiatives, or earning certificates in pedagogy, GIS, or diversity and inclusion? How are students supported financially (see *Financial support* below)?

Ask the graduate students what they think of their advisor and of the program in general. Get individual graduate students alone, one on one, so they can speak candidly and tell you what they really think, and so there is less fear that this information will leak out. Yes, these can be delicate conversations. Ask them if they had to do it all over again, would they? Remember, your selection of an advisor is *the most important choice* you will make with regard to your graduate degree. In general, if the graduate student population is excited and enthusiastic about their advisors and the program, then you have probably found a great place. A few disgruntled comments from a couple of students is expected but a general negative tone from the graduate students as a whole is a bad sign

2. Let the prospective advisor, graduate students, and laboratory personnel evaluate you and decide whether they want you hanging out in their laboratory. Note that current graduate students and laboratory personnel will likely have input into the decision on selecting new students. Additionally, you will almost certainly meet with other faculty who may have a say or vote in graduate admissions. Thus, before your interview, you should read about the other relevant faculty and their research interests (e.g., via websites). Reading some of their recent publications is highly recommended.

3. Allow you to inquire further about the program. You may want to ask such questions as follows: how many courses are required for the degree? How reasonable are the examinations and hurdles associated with the degree? Graduate students are an excellent source for this information but remember to query as many students as possible. A trip to the local coffee shop, diner, or pub may be helpful here. Regardless, come prepared with thoughtful questions about the program.

Financial support

The vast majority of institutions offer financial support in the form of Teaching Assistantships, Research Assistantships (sometimes provided directly by the professor from a grant), and Fellowships. Many, but certainly not all institutions, will offer up to five years of guaranteed support that typically comes with full tuition remission (i.e., school is free), health benefits (see also Boxes 1, 2), and a modest salary in exchange for conducting research or teaching part-time. Whether the salary is sufficient or “livable” can vary a lot regionally and depend upon a host of factors, not the least of which is if you have dependents (Box 1). Students may be funded through different mechanisms during their graduate tenure, with different expectations depending on the funding source. A fellowship typically includes a salary and tuition remission with relatively few strings attached. The National Science Foundation offers prestigious 3-year fellowships that you can apply for in the year prior to enrolling or in your first or second year of graduate school, or if you obtained a master’s degree and left school for at least two years (see <https://www.nsfgrfp.org/>). The GEM Program offers fellowships in the sciences to African Americans, American Indians, and Hispanic Americans (see <https://www.gemfellowship.org>).

Overall, find out whether you are likely to be awarded financial support upon admission, and if so, what kind? Support can vary dramatically among institutions in terms of the actual salary, whether health insurance is included, and how long the support will be guaranteed from no guarantees to 5 years or more. *Find out the facts regarding your support!* Other questions to ask include: Will there be support during the summer and is there funding for graduate student research? Current graduate students, rather than professors, are often the best source of information; they will know just how livable the support is. Support of \$25,000 a year may go a long way in Little Rock, but not so far in New York City.

Accepting and declining an offer

Once you have decided that a program is right for you, contact them to accept the offer. Do not accept an early offer as a “back-up” in case your preferred school declines your application; your acceptance means you agree to attend that school. If a deadline is approaching at one school and you still have not

heard from other schools, see if you can obtain an extension. Most schools are members of the Council of Graduate Schools, which has a resolution among member institutions that students are under no obligation to respond to offers of financial support for grad school before April 15 (<https://cgsnet.org/april-15-resolution>). This means that you can wait until this time to accept or decline an offer.

Once you have crossed a school off your list or have accepted an offer from another school, immediately contact those schools and let them know you plan to go elsewhere. Write a short email to each faculty member with whom you interviewed, thank them for considering your application, and let them know where you decided to enroll. Do not forget this simple courtesy; it will save you embarrassment when you run into them at a scientific meeting. Additionally, students on waiting lists will appreciate your timely decision.

Concluding Remarks

Obtain advice from others

Overall, this is just a primer on obtaining experience and applying and getting accepted to graduate school. Seek out other professors, graduate students, and advisors. Procedures and strategies on admission can vary from one institution or discipline to another.

Thrive in grad school

Remember, *you are trying to go from one who consumes knowledge to one who produces it*. Make research your priority. To help you thrive in graduate school, we strongly suggest reading Stearns (1987) and Huey (1987). Though a bit dated in tone, these articles remain highly relevant, and they offer a pithy and provocative exchange on how to be successful in graduate school. They should be read by all beginning graduate students. For additional insight, we also recommend Binkley (1988) and Witz (1994).

Diverse voices, earlier times

In this article, we attempted to incorporate a diverse set of voices and experiences; authors ranged from those currently applying to graduate school to seasoned veterans. Five of the authors became parents while in graduate school or as postdoctoral associates, three are African Americans, three were first-generation college students, and four attended primarily undergraduate institutions.

Acknowledgments

We thank Sarah Hainer, Kenneth Klemow, Rose Marie Muzika, and John Wenzel for comments on earlier drafts of this guide.

Literature Cited

Binkley, D. 1988. Some advice to graduate advisors. *Bulletin of the Ecological Society of America* 69:10–13.

- Carson, W. P. 1999. A primer on how to apply and get admitted to graduate school in ecology and evolutionary biology. *Bulletin of the Ecological Society of America* 80:246–250.
- Fournier, A. M. V., and A. L. Bond. 2015. Volunteer field technicians are bad for wildlife ecology. *Wildlife Society Bulletin* 39:819–821.
- Fox, J. 2020. A data-based guide to the North American ecology faculty job market. *Bulletin of the Ecological Society of America* 101:e01624.
- Graves, J. L. Jr. 2019. African American in evolutionary science: where we have been and what's next. *Evolution: Education and Outreach* 12:18.
- Huey, R. B. 1987. Reply to Stearns: some acynical advice for graduate students. *Bulletin of the Ecological Society of America* 68:150–153.
- McGill, B. M., et al. 2021. You are welcome here: A practical guide to diversity, equity, and inclusion for undergraduates embarking on an ecological research experience. *Ecology and Evolution* 2021:1–10.
- Miller, C. W., B. M. Zwickl, J. R. Posselt, R. T. Silvestrini, and T. Hodapp. 2019. Typical physics Ph.D. admissions criteria limit access to underrepresented groups but fail to predict doctoral completion. *Science. Advances* 5:eaat7550.
- Moneta-Koehler, L., A. M. Brown, K. A. Petrie, B. J. Evans, and R. Chalkley. 2017. The Limitations of the GRE in predicting success in biomedical graduate school. *PLoS One* 12:e0166742.
- Petersen, S. L., E. S. Erenrich, D. L. Levine, J. Vigoreaux, and K. Gile. 2018. Multi-institutional study of GRE scores as predictors of STEM PhD degree completion: GRE gets a low mark. *PLoS One* 13:e0206570.
- Stearns, S. C. 1987. Some modest advice for graduate students. *Bulletin of the Ecological Society of America* 68:145–150.
- Tseng, M., R. W. El-Sabaawi, M. B. Kantar, J. H. Pantel, D. S. Srivastava, and J. L. Ware. 2020. Strategies and support for Blacks, Indigenous, and people of colour in ecology and evolutionary biology. *Nature Ecology & Evolution* 4:1288–1290.
- Witz, B. W. 1994. Some pragmatic advice to graduate students: a hybridization of Stearns, Huey, and Binkley. *Bulletin of the Ecological Society of America* 75:176–177.