Carleton College
Department of Physics & Astronomy

Guide to Graduate School Applications

2007

This collection was assembled by the 06/07 Student Departmental Advisors. It contains first- and second-hand advice from the internet, members of the classes of '04, '05, '06, and '07 who survived the applications process, and random other sources we would cite if we could remember them. Some of the material, such as the graduate school rankings, is under some sort of copyright, and therefore is not available in the online version. None of the content that follows is official endorsed by Carleton College or guaranteed to get you into graduate school, though we suspect it might help.

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Introduction

When we applied to college, we had a pretty good idea of what we were getting ourselves into. Our guidance counselors could look at our SAT scores and grades and tell us where to apply and what our chances might be; there were shelves full of books of advice. But when we started to think about grad school apps, we got scared. There were so many more factors that went into our chances, and a lot more things we had to think about when making our decisions. Advisors, specializations, funding.... We had to study for the GREs and wondered how much our scores would matter. Even with the support of our professors, the whole process was intimidating, nebulous, and expensive.

So after we all got done with it and started to get answers back and didn't *really* have to worry about our grades anymore, we sat down and put together this collection. It primarily contains advice relating to Ph.D. programs in theoretical or experimental physics, but much of it will also apply to programs in engineering, materials science, or related fields. It's an effort to pass on the advice of a few generations of seniors who have been through it all to those of you who are just getting started. This is just a starting point, but our hope is that when you start getting those happy emails back you'll take a moment to add your own advice to the pile.

Good luck, and keep your chin up, kids!

Melina Blees and John McDonough, SDAs 06/07

Note: In the version of this text being distributed to students at schools other than Carleton, the quotes from various alumni and professors have been anonymized. Bulleted text in italic are quotes. Those consulted are in many cases presently attending the country's top graduate programs, so take their advice accordingly!

To Sophomores and Juniors

If you think you might want to go to grad school, you should start worrying about it during your sophomore year. You won't need to start the actual applications/GRE process until fall of your senior year, but there are a number of things you can do even before you declare that will significantly help your chances of being accepted to grad school.

1. **Apply to REUs.** These summer research programs are designed to give you a first look at real research, and they're a great way to figure out whether or not you actually want to go to graduate school. Although the programs tend to favor rising seniors, a number of rising juniors are accepted every year. Applying sophomore year would not only give you the opportunity to have another research experience the next summer, but also provides pretty much the best summer job you can get. REUs are not only great experiences for you, but also *significantly* add to the strength of your graduate applications. In fact, REUs are so important to your competitiveness as an applicant that we suggest applying to somewhat obscure programs (in geographically undesirable places, for instance) as backups. Most programs provide housing and meals, plus a stipend in the $3000-$5000 range for about 10 weeks worth of work. There are REUs available for theoretical and experimental physics, electrical engineering, geophysics, and so on. If you have specific research interests you can note that on your application, but these programs can also be a great way to decide in what area of physics you might specialize at graduate school. Alternately, apply for summer research positions at your school.
2. **Start a special project.** Most graduate programs will expect you to have had some research experience, and work during the school year can be a big bonus. It can also help you to decide what you want to study in the long run, and develop a connection with a mentor who will help guide you through your college career.
3. **Lab assist or tutor.** Teaching experience is looked upon favorably by admissions committees because you'll be expected to TA in grad school, and it can also be a good way to help you decide whether or not you want to consider a career as a professor. It can also be a lot of fun.
4. **Talk to your advisors.** Professors are there to help you if you have questions about REU apps, post-graduation plans, and so on, but they usually won't come to you. Seek them out, ask questions, make appointments, and take in their wisdom. At the same time, though, be sure to get more than one opinion.
5. **Learn about graduate school.** By all accounts, grad school is tough but rewarding. Read up on the process so you know what you're considering getting yourself into. Most people go straight for a Ph.D. in physics,

without worrying about getting a masters along the way. We especially suggest *The Ph.D. Process: A Student's Guide to Graduate School in the Sciences* by Bloom, Karp, and Cohen (see additional resources) for what may be an especially brutal take on the trials of grad study. Also consider discussing it with your research advisor(s), grad students at your REUs, or your favorite prof. The more you know about grad study, the better you can prepare yourself and choose a good program. You might also consider studying something that's not pure physics, such as materials science, electrical engineering, planetary science, biophysics….

6. **Think about taking time off.** Many students take a year or two off before they go to grad school, and admissions committees don't frown on this at all. Consider a one- or two-year national volunteer program, or join the workforce for a year. Don't go to graduate school directly if you're burned out. It's five to seven years more of school for a Ph.D., and there's no reason not to take a break. Some schools even say they prefer students with real-world experience, and some (but not all) graduate programs may let you defer for a year even after you've been accepted, especially if you'll spend the time with something like the Peace Corps or Teach For America.

Approximate Timeline
(adapted from *princetonreview.com*)

Sophomore year:

• Apply to REU programs (deadlines are in February/March). Consider beginning a research project at your school during the year.

Junior year:

Spring term:

• Start thinking about the GREs. Try to find a copy of ETS's practice book, which is currently out of print; try older students, the department library, or the internet.

Summer:

• Hopefully you're doing research at your school or at an REU. If you have research downtime, start studying for the physics GREs.

• Talk to the grad students in your lab about their experiences in graduate school.

• Summer is the best time to take the general GREs. You probably won't have to spend more than a week studying, but register as early as possible for the best choice of times.

• Start to make up a list of where you might want to apply.

Senior year:

Fall Term:

• Ask for recommendation letters. Even if you haven't finalized your list of schools yet, giving advance warning can be helpful to your writers.

• Register for the November physics GRE. When ETS sends you the paperwork, immediately register four schools where you want score reports sent.

• Study for the physics GREs as much as possible.

• Consider applying to fellowships; some have November deadlines, and you'll need rec letters for most.

• If possible, start your statement of purpose.

• If you have a chance, email a professor at each school whose research seems particularly appealing. Any contact is good, and if you live near the school you might be able to visit their lab over winter break if you've planned ahead.

• Finalize your list of schools, and give your recommenders the necessary forms and info. Request transcripts. Get GRE scores sent to all your schools.

Winter Break:

• Take the general GRE as soon as you get home if you haven't already; this is cutting the deadlines a bit close.

• Polish up your statement of purpose, and get some editors.

• Visit schools if you've made contact with friendly professors.

• Some deadlines will fall in mid-December, so get those applications finished!

• Make sure your recommendations went out. Try to finish up all your applications, even those due in January, while you're still on break. The earlier you get your applications in the better.

Winter Term:

• Fill out the FAFSA.

• Wait for those responses!

• Visit campuses.

Spring Term:

• Make your final decision by April 15th.

Where To Apply

When you decide to apply to graduate school, you'll need to narrow down your choices. How many schools you'll apply to is up to you, but most people suggest between six and nine. Applications cost $40 to $120, with most falling in the $60-$70 range.

Gauging where you fall in the competitiveness scale is tough for graduate apps. Talk to professors and advisors, and look at the admissions criteria of the programs you're interested in. Keep in mind that the "average" GRE scores listed by programs are inflated due to international student scores, and the admissions committees often tend to forgive students from liberal arts schools for low scores. If you have a strong research background (one or more REUs and a special project) and strong grades you can aim for schools with fairly high average GRE scores. Look at where previous students from your school have gone, and pick a few reach schools, a few good bets, and a few safety schools.

If you have a possible area of specialization, talk to professors in that subfield who can suggests especially strong programs. Some schools are great for plasma physics, for example, while weak in atomic physics. Hopefully by now you have some idea of what you want to study, but you'll at least have to decide whether you want to study astrophysics, experimental physics, or theoretical physics.

Organization has never been so important. Make a binder or a folder for each school, and write up a list of deadlines. Be careful - some schools have different deadlines for different parts of the application!

• Deciding where to apply can be very hard if you are not sure what you want to specialize in. Ideally, you would know what field you wanted to pursue and apply to the schools having the largest resources/faculty. Another consideration is breadth of research opportunities; for those who aren't sure what they'd like to do, larger schools tend to be better, offering a more diverse research landscape. I applied to six schools in all, and I think this is a good number to give enough variety but not bog you down in having to tailor applications to too many schools.

• Apply to the best schools possible for what it is you want to do, even if it seems unlikely that you will get in. Also find a good school that you know you can get into for a backup. I did not choose the best schools to apply to, but instead chose what I thought were the best people to work for. You have no way of knowing whether that is a good choice or not, so go for the best department over what you think is the best person.

• I searched the internet for departments which had programs I was

interested in and rated them on a scale of how interested I was in their research. Then I cross checked that list with a similar list created by my girlfriend for her department. Then we decided which schools would both be happy at and that pretty much narrowed it down. I applied to six, which was way too few. I think we were really lucky getting in to the same school knowing how many people applied. Two-body problems are much harder to solve.

• I applied to seven in total (six astro, one physics). That seemed just the right amount (I was accepted at three, so there were some choices). I wanted to live in the West, and thankfully many of the best astro grad schools were out here. I asked my profs, research advisors, and friends in grad school for suggestions, and also browsed heavily the websites of all the schools I was looking at.

• I picked some schools because I thought they sounded prestigious, I picked others because I thought that they were in beautiful places. I also picked some schools because I had contacted them and I felt wanted. I applied to five schools, in a wide range of programs. It felt like the right amount. I could go PhD or Masters, ocean engineering, oceanography, or ocean physics, I could go with full funding, some funding, or no funding. Tropical, southern, northwest, and northeast. After visiting, it was an easy choice.

• Always apply to more than you think you should. It can only help. But that doesn't mean you should just apply to a mess of schools, find a bunch you're interested in. You can look at rankings information, but ultimately what's really helpful is asking faculty. They've all been grad students, and they know a lot. Especially if you're going to be continuing in their field. Look around online. Most departments have pretty good prospective grad student resources. You can look into specific projects and see what's really interesting to you. And don't apply to anywhere you wouldn't want to live for six years. Location is important.

• I applied to eight schools. In retrospect, that was too many. Getting all of the applications filled out was pretty stressful, and I didn't have time to visit all of the schools I was accepted to. On the other hand, it's better to apply to too many and have lots of choices than apply to too few and not have many (or any!) choices. I decided where to apply by asking my research advisors to recommend some places. I visited some of them before I applied to get a feel for the departments and narrow the list a bit.

• Applications will take a lot longer than you expect. Limit yourself to nine at the most. I did eleven, but it took most of winter break and cost a lot of money. If you pick the right programs (a few reach schools, a few

good bets, a few backups) you shouldn't have to do that. Of course, what constitutes a backup school may be really hard to judge, which is how I ended up with eleven... but don't do that.

Results-wise, it seemed like the competitiveness of admissions usually scaled closely with the school's ranking on the US News report, but I did get rejected from one of my backup schools. I think some places care more about things like GRE scores than others do, while some have a particular respect for the liberal arts background.

• I applied to eight schools, and that was a good number. Eight applications is pretty doable, but any more than that and I wouldn't have enough time to figure out what the schools had to offer. You want to send out a lot of applications because you will probably get a lot of rejections, so if you're pretty sure you want to go to grad school next year you'll want to blanket them.

I only applied to schools where I'd found two professors I wanted to work for whose research seemed interesting and had funding, and that weeded out a lot. I also made sure the departments were flexible. I want to do biophysics, but I made sure that if I decide to switch to nanotech it would be possible.

After I was accepted to schools, there were some that I didn't end up going to because I contacted the professors and they never got back to me, which I took as a bad sign.

• Applying to grad school was a two-body problem. My wife and I were both looking for grad schools. We did our research individually and came up with lists of good programs. Then we compared our lists and looked for schools that overlapped or were in the same cities. I also talked to physics professors about the list of schools we had and solicited advice on schools to add. We settled on a list of eleven schools to apply to. I only got into four of them and we only got into two of them together. Fortunately, we both got in here, which is a great school for both of us.

• Location (as in a place I'd like to live) was the first thing I looked at, then I narrowed it down in terms of which schools I was interested in those given locations and then what those programs had to offer in terms of research. I applied to five schools, which was about right, but I kind of wish I had looked at a few more applied physics programs.

• I believe that your advisor is just as important as the school you attend. Your advisor will control your stress level, your productivity, and what you study. This person will introduce you into a research niche that will involve scientists at many different institutions. If your advisor has a good reputation, your education will be respected by people in your field. Your advisor's connections may also find you a job when you finish.

• I applied to seven schools and most of them were in the Midwest because I don't really want to leave, but I did apply to a few east coast schools because I wanted them to fly me out there for a visit. I pretty much chose the good schools around Wisconsin, Illinois, and Minnesota, and then the east coast schools I had a gut feeling about. I applied to physics and materials science programs, but at most schools if you want to apply to two programs you either have to send in two applications or they won't even let you, so at most places I applied to either one or the other. The non-physics programs are good, too, and they don't require the physics GRE.

• Schools in the UK are due early and they reply really late, so it takes some risk management to decide whether to accept schools here by the deadline before the UK schools have gotten back to you. They don't automatically fund you, so you have to fill out a separate scholarship application, and those take a lot of time. They have a different way of approaching things; in theoretical physics, for example, there's a way to do an applied mathematics program for a whole year before you start your actual program.

• I applied to eleven schools, but that was a bit much. Eight probably would have been good. I guess it's because there were a lot of reach schools that were either fairly hard to get into or had small programs, so it was sort of a risks/rewards thing. I'm going to study nuclear engineering, and if you're looking to do applied or engineering you may have to do a little more research to figure out what departments you actually have to apply to. Nuclear engineering ended up being a subset of the mechanical engineering department.

• A lot of times if you're in an interdisciplinary field, the department they stick it in can end up being pretty random. If you're doing biophysics, for example, it sometimes gets put in the medical school, at Cornell it's in engineering & applied science, and at Boulder it's just physics.

• The school itself does not mean nearly as much as the group you end up working with. You'll be doing most of your grad school work with a single professor, so you really should not be looking at which school is good, but which groups you want to work with. To determine this, talk to anyone you can get in touch with (alums and faculty is a good place to start) to ask who is doing good work in the field you are interested in (if you don't know what you want to work on yet, then general school looking is what you're stuck with).

• I applied to twelve. It was enough.

• I started with internet research starting from lists of top applied math schools, and narrowed to those with multiple people doing fluid dynamics. Also, correspondence with several graduate students I met at an REU in my intended field gave me valuable insight.

• I started by finding an REU program that I enjoyed. Once I knew a field I enjoyed and some people in the field who could write me recommendations, I went to the "faculty research" page at various universities to see what other folks were interested in. From there I contacted specific professors until I found someone I liked in a good department. Look for people doing interesting work in fields not directly connected to physics. There are plenty of interesting projects going on in other departments. I found that many schools were anxious to find physics students.

• I used the US News rankings and the book of graduate programs that the department owns to find programs that might be of interest. Then I used the internet to look at the specific research programs and professors. I applied to six schools total. If you're applying with a significant other and want to be together, start researching schools early, and apply to lots of school. I think I significantly underestimated the number of people who would be applying to the programs.

Recommendation Letters

Most programs expect three to four letters of recommendation, with at least one being from a research advisor of some sort. Hopefully you've done REUs or summer research, so that shouldn't be a problem. You'll also want at least one letter from a professor at your school, hopefully one who is very familiar with your academic history. Someone who you've had for multiple classes or your academic advisor can be good choices. Also consider asking professors from related departments if your interests span fields of study, such as CS, math, or biology.

The question of who you should ask from within a lab – a graduate student you worked closely with versus the PI, for example – often comes down to how much interaction you've had, but one possibility is asking for a joint letter on which the Impressive Person and the one who knows you well can collaborate.

Ask for rec letters politely (obviously) and early; then provide all the necessary information as soon as your finalize your list of schools. All forms should be to your recommenders as soon as possible, definitely before you leave for winter break. Include a cover sheet listing the deadlines in order, and write the first deadline clearly on the outside of the packet. Fill out everything you can on each of the forms, leaving less work for your recommenders. Include stamped envelopes addressed to each program.

Some rec letters can now be submitted online, and this can save a lot of time and paperwork. You'll need to designate your recommenders on the application website, and the site will generate emails to your listed recommenders.

- *Ask your thesis advisor at your school, advisors from REUs, and any professor who knows you AND YOUR ABILITIES well (i.e., someone you've worked for as a tutor/grader, had several classes with, served with on a committee, etc). They need to be able to say something besides "this person got an A in my class".*

- *Ask for recommendation letters early from the professors that know you best and, if possible, from a source outside your school, like an REU advisor or someone you know from an industry internship. I've heard having outside references is important.*

- *Ask profs who you've done research with; they'll have more to say than ones who have just had you in a class. It's also a good idea to ask profs with research interests that are similar to yours. The department webpage has guidelines for when/how to ask. Some profs want you to fill out forms to give them ideas of things to talk about.*

• If you want more than the usual three people to write you letters, don't hesitate. It might be polite to call or email the graduate office to ask if you can send a fourth letter, but every school I applied to said yes, although some wanted the fourth sent to the department directly as a paper letter. Don't feel compelled to add an extra letter, but if you think it would really help your application it's worth the trouble.

• Get someone that can write something about you in lab, so either someone who knows you here or at a summer research program. Someone who can vouch for not only your academic abilities but for your competence in a lab is extremely helpful.

• I asked a bunch of physics professors if they felt comfortable writing a positive recommendation for me. I tried to ask way in advance, and gave each one of them an organized packet with my resume, grades, and even some notes about things I did in their classes.

• Ask people who have some sort of unique relationship with you that can say things more than just, 'so and so was a good student' etc. If you did an internship, definitely ask someone from it to give you a recommendation, because if you don't it may look like you had a bad experience.

• A lot of the recommendation forms are online now. One of the first things you can do when you start an application is to fill out your recommenders. We only have eight or so faculty and they end up writing a lot of letters, especially the popular/ubiquitous faculty, so find out who's going to write your letters, do it early, do it before you leave for winter break. Give them a big stack of stuff. It helps if you print out information, both the cover letters and information about a particular lab if you've got one in mind. When you fill out the recommender form it'll automatically send them an email, and that's good for two reasons: it alleviates your responsibility, and it acts as a reminder to your recommenders that they need to actually get that done on time. The forms will also let you know when the letters have been received, which is helpful at reducing your stress.

• Make sure the professors have agreed to write your rec letters before you fill out the online rec forms, because otherwise they can get kind of grumpy.

• There's a check-box waiving your right to ever see the letters, and you'll want to check all of them. The schools and your writers both expect you to do that, and even if you don't you'll only get to look at the letters in the school's records after you attend - long after it's sent and

done with.

- *Ask advisors, those how you've done research with, profs you think know you well enough to say all sorts of nice things. Give them as much time as possible. No one likes too tight a deadline, and its not good to annoy the person you're asking to sing your praises by not giving them time to fit it into their busy schedule. Some profs may not even write for you if you don't give them enough time.*

- *Ask well before your applications are due (remember, professors are busy people). It's a good idea to provide them with a self addressed envelope to make it easier. I had a letter from my advisor as well as one from a professor outside of the department with whom I had taken several courses.*

- *Get recommendation requests to professors as soon as possible, and if you had an internship, try to get a recommendation from them because it might look like you're hiding something if you don't.*

- *Um... don't ask them the day before it's due.*

The GREs

There are two GRE exams you will have to take if you're applying for graduate study in physics. Each test cost approximately $130, plus score reports. The general exam (usually just called "the GREs") is much like the SATs, and with minimal studying you will probably do very well. This exam, which covers math, reading, and writing skills, is computerized and can be taken at any time during the year as long as you sign up ahead of time. Testing centers exist around the country.

The subject exam in physics, or physics GRE, is generally considered to be a rather brutal test. Forget you ever took the AP physics exams or the SAT II Physics. Extensive studying is advised. The test is 2 hours and 50 minutes long, 100 questions, and is a paper exam. It's given in May and early November. Register early to be sure you can take it on campus. If you take the subject test in early November, the scores will make it to your schools on time (assuming you pre-assigned them). Even if you think they won't be in by the deadline, the same is true for everyone else who took the test on that date (which is most people), and the schools know it. Furthermore, lots of schools receive your scores electronically, so they'll get them as soon as ETS actually scores your test (though this can take up to six weeks).

General advice for the subject test includes studying past exam question for a long time prior to the test, ideally beginning in the summer before you take the test. ETS used to print a book of four past exams, and this (now out of print) collection will be your only source for real example exams. This book costs about $400 online, but your physics department may have a copy; in some cases (especially if you're at an REU), you may be able to get a copy from a university library. When you register for the subject exam, ETS will also send you a single and more up-to-date practice exam. There are a few other texts available, but they don't contain real test questions and are renowned for being really bad.

The General Exam:

• *The best thing you can do for the general GRE is take a few practice exams. The questions aren't too difficult, but it is a challenge to answer them all in a short amount of time.*

• *Don't stress yourself out about the general GRE. Practice the math a little ahead of time just to warm up some of that high school math machinery. As long as you can read and write in English, you'll pass the verbal and writing sections.*

• *As far as the general GREs goes, try to take it during the summer or early fall term. Any time later and you're cutting it really close. Also, study for it... Liberal arts students tend to do well, but studying really*

can't hurt your score and it's an amazingly coachable test. I had the Kaplan book and it was immensely helpful. Also, In my experience, a lot of the people who work at ETS are stunningly incompetent. If you're having trouble with them for some reason, ask to speak to a manager (or two) until you find someone who actually knows what's going on.

• Take the General GREs early. This summer even. Once fall term rolls around, you'll be busy. The Generals are not hard; don't stress about them. You'll do fine. But once you're done, STAY ON TOP OF YOUR SCORES. Don't let ETS screw you. Take advantage of every free score report you get. Make sure your scores get reported. If you're unsure, email the program.

The Subject Exam:

• When you register, make some decisions about where you want to apply, because they give you four free score reports when you register and after that they're fifteen bucks a pop, plus a six dollar "service call fee" even though it's automated and you don't actually talk to anyone. They mail a score report form out to you when you register for the subject test, but it needs to be returned to them more than a week before you actually take the test. Knowing this can save you $60.

• I took quantum from a more matrix-based approach, but almost all of the quantum on the GREs is from the wavefunction approach. I'd say it would be really intelligent to go back beforehand and get yourself aquainted with the formalisms of the PDEs wave approach. I probably could have answered more of the questions but I didn't know what they were asking because they weren't phrased in a way that was familiar. Although a few of the questions are in Dirac notation, but those are usually really simple as long as you understand the basics of the notation.

• I started studying from textbooks, over the summer, and figured I'd go back and skim through all my old textbooks. Don't do that, it doesn't work. The intro and modern physics books were really helpful, however; skimming through them and paying attention to equations in blue boxes can be really useful. Otherwise, I'd say do practice problems and go look up the things you don't remember.

• You can sometimes find the tests online, even though they're not supposed to be there, if you look hard enough.

• Do all of the problems in those practice tests, because if nothing else, ETS loves to recycle questions, or give you the same question with one value changed. If you do all the questions there, odds are you'll end up

with a question you've seen before. They also always love the question about Maxwell's equations and magnetic monopoles.

• The other general strategy that I think worked pretty well was eliminating answer choices just based on the units, because a lot of times, you don't even really have to know how to do the question. You just have to know what units the answer would be in and then there will be only one or two answers with the right units. That said, the tests in the ETS book (the four old tests) are actually a lot easier than the real test, because a lot more of the old questions can be answered by dimensional analysis.

• If you had a textbook with you, you could solve these problems. You could do them easily if they were homework problems. It's very different from how we study for exams here or how we do all our homework. You could get ten or fifteen questions if they just gave you Purcell. Take a long period of time to look over your textbooks to remember those equations... flashcards are good.

• There's something to be said for route memorization of equations... you get a hundred questions in just under three hours, so even if you really understand the Compton equation for wavelength expansion perfectly, you should have it there in your mind. You don't want to sit there and take five minutes to derive it.

• The GRE sucks. Take it anyway. Study hard. Memorize those equations and practice cold recall (even though you'll forget them by third term). Finally, don't borrow a GRE practice book from your professor and then leave it out in the rain.

• If there's a dumb mistake you can make doing a problem, you can be sure that answer will be there. It'll be right next to the right answer.

• There are a few practice GRE books that are put out by people that are not ETS, and they're awful. There's a big purple book ["The Best Test Prep for the GRE Physics" by REA, Joseph Molitoris], don't buy it. It was just a waste. We worked on the problems in there and couldn't get a single one.

• It's really helpful to go into the test knowing what kind of questions are your strength and focus on those. If you can pick out the types of questions that you know you have down cold and skip the ones you know you're not as strong on, that can really help your score. Also, basic special relativity and the Doppler shift equation are things that show up on every test.

• If you can get your act together to organize a weekly study session with your friends during fall term, do it. Despite your best intentions, you might find that's the only time you study for the GREs. It can be hard to prioritize it if you're working alone, and you have a hard term. It's gonna be a source of guilt for you all of fall term.

• I've been told that GRE scores are used primarily for comparison of institutions that the admissions committee doesn't know a whole lot about, particularly the international institutions. So if you're from a place like Carleton and someone there knows about it, the GREs might not be as big a deal. They really just want to know if you'll be well prepared, and studies have shown that the only thing the subject GRE predicts is how well you'll do in your first two years of classes.

• I've heard first-hand from the directors of two different graduate programs that they expect liberal arts students to do poorly on the subject GREs. We haven't had as many specialized classes and tend to not be trained very well to do fast, multiple choice tests. So they know we're not going to do as well as students from tech schools or big universities.

• My advice is to do GRE practice tests until you get sick and then do some more. Go back and figure out all the ones you missed. Sorry. It's the only way.

• I essentially did not study. It seemed to work out... I'd like to believe that good programs do not use your GRE score as a major deciding factor, but I really have no idea what they do with it. It's probably best not to stress too much about it.

• If you want to get into a program that fixates on test scores you should do well on the tests. I didn't take the physics GRE and I didn't study for the general GRE. That might have hurt one of my applications, but it may have helped me find an institution and advisor that were a better match for my personality.

• Especially for the physics subject tests, the more [studying] the better. I think many liberal arts students don't put enough emphasis on this and resign themselves to a low score. Many schools that you might fit with perfectly research-wise may never even look at your application beyond this number. Go into the exam having at least taken two older exams under real testing conditions so that you know what you are up against.

• Take the subject GRE now (your senior year), regardless of your immediate plans (you can take it again, but it's much more difficult if

you've been out of school for a while, so I've heard). Study often, talk with other students taking it, and make sure you do old tests (preferably in a timed environment at least some of the time). Don't be nervous about aiming high, even with what you might consider mediocre scores - many people I know in grad school (professors and students) did not do spectacularly well on the physics GRE.

• I would add that there's no such thing as doing well on the subject GREs, only doing well enough. The goal is to get into grad school, then throw it away and never look at it again.

Fellowships and Funding

One bonus to going to grad school in the sciences is that you won't be accruing more debt. Most of the loans you may have now won't start to collect interest until after you're out of graduate school, and the program you attend should at least provide you with a tuition waiver and a stipend you can live on. Unless you're offered a fellowship as part of a recruiting move, you'll likely work as a TA for your first year or two and then move to a lab for a research assistantship. RA positions are often more difficult to get for theorists, but most schools will promise you continued funding of some kind.

Fellowships are large lump sums that you don't have to work for. You will be automatically eligible for a department fellowship at some schools when you apply, but there are often others (especially minority scholarships) that you'll have to apply for separately. In the fall of your senior year you can also apply to the National Science Foundation's ridiculously generous two-year fellowship, which is difficult to get but also very worth it. That will require some proactive efforts on your part, however, since it's due in mid-November.

Some schools have an earlier deadline for their fellowship applications than their program applications, so be sure to check!

- *I didn't apply to any fellowships, but found that most science Ph.D. programs only accept students if they can fund them. Masters engineering programs don't always provide funding right off. Ask current students about how stable grad student funding is. Some students have to write grants to fund themselves.*

- *The available funding often changes by subsections. A lot of the theoretical stuff doesn't really have money for students, so they'll have to work as a TA for their entire career. They'll also be in a research group, but won't get any money for it.*

- *A warning: many fellowships are geared towards fields with practical applications, which may hurt or help you depending on your interests.*

- *The more fellowship applications the better, if you have the time.*

- *I suggest that you apply [to fellowships], especially things like the NSF - if you get a good one, you can often write your own ticket as far as research advisors and areas of interest.*

- *You're clearly not going to graduate school to make the big bucks, but it's also nice to be able to eat. Think seriously about the funding if there's a big discrepancy between your offers, look at the cost of*

housing in the areas, and consider calculating what the money will wash out to over five or six years; some offers may look great but end up summing to less in the long run.

- *You should apply for fellowships, and again in your first year of grad school if you don't get one this time around. I wish I had.*

- *Figuring out who has funding is harder to work out - a lot of that is word-of-mouth. Those guidebooks do have some information about that, as well.*

- *A lot of labs only have one graduate student, and that's usually a bad sign about how much funding the groups are getting. If they publish lots of papers and have lots of postdocs, that's a good sign that they have money, but the downside is they might not want to talk to you.*

- *I found that the particularly well-endowed places like to tell you how much funding they get, so it might be a good way to think about it; if they tell you how much money they have then they probably have a lot, and if they don't mention it that can be a bad sign.*

- *I applied to two fellowships, each one from a specific school. I wasn't even aware of these fellowships until professors whom I wanted to work for mentioned them to me. Be sure to ask about fellowship opportunities, there is a lot of money hiding out there.*

Contacting Potential Advisors

Many people suggest picking a professor whose work interests you at each of your schools, and contacting them well before your applications are due. This approach has multiple benefits: you'll begin to narrow down your interests, appear serious about the program, have someone to cite in your personal essay… and, if you make a good contact, maybe even have someone in a position of influence who will vouch for you.

A good phone call or introductory email expresses your interest in their research, includes a line or two about your background in the field (this is a great place to cite REU experience), and asks whether they plan to take on new graduate students in the next few years. Some professors will be frank about having no funding, some will never respond, and some will be friendly and enthusiastic. If they offer to speak to you by phone or invite you to visit their lab, take the opportunity. Graduate admissions, unlike undergrad, have a lot to do with who they want *that year.* Does someone with your interests need a grad student at the moment? It means grad school apps are a lot less predictable than undergrad apps, but it also means any contact you can make with professors will be valuable.

- *For each institution, contact a professor who's work interests you, early enough to get a response; having a person in mind while writing the personal statement makes the process more pleasant.*

- *In my experience, some will be really friendly and some will blow you off with a "I put my efforts towards students who have already been accepted." Their reaction may actually end up telling you something helpful about their potential as an advisor. I contacted people and found it informative, but I think it helped me more than it helped my application.*

- *I sent out emails to professors I thought were doing interesting things, or sometimes just to departments. Some professors wrote back, called me, or referred me to another professor. Others I never heard from. Talk to professors before you apply, often times it is just a matter of funding. If they aren't looking for a graduate student you can save yourself some time.*

- *I tried contacting potential advisors, with mixed results (professors are busy). At my current school, professors went out of their way to contact me during the applications process, calling me at Carleton to discuss things with me personally, which I appreciated a lot (and contributed to my decision). Have some familiarity with profs' research and experience before contacting them, if you choose to do so - you want to be able to talk intelligently with them.*

• [Contacting professors] is probably THE biggest overlooked point by applicants. In particular, talking to professors about their research and ability to fund students can give you a good in.

• I mentioned a couple of professors in my personal statement, and then I ended up contacting them as well. I found out later that they actually read my application and had recommended me for admission to the committee, which is kind of nice. I've heard a lot of strange things about admission to grad school, they have committees and a lot of it is professors saying that they want someone to work in their group and do x, and bid for people, so it's not always like undergrad where you get ranked. Little connections can help.

• I did email individual professors at the schools I applied to and said, "Hi, I'm interested in your group. Are you planning to take on any new students in the next few years?" I also mentioned those people in my essays. I don't know if that helped me or hurt me... I think it helped, but I can't be sure.

• Not all the professors you are going to talk to will have great people and verbal skills, so don't be totally awkward or weirded out if they're not personable. But make a mental check of that; do I want to spend the next six years working with someone has no social skills?

• I contacted professors ahead of time at all but one of my schools. It's a great idea. It will make your application stand out a bit, which is really important considering how many applicants they get every year. Having a prof who is interested in working with you is a huge help.

• I contacted people at all the universities I applied to, and it definitely helped. Not only did they look for my file during applications, but they also provided a good place to start when going to visit.

• I think [contacting potential advisors] helps in learning what the department is like, if they are generally good with answering questions, if they are helpful, who is taking grad students, etc. but I doubt it influences their decisions on whether or not they accept you.

• I emailed a few professors. Most never responded, but one from UPenn did. She was very nice and pointed me at a few of her groups papers I could look into. I didn't get in, but I was waitlisted. Talking to her may have helped, but I can't be sure. If there's someone you're REALLY interested in working with, by all means get your name out there and try to get your foot in the door.

• I e-mailed the professors I was referred to and asked them if they

were looking for students. I then crafted my application to the school around that professor. Some background work on lab websites allowed me to find out what that professor was doing in particular, and then I talked about that in my statement of purpose. I also used my statement of purpose to describe how my background had prepared me for the work I wanted to do, and I tailored my statement to each individual professor.

- *I came in and talked to a professor before I applied and it was very helpful. It gave me a much better idea of how the program worked than reading the official stuff.*

The Personal Statement

By the end of fall term you'll be finished with the subject GREs, and you'll think the worst is over. It is, but writing the personal statement is often the second most stressful part of grad school apps. For college apps we were told to be exceptionally original, but it's hard to know what tone to strike for the graduate school personal statement. Get started early, and find a few really good critics to help you.

Two pages double-spaced is a good maximum length - much over that and you're risking being boring. Some schools will also provide specific length requirements.

The essay usually consists of a strong opening, a discussion of your research experience, your specific interests, and why you want to go to that school in particular. If you've made contact with a professor at the school, cite that and express your interest in their work. Also include any teaching experience or involvement in your department.

Finally, really investigate the programs you're considering. The more you know about what makes that program special the more you can tailor your essay, and they seem to really appreciate that. They want to know how well you'll fit in there and how good a grad student you'll be to them. If you can talk about their personalized graduate curriculum, research rotations program, or their new nanoscience institute, it'll show real interest and knowledge of their program. Personalizing each essay will take a long time (especially if you apply to lots of schools), but it'll be worth the work.

And the obvious: make sure you have the right school's name everywhere!

• *Don't get too saccharine (the problem with mine), have lots of people vet it for you, and be honest about what interests you about physics and what you can bring to the school that accepts you.*

• *I knew that there were a lot of liberal arts skills that I have that will make me unique and really important to a department, so I spent a lot of in my personal statement saying, "I've proven that I can do physics and that I can do research, but I also have these other qualities that I don't think a lot of your applicants might have, and here's how I will apply them to planetary science in your department. This is why you want me rather than someone else, because this is how I'm going to add to your program."*

• *Get many people to look over it. Give a balance of general statements and specific examples of what you've accomplished and what you want to accomplish. Be unique, so that they remember your statement over the 500 others they read. Don't be afraid to talk yourself up. It's*

difficult, but you have to do it.

• It helped me to think of it as a job application - what my background was, how I'd be a good TA/researcher, how I could help them. They don't really care about why you're motivated, they just want to know that you are motivated. My first version had a long story about how I got involved in physics, but I ended up cutting almost all of that in favor of saying, "Clearly I'm interested in this because I've done x, y, and z in terms of research and classes, and here's what I want to do with it in the future." Show that you're interested and excited, but that you really know what a career in science will entail. They want to know that you have direction and will stick with it when it gets tough. You don't want to be dry, obviously, but think of a personal yet professional way to explain your reasons for wanting to devote another six years to physics. Don't use the word "passion." Try really hard to avoid cliché of any kind. Sell yourself as a job applicant, more than by telling them how they can help you. Just saying, "I'd love to go to your graduate school to continue my dream" isn't necessarily what they want to hear.

• The actual application process is grueling. You really should have other people help you with your personal statement. I didn't ask for comments on mine (I was too chicken), and I think that hurt me.

• You don't want to be really redundant about information that's already in your application at other places, so if they have a separate place for really detailed information about the research that you've done, use that. You're only going to have maybe 500 words, and the whole point of the personal statement is to make sure that they remember you. If you're just putting in all the information into essay form that you've included elsewhere as a list, I don't think that's very helpful.

It's also a good idea to think about the atmosphere of the department you're applying to. Cornell, for instance, has a lot of liberal arts students, so in my application I played up my other interests and liberal-arts-style skills. But if I was applying to Caltech I don't think that would be a very helpful strategy, because I know that they don't really care about that, so I'd focus on other things that fit better with the atmosphere of that university. That's one way to tailor your applications to individual schools if you've done your research.

• Obviously, the technical aspects (grammar, spelling, etc.) are important. Be honest about your aspirations and explain what you hope to get out of the grad school experience. If you have an idea of the type of research you are interested in, mention that as well.

• Since I knew fairly little about the details of what I wanted to study, I spouted some boilerplate about wanting to study physics to understand

the universe. If I had actually had the time/motivation/ability to figure out what the current big questions in neutrino physics were and what efforts were being made to answer them, it probably would have substantially strengthened my application to demonstrate this. However, given that I didn't, probably speaking in generalities was a better tactic than trying to BS based on Scientific American articles or whatnot.

• I started with an overview of research work and experience. Start with something solid, and then feel free to propose your own theories. Make sure that you start with really solid points about yourself. Then, if you have some revealing personal anecdotes, include that.

*• When submitting personal statements, read them through *very* carefully to make sure you don't still have the name of the last grad school you applied to hidden somewhere amongst your expertly cut-and-pasted masterpiece.*

• The one thing you have to remember is what they're looking for in a graduate application. They're going to spend a ton of money on you for at least the first two years and they're not going to get a return for it, so what they want to make sure of is that by the time you're done with those two years you're going to be competent. So what you want to show on your application is that you're a safe investment for them to make and that you can do things well. I found it really helpful to think of it as selling myself as an investment to the university.

• The applications I put a lot of time into, I got in, and the ones I just sort of routinely filled out I didn't get in. At Princeton, for example, I emailed a professor and told him I was interested in numerical relativity, and he said they were hiring a new guy to start a numerical relativity group at Princeton, so I wrote in my essay that I wanted to contribute to their new and growing numerical relativity group. That ended up being really effective.

General Advice

• If you are waitlisted, do not be afraid to call and talk with department admissions. Had it not been for a call to the professor in charge of admissions, I may not have ended up in Madison.

• Apply early. Don't be late. Don't be on time, either. Most deadlines are Jan. 15th but some are Dec. 15th, and some places will offer fellowship money to early acceptees. Also, put away some money if you're going to apply. Ask for help for Christmas. It costs a LOT of money to go through this application process.

• It's a lot easier to decide a Ph.D. isn't for you after a few years and graduate with a master's than to finish a master's program and try to get into the Ph.D. program.

• Don't feel pressured to enter grad school immediately out of undergrad. Most of the really good students I know here took a year or two off, usually doing useful things (lab work, travel, etc), and it has made them much better students. Consider deferring if you're unsure, or getting some physics-related experience before plunging back into classes. I know I've felt burned out at points, and could have benefited from a year off.

• If you want to apply and then defer, don't tell them that initially. Get accepted, then tell them that. And make sure before you apply that they'll permit deferrals. They've secured a space for you, and they tend to find that a lot of the people that defer for a few years end up deciding that they don't want to go to graduate school after all. So it's more of a risky investment for the school, and even if they allow deferals it's better not to advertise that when you apply.

• If you want to take a year off, that's not at all unusual or looked down upon by admissions committees; if fact they often seem to prefer that, because the people who come back tend to be very dedicated and know why they want to do it, rather than just going because it's the next step. If you decide to wait before applying, though, try to take the GREs while you're still in school, and get your recommendation letters squared away.

• If you are feeling a little burned out, don't worry, that's normal. Taking a year or two (or three?) off after college is entirely healthy. Grad school can be an intense experience so make sure you start out with the same excitement and energy you had during new student week.

Good luck!

• There are a ton of graduate programs that want physics majors. You'll learn new things very quickly in graduate school, so don't worry about going into something that you feel you know a lot about right now. Engineering, meteorology, oceanography, biophysics, and applied math are obvious possibilities, but depending on your non-physics classes there may be several other areas you can study. Many sciences depend on physics.

• Start looking at schools, coming up with your personal statement, talking to professors, asking for recommendations, studying for the GRE, and everything else, as soon as possible!

• A word of caution: Do not make any agreements to work with somebody until you get to the department. I chose to come to this graduate program because of the professor I was talking with. He seemed great, even in person, and asked me to come during the summer to jump-start research. I was excited. Of course, I did not do thorough research as to what it is I wanted to study in general, but thought that mineral physics would be a good area. I ended up hating my research as well as my advisor and got stuck in the middle of a departmental feud when I switched advisors to his enemy. Contact people you think you would like to work for to get a feel for what it is they do and what it would be like to do research with them. Do NOT make formal plans to work with anybody until you get a chance to be in the department and get to know all your options. It's silly to narrow things down when you don't have to. Getting a jump start on research is something you should do only if you are completely sure, and even then proceed with caution.

• Order transcripts early - it can't hurt, and hoping they get there on time isn't a stressor you'll need.

• Do an REU and independent research. Independent research was one of the best experiences I had at college (and it looks good on resumes).

• Getting into grad school is a lot of work. Worry about it and devote time to it. Sure, you're already busy with comps, but forget that. Everyone passes comps. Not everyone gets into grad school. So if your aim is grad school, make it the priority.

• Be on top of things. Don't wait till the last minute. Don't be insecure. Talk to the faculty, they're a phenomenal resource. Lean on your friends; but be careful. Grad school is a touchy subject for a lot of people, and it can create a lot of stress since we tend to compete for a lot

of the same spots. Be tactful, and keep in mind that not everyone gets in everywhere; as Carleton students, we're not used to being told "no," and its a competitive process. Be kind to your friends and support each other.

- *My recommendation is to start networking. Alumns are very good for that, even parents who aren't in the same field. Talk to people you know who have parents in the field you're interested in, and get yourself out there. My way was mainly through an internship. By showing the school ahead of time what success I could have in the lab and research, they wanted to keep me working at their school. So get an internship, get your name out there, and start looking now!*

- *I guess the biggest piece of advice I would have is to talk to as many people as possible. Get advice from your current professors, people you know who have gone through the process, etc... It is very stressful, but the more you talk to people, the more options you'll realize you have.*

- *If you still want to go to grad school then read some of Piled Higher and Deeper at www.phdcomics.com. If you still want to go to grad school after that, then you might just be crazy enough to survive it. Best of luck!*

Visiting and Deciding

Most schools send out acceptances as they pick students, so the first emails you'll get will probably be acceptances and the rejections will come later (if they come at all). Offers should begin to arrive around March, and you'll need to decide for sure by April 15th, the universal agreed-upon deadline. Schools may offer to fly you out for a visit; if so, you should absolutely accept these offers, especially if they're someplace warm. In a lot of parts of the country, March is spring.

• *When you're on the visit, talk to people! Ask questions! Be brave! They let you in, they're not going to toss you out because you ask to many questions on the tour.*

• *Go expecting it to be an all-day thing. Be well-rested. Most programs have a whirlwind of two or three straight days of breakfast at 8am and evening events, and you really want to make the most of it.*

• *Don't get discouraged if you get turned down. You are not a failure. Most people who will respond to this questionnaire will tell you how great it is to be accepted, and how much fun it is to visit, and how exciting it is to make your choice. But the truth of the matter is, you will not get in everywhere you apply. And that's not a bad thing; it's a fact of life. The admissions process is subjective. There will be a lot of applicants. You will be turned down. But don't let it get to you, and don't let it consume you. I learned that the hard way.*

• *Listen to your gut about where to apply and where to accept. You'll know which places feel like a good fit and which ones don't.*

• *If you're seriously considering a school, take the time to talk about housing with current grad students when you visit. At some schools everyone lives in the school-sponsored housing their first year, and you probably wouldn't want to be left out, but at other schools it's not your best option. Your visit may be your only chance to get that information. Also, some schools will put you on a housing waitlist before you've even accepted, so it's worth asking if that's possible.*

• *PAY ATTENTION TO CURRENT GRAD STUDENTS!! When you visit schools make sure you talk to the grad students. If the department is hiding them from you, it usually means they are unhappy in the department. If they complain they hate their lives, listen to why. I got fair warning from the grad students of my former advisor and didn't listen. I thought it would be different with me. It was not. But also know that being a grad student automatically means lots of work and lots of complaining, so be able to filter advice.*

• *Visit as many places as you can even if you don't think originally that you're interested in a given school, because you might be totally surprised. Plus, I thought it was really fun to meet the other incoming grad students in my field because a lot them I met at all of the places I went to, and some of the professors were telling stories about they met colleagues they work with at grad school visits, so it's a good way to get to know people who are going to be working on the same things as you are.*

• *Talk to current graduate students. They, more than anything else, will give you an idea of the department. Ask them if they're happy. You can just straight-up ask if they're happy, ask what they don't like, and most of them will be very honest with you, especially the students you just meet and haven't been set up with by the department. The disgruntled people will tell you at least as much about a department as the happy ones. If you have time, get a sense of the environment of the school and the housing situation, what quals are like (some places pass everyone, some fail out half of their 2nd-year grad students), whether the atmosphere is competitive or collaborative, and whether there's funding. A campus visit will give you a strong sense of atmosphere, which you may love or hate; I would say never go anywhere you haven't visited.*

• *I visited my top choices and made sure to seek out professors who had interesting research projects. Even if you aren't invited to an official recruiting weekend, make sure to check out the department's website, and if possible, make a trip out there on your own if it's one of your top choices.*

• *In addition to paying attention to all the things they say, also pay attention to the things they don't say. These visits are very well-run and well-scheduled, and someone has thought a lot about the things that they want to focus on and the things they want to sort of push under the rug. So those are the things that you should make a mental note about: "They didn't mention this, so I should remember to ask a grad student about it."*

• *Applications are expensive, but if you get in, it's kind of a payback. They treat you well.*

• *I visited the schools where I'd been accepted (on their dime) and decided where I wanted to be. When you're deciding where to go, I'd recommend making sure to take some time to talk to each professor you're thinking of working with, to see if they're a person you can spend six years working with. Also be sure to talk to the grad students. They'll likely tell you what it's really like working there, the professor's management style, the degree of bureaucracy at the school, the financial support provided (RA/TA), the ease of living on such a salary and other such things. Ask tough questions, since you will be there for a while, and try to see if you would get along with the professor and the other grad students in the group.*

Further Resources

http://pages.physics.cornell.edu/~larrimore/gradschool.html

http://www.dartmouth.edu/~physics/academics/beyond.ug.degree.html

http://www.csus.edu/indiv/t/tumminia/Grad.htm

The Ph.D. Process: A Student's Guide to Graduate School in the Sciences by Dale F. Bloom, Jonathan D. Karp, and Nicholas Cohen. Oxford University Press, 1998. ISBN: 0195119002.

GRE: Practicing to Take the Physics Test by the Educational Testing Service (ETS). Educational Testing Service, 1997. ISBN: 0886851971 (although other editions occasionally surface).

Kaplan GRE Exam 2006, Premier Program (Book & CD-Rom) by Kaplan Publishing, 2005. ISBN: 0743265440.

Peterson's Game Plan for Getting into Graduate School by Marion Castellucci. Peterson's, 2000. ISBN: 0768903912.

A Ph.D. Is Not Enough: A Guide to Survival in Science by Peter J. Feibelman. Perseus Books Group, 1994. ISBN: 0201626632.

- *Read the websites of the programs you're interested in detail; many have links to student's individual pages, which are also great for seeing what life as a grad student permits you.*

- *Any of the professors is a good resource; after all, they've all been through the grad school application process!*

- *Gradschoolshopper.com is a great resource. It's all the content of the Big $70 Book-O-Graduate Programs, only free and searchable!*

- *I did a lot of websurfing to find some cool non-tradition physics programs. Google schools, peoples names, and science topics.*

- *Utilize the GRE practice books we have. They give you a lot of good practice questions. Other than that I tend not to trust a lot of the material out there because you never know who has what agenda when they're creating all of it.*

- *www.insertphysicsdepartmentwebsitehere.edu. The departmental*

websites of most schools have a lot of information regarding the program, the professors, the campus, etc.

Final Thoughts

The application process is a pain, and it's often terrifying. The wait can be very long. It's tough to judge your own competitiveness, and you may start to second-guess just about everything. Still, though the resources for grad school apps aren't as easy to find as they were for college applications, they do exist. Seek them out.

Your winter break will be full of personal statement drafts and time spent in the line at the post office, but keep in mind that in the end you'll be getting paid to go to school instead of accruing the unimaginable debt of med school or non-science graduate school. Think about that a lot when you're writing checks to your reach schools.

You'll survive.

Melina Blees and John McDonough, SDAs 06/07