

THE RUTGERS UNIVERSITY
DEPARTMENT OF PHYSICS AND ASTRONOMY PRESENTS

“If I Were Starting Over.....”



Dear incoming graduate students,

“If you were starting graduate school over again, what would you tell yourself?” This is the question we asked all members – current students, postdocs, faculty, and staff – of the Rutgers Department of Physics and Astronomy. Their answers are surely worth a sociological study, but for the time being, we hope they can be useful as you begin your journey through graduate school. From inspirational to cautionary, from research to recreation, here are the wise words of our department’s collective experiences. You can find them under five categories: GENERAL ISSUES, RESEARCH, ACADEMICS, PROFESSIONAL DEVELOPMENT, and LIFE.

And of course, welcome to Rutgers!

Sincerely, the 2011-2012 GSO officers:

Michael Manhart
Maryam Taherinejad
Amit Tagore
Aline Ramires

GENERAL ISSUES

Don't hesitate to ask the important questions as you study, even when they seem naïve. Engage in lots of conversations with professors and other students. Seek the deepest possible understandings – don't be satisfied just because you have learned to solve a problem, but pursue the “why” of the problem solution. For each new concept or idea, ask not only what it means or why it works – but explore how you might yourself have discovered it, were it not already known to the world of physics or mathematics. Work “smart” as well as “hard.” From the beginning, keep a personal journal of unanswered questions or ideas that you have but cannot pursue immediately.

Gerald Goldin, professor



Talk to people. As many as you can – professors, postdocs, other students – and do it early and often. Not only will this establish a multitude of useful contacts in the department, but it is essential for broadening your horizons and learning from their wisdom. And don't limit yourself to a particular research group. Talk to people from all areas, especially in your first year, but continue as much as possible even after you've picked an advisor. It is amazing what you can learn from a discussion about your research with someone who knows nothing about it. Often they ask the seemingly naïve questions that are most important. I've learned far more from talking to people than in any class, and I suspect this is true for many others.

Third-year graduate student



Don't just be a joiner, be a starter.

Graduate student



Ask many questions! No matter how much physics you know now, there's so much more to learn, and your professors and classmates can help you get there. If you feel silly taking up class time or you're embarrassed (which you should never be), meet your professor in private. Many are happy to chat with you and clear things up, and you'll get great 1-on-1 attention.

AJ Richards, graduate student

Graduate school is indeed a time to explore your interests, but do not be lackadaisical about it. You are still a part of a large machine that only needs you for the labor and the good PR associated with benefitting your life in some nondescript manner. This is still, in spirit, some kind of extension of undergraduate college or better yet, high school, with all of the same lack of respect and control over one's life.

Its length, however, can be shortened greatly. One should try to get past one's courses as quickly as possible (not taking them at all if necessary) and start research with someone as soon as possible. It doesn't matter what you do, just do something vaguely interesting, complete a few projects, and move on with the next stage of your career. Nothing is ever going to be perfect so compromises must be chosen carefully.

No one really cares about what you do as a grad student later on. The important thing is that you are actively learning skills that you will actually use in the future (post-docs are under much more pressure) and making the connections to people who will hire you down the road.

Find allies quickly, most importantly among the faculty. One should not expect to encounter enlightened beings who understand your follies and insights. One will meet only technicians and bureaucrats. Do what you can to at least find people with intelligible speech and respectable habits: this is as good as it gets.

Lastly, do not forget about life on the other side of the ivory walls. One can easily become ill with too much exposure to work and study. Of course, it is the case that the vast majority will leave academia. It is therefore wise to cultivate interests outside of physics which can carry one beyond unfortunate tribulations in one's career.

Anonymous



Never forget that science is a human pursuit. Even though we are seeking "truth" in some objective and rational sense, scientists are still human beings. With that inevitably comes all the subjective and emotional aspects of being human. Too often, as scientists, we try to hide or deny these things: we want to be cold, objective machines that process information without regard to our feelings. But not only is this impossible to achieve and likely to damage one's emotional health, but it ignores the great importance that beauty, intuition, and sheer wonder play in the scientific endeavor.

My advice is to embrace the human aspect of what we do. We are more like artists than computers, but our great pursuit is not the human condition but the physical universe. Accept the emotional roller-coaster that is being a scientist – from determination to disillusionment, from ecstasy to humiliation – and surround yourself with people who will be supportive of you, not only as a scientist, but also as a human being. And do not submit to anyone who expects you to be otherwise.

Anonymous

If you don't know: Ask!

Grad student



Do not worry about impressing people, or appearing less than brilliant. Be generous with your knowledge and understanding as you acquire it. Remember that although it may not always seem that way (and they may not know it), your professors are learning from you just as you are learning from them. Above all, keep alive the flame of love for scientific understanding, truth and integrity. Let this, and not fear of failure, always be the source of your energy and inspiration.

Gerald Goldin, professor



Have fun in graduate school. We are lucky enough to be able to do what we want to do, so don't stress about the little things. Grades don't really matter (as long as you score high enough to keep funding and pass the qualifier). Research is much more important. Grades in graduate school are nearly completely subjective: Get over it! It is not worth stressing over. The qualifier is a lot of work. Start early and work hard on the qualifier. The oral questions will be painful: it is for everyone. It is your qualifier committee's job to figure out what you don't understand. They are often looking to see how you think on your feet, not just how well you have prepared. Start research as early as physically possible. Don't trick yourself into thinking that you will just start when you finish all of your classes. Starting early will help to prepare you for the qualifier, possibly provide you funding, and put you in your advisor's good graces. Classes will also be easier if you are involved in research (at least if they are related to your research area). Getting your hands dirty is often the best way to learn something anyway. Graduate school is hard work: put in the effort! Don't expect everything to be handed to you on a silver platter; it rarely is. However, the work is worth it and hard work does not go unrewarded. Don't just work hard, though: take time to relax and rest. I find that my efficiency drops by orders of magnitude after working too many hours in a row. It is better to start early and put in a constant level of effort for several days rather than pulling an all-nighter to finish something that I hadn't started until that day. The quality of the work will likely not be as good (and your professors will notice), not to mention the quality of life in general. Good luck and have fun!

Curtis McCully, graduate student

All knowledge is valuable. Never underestimate any topic because you think it is not important or not on your field. In undergrad you create your physics background; grad school is the time to understand how beautifully connected physics is.

Grad student



The perspective of having begun graduate school over 40 years ago is at once staggering and frightening. But a few words of advice might be useful.....

The most important aspect of success in graduate school is your attitude. You need to want this, more than anything. Only with that perspective can you navigate all the pitfalls of graduate school. You will be getting criticism (hopefully constructive) from many sources: friends, professors, parents, etc. You need to cultivate a “thick skin” so you can extract what is useful from them, while not getting discouraged just because someone said something silly or hurtful.

You need to give yourself permission to make mistakes. The requirements of research are quite different from those of your undergraduate education. For the most part, you will be doing something that no one else before has done. No longer is the answer to the question something that someone has already solved. Your imagination will therefore be key, for the first time. You need to be able to play: with data, with equations, with ideas..... You need to accept the frustration of having things break, or not being able to put that equation into a form that can be readily integrated, etc. It may take days to do something that you thought would be done in minutes. Accept this, and move on.

The positive side of all this, is that your project will be something that you know more about than anyone else in the world, including your advisor. Thus, most questions, exams, etc. will be as colleague-to-colleague, with YOU in charge. You will be living this project, day-in, day-out, and you will probably have anticipated almost all aspects of it, in advance. So you don't really have to be afraid of your yearly meetings, or your thesis defense, etc. (even though, of course, you WILL be!).

Remember that the essence of science is NOT what we know, but what we DON'T know. Therefore, do not be ashamed to ask questions, even though you seemingly make yourself vulnerable to the charge of ignorance. You MUST be able to do this, even though some people may make you shrivel up (physicists are notorious for being socially “difficult”; learn who has a sympathetic character, and who should be avoided.....). Adopt the attitude that asking questions is the mark of intelligence, and NOT ignorance. (This can be hard to do!)

Don't burn yourself out. Know when to take a break, so you don't get stale. The demands placed on you will be enormous, so there is a tendency to be nervous about everything: homework, lab work, “progress.” Trust yourself when you feel you need that weekend off, or the need to sleep a bit more in the morning. You'll know if you are making the right decisions with respect to this, if you return to work feeling renewed or refreshed. If, however, you don't feel that way, you have to figure out what is preventing you from being motivated.

This can end up being a complex psychological problem that you need to meet, head-on. Life is complicated; accept that.

Have fun! You need to appreciate that you are being given a unique opportunity to learn something new about the Universe. Very few people are this lucky. Just keep up the good work that you have begun as an undergraduate. Recognize that even though there will be tense moments (even weeks!), everyone here WANTS you to succeed, and wants to help. If you're having fun overall, the process will be smoother and easier to cope with. It's a long road, but it is worth it.

Terry Matilsky, professor



RESEARCH

Read the book The Art of Being a Scientist: A Guide for Graduate Students and their Mentors by Roel Snieder and Ken Larner (2009). It has useful material for everyone, but has a few chapters on choosing a research project/advisor that is best read during your first year.

Graduate student



Find yourself an advisor who is enthusiastic about helping you learn and improve. Avoid working with people who are forever evaluating whether you are “good enough.”

Gyan Bhanot, professor



Be prepared that even when you did all the thinking and planning well ahead, still 90% of your attempts at an experiment will fail and that is normal. You will be disappointed, you will want to quit, but at the beginning of the next day if you are truly interested in finding the answer, you will start with fresh new energy and try again. And most importantly, never start over without understanding what failed before; in other words, learn from your mistakes.

Fifth-year graduate student



As long as your research is going on, write all your preliminary results, in digital format, and make nice and beautiful plots of those preliminary results with an initial caption. It will help you to write your thesis and future articles. When the time comes, and you have to start writing your thesis, you will have all the material that you need; and all you have to do is to link the material, writing a very nice story for your thesis around the plots and the paragraph that you already have.

Diego A. Torres, postdoc

Choose an advisor who actually gives advice! That may sound obvious, but some advisors are much better than others at guiding students to a good thesis project and helping them find a good postdoc or other career path. It helps to have your letters of recommendation written by someone famous, but it helps even more to have an experienced guide help you navigate the peaks and valleys of completing a Ph.D. thesis and applying for jobs.

Physics and astronomy faculty member



Read Steven Weinberg's essay "Four golden lessons" (Nature 426, Nov. 27, 2003). His sage advice on choosing a field of research: "Go for the messes – that's where the action is."

Michael Manhart, graduate student



I would strongly encourage new students to take their time before selecting an advisor, let alone a branch of research. Determine what you want to get out of this experience and what options you would like to pursue at the conclusion of your degree. Talk to upper level graduate students about their experiences, but understand that each student has their own personal bias. Lastly, enjoy the time with your classmates, even when you are sympathizing over a rough exam or solving a Jackson problem; your stay at Rutgers will not last long!

Third-year graduate student



How to deal with everyday life if you do experiments: "Ever tried. Ever failed. No matter. Try again. Fail again. Fail better." (Samuel Beckett)

Fifth-year graduate student



Find an adviser – pretty much like "dating": In addition to the usual process of meeting, discussing and figuring out if you and your adviser are a good match, if you do experiment visit the labs and meet your possible future lab mates – they are the ones you will be spending most of your time with, so it is important that you feel comfortable in that environment.

Fifth-year graduate student

When you do thesis research, there will be times when the work will seem overwhelming. At such times remind yourself that you are working on developing new knowledge in some aspect of Physics, so of course the work is challenging. But it is also a remarkable intellectual adventure. Say to yourself, “This is MY project and MY responsibility. I am going to see to it that it is carried out successfully.”

Mohan Kalelkar, professor



Dear incoming students:

Doing research is an intensely personal pursuit. If you don't know the reason you're doing a PhD, figure it out soon. To get the ball rolling, here is cosmologist Ralph Alpher's point of view:

“There are two reasons you do science. One is the altruistic feeling that maybe you can contribute to mankind's store of knowledge about the world. The other and more personal thing is you want the approbation of your peers. Pure and simple.”

My reply to Ralph? “The probability of making a big discovery is small, but the probability of being paid to do something you truly enjoy each day is large.”

Anonymous



Find a good thesis adviser. Look for someone who will give you the support you need to grow and allow you to shine. It's important to do something you like, but don't be so focused on your first desire that you ignore good possibilities. If you are planning for an academic career, it is important to have a good thesis, which will help you get a good post-doc, which is really critical to getting an academic job. It's hard to tell what areas will be “hot,” and being in a hot area will also mean you have lots of competition, so don't focus overly on that aspect. While it is always good to have a plan, be open to opportunities, especially when you are first starting out. Life is full of randomness, sometimes that will work in your favor if you pay attention.

Anonymous faculty member



Go to SSPAR, the student seminar series, as much as you can, especially in your early years. It's great for learning about research in many different parts of the department.

Fourth-year graduate student

Keep an open mind with regards to research. Many people discover completely new interests in graduate school, so even if you think you know what you want to do, try exploring a few different options first (i.e., go to some seminars, talk to faculty members, other students, etc. in different groups).

Biological physics graduate student



ACADEMICS

Take the core courses. It's tempting to avoid them if possible, but knowing basic physics well is essential.

High energy physics graduate student



Register for classes as late as possible to avoid premature term bills. If you are unsure, you can register for random classes and change your mind during the first few weeks of the semester.

Simon Knapen, graduate student



*On exams, if you are stumped, write down what you *do* know about the problem. Use complete sentences. Ask questions in class, even the dumb ones. Your classmates are all wondering the same thing.*

Bob



Take the placement exams seriously. Don't waste your time on core courses if you can skip them.

Third-year graduate student



Balancing research and studying for the placement exams is very difficult; do not try to do both, since you will end up half-assing both, and then you will neither get the paper published nor pass out of the annoying classes. That said, it is definitely worth the time investment to pass out of an annoying class.

Graduate student

My advice to the first year students is to take the required physics courses very seriously. Since 2009 (when the new qualifying procedure became mandatory), over 30% of first year students “failed” one or more of the six required first year courses. To advance to candidacy, you must receive a B or higher in Classical Mechanics, Statistical Mechanics, Quantum Mechanics I+II, and EM I+II (astrophysics students are not required to take QM II and Statistical Mechanics). If you receive a C+ or lower (effectively “failing”), you will have an opportunity to take the challenge/placement exam to pass the course. The department has significantly increased the difficulty of the challenge exam from 2009. You need to do well on it to pass out of the course, and few students who fail a course pass the corresponding challenge exam (the challenge exam is harder than the class finals). If you fail a course and do not pass the challenge exam, you must retake the course and receive a B or better or be kicked out of the program. Since so many students did not pass the courses (and the placement exam is so difficult), the first year courses had many upper classmen in them. For example, only about half the students who took EM II last semester were first year students.

You really want to pass these courses, as your second year should be devoted to passing the research qualifier. I recommend that the first year students talk to the second years about classes and professors. They can tell you what each professor is looking for and help maximize your chances of taking the required courses once. If you do feel that a professor is being unfair in grading, I encourage you to talk to the graduate students on the graduate student life committee (Curtis McCully or Brandon Patel).

Good luck with your first year.

Brandon Patel, graduate student



Homework handed in on time with errors is almost always better than perfect homework handed in late.

Bob



If I could start over my graduate career, I would take Overview QFT, or special topics in solid state in the first semester, but not many-body physics.

Second-year condensed matter graduate student

Classes matter, but not for long. This is your final chance to learn general physics (and astronomy) material before moving on to Ph.D. research. Good grades help when applying for graduate fellowships and are a chance to impress potential advisors and to build your confidence, and decent grades are needed to advance to candidacy. However, good course grades are in no way a guarantee of success in research, either during Ph.D. or future career - doing research is entirely different from taking classes. It is very rare for anyone to ask for your transcript or even GPA once you get your Ph.D. and apply for postdocs or other jobs.

Physics and astronomy faculty member



PROFESSIONAL DEVELOPMENT

Writing well and giving good talks will give you a serious advantage in your career.

Graduate student



Do not forget all that faculty members do besides research: advise students, teach classes, sit on committees, give talks, apply for grants, review papers, etc. If you want your advisor's job, you should try and get some practice in as many of these areas as possible while you're still a student and it's okay to learn from mistakes. You'll be a much stronger job candidate for it down the road (assuming you have all your research ducks in a row).

Graduate student



Keep your eye on the prize. Because the things that really matter take so long, it's easy to get distracted by small tasks such as installing a neat computer program that might eventually help with your research, or reading yet another paper. Or to key in on tasks with clear deadlines (like problem sets or grading) versus those that lack deadlines but are more important in the grand scheme (your research). You need to spend some time on all of those things, and you should never miss deadlines, but once you start research, if you don't make progress in a given week or month, it's time to think about why and to discuss the hang-ups with your advisor.

Physics and astronomy faculty member



Attending seminars is tough, but oh-so-important. Many people think they only need to attend talks in their area of interest, but this is a big mistake. Everyone's time is limited, but there is a huge benefit to attending as many talks as possible, even outside your field. Getting out of one's comfort zone will strengthen you as a researcher and open your mind to possibilities you may never have considered.

Theory graduate student

You need to give talks at some point eventually. Student seminars are the perfect opportunities to gain the skills and experience you need in a friendly setting.

Condensed matter graduate student



If not already, become familiar with Linux/emacs/L^AT_EX, etc...

Bob



When you become an advanced graduate student, be sure to help any undergraduates or new graduate students who may be in your professor's research group. Show them the ropes, and be a great mentor.

Mohan Kalelkar, professor



Publish or perish is 100% true. It is not worth it to go on the academic job market half-cocked.

Graduate student



Stay mathematically strong. My biggest regret in my time here was not knowing enough mathematics. You always hear that math is the language of physics, but you really start to appreciate that fact at the graduate level. Most of my coursework struggles were because I didn't grasp the underlying mathematics, rather than failing to understand the physics.

AJ Richards, graduate student

Set realistic goals for yourself each day. Problem sets can take several days, studying for exams can take weeks, publishing a paper takes many months, and completing a Ph.D. thesis takes years. So it can be very difficult to see progress each day, and that can lead to procrastination or a sense of not accomplishing anything. Be realistic about how much you can accomplish in a given day, and try to get it done starting each morning. Once a goal is achieved, give yourself a break! You can even set small goals for each morning, afternoon, and evening if that works for you - just try to accomplish something in each time period, and your small accomplishments will accumulate into larger ones.

Physics and astronomy faculty member



Go to seminars and colloquium: of course, you will not understand everything the speakers will be taking about – it will all seem unclear, but that is the key part – getting yourself exposed to new things. After a while you will read about them, ask around experts about them and by end of your PhD things might get clearer.

Fifth-year graduate student



Regarding seminars: follow mathematician Ravi Vakil's advice. (Google him for lots of other great advice for grad students.) He recommends writing down three things during the course of every talk. These items can be a simple definition of a term, an interesting example, an important big question, a question you want to ask the speaker, a key result, etc. The point is to make sure you take away three SPECIFIC things from each talk, even if they are extremely modest.

Anonymous



LIFE

As a staff member and a mother, I have come across a lot of students who come from overseas and have left home for the first time. I tell them that I am here for them, and if they are in need of anything other than money, please come see me. I have had students come to my office telling me that they received money from a credit card company not realizing that it is the card's way of getting you to get a credit card. I would tell them that before you sign your name to any check that is from a credit card company, please come see me. When they have health issues such as a stomachache or headache or even a simple cold, they would run to the emergency room at the hospital and wonder why they would receive a huge bill instead of going to Hurtado Health Center. Sometimes they would just need someone to talk to because they miss their mom and dad. So if we could have someone help them in that way, I think it would be helpful to them other than physics. I have many friends that I keep in touch with because they have become my friends, not just students.

Diane Soyak, staff



On the personal front, I'd say from a purely practical view you should look for a spouse with more options for jobs than a physics person. The "2-body problem" is much less of a problem if your spouse is a lawyer or dentist or almost anything but another academic. Look for someone who will complement you with strengths where you are weak. This is by far the most important decision you will ever make, use some reasoning. However, true love goes a long way in the world, pay attention to your heart. If you want kids, don't wait too long. If you go to parent-teacher meetings and they don't know if you are the parent or grandparent, you waited too long.

Anonymous faculty member



Make friends with your classmates. When you're sitting in the ARC lounge working on an E&M problem set at 1 AM, you will very much appreciate having friends next to you, both to make you laugh and also to collaborate with. My favorite part of grad school has been the camaraderie. You and your classmates are a team going through an ordeal together.

AJ Richards, graduate student

Go to the gym when you can – it’s free! Be sure to maintain a balance of work and play.

Fourth-year graduate student



Get to know your fellow graduate students, both in your own year and in other years. Not only will it make classes more manageable, but it will make your life so much richer.

Anonymous graduate student



Live within your means. As hard as it may be, always try to put 10% of your take-home pay into savings. Discipline on this front when you are young will make your life much easier when you are older. Finding when you get to 60 that you have more money than you know what to do with is a lot better than finding you can’t make ends meet. And doing cheap stuff when you are young is a lot more enjoyable than when you are older. I enjoyed going to cheap “all you can eat” places when I was 25. Now I don’t want or need that much food, but I like the expensive stuff and don’t enjoy the cheap all you can eat places anymore. I didn’t mind sleeping on a friend’s couch when I was 25. Now I want a comfortable hotel.

Anonymous faculty member



Take advantage of Rutgers recreation programs, especially the outdoor trips (hiking, skiing, etc.). They are inexpensive, a great way to meet people, and a great way to explore the region without a car.

Maryam Taheri Nejad, graduate student



*Keep some snacks in your desk.
For unlimited scratch paper, raid the paper recycle bins in the ARC computer lab.
Use www.nextbus.com to avoid waiting outside for the bus. Weekend 1 bus = clockwise, Weekend 2 bus = counter clockwise.
“National Brand” computation notebooks make great mouse pads.
If it is raining, you can walk almost all the way to the student center while staying indoors. Enter the Hill center, and track northeast...
Any card will open the parking gates, even a library card – but the lots are monitored by parking enforcement.
Coffee is not a food group.*

Bob

Make good friends now. It's much harder to make friends when you are older, and the friends you make now may last much of your life.

Anonymous faculty member



Try to find one thing every week that is non-physics related that you always do no matter what.

Anonymous



Get to know graduate students in other departments. Yeah, it's hard, but it's well-worth it.

Graduate student



Schedule time for exercise, relaxation, and sleep, and protect that time on your schedule. It's easy to feel like you need to work 24/7 to excel in graduate school. But nobody can work that many hours efficiently. Letting yourself get out of shape will reduce your energy level and productivity, and at least for me, exercise is key to keeping the stress level manageable. Relaxation, be it a healthy social life or even just playing a few computer games, can keep you happy and confident in your work. Finally, you need to think clearly to do well in courses and research, and sleep deprivation makes you dumber. Some people manage to start a family and still excel in graduate school - that requires careful time management but is definitely possible.

Physics and astronomy faculty member



Keep an optimistic attitude. You will be much happier.

Anonymous faculty member

Contrary to what MTV and New Yorkers might tell you, New Jersey is actually an extraordinarily multifaceted state. There is incredible natural beauty – forests, rivers, beaches, hills – and an abundance of sites rich in culture and history. Be especially sure to check out the northwest quadrant and southernmost tip of the state.

Michael Manhart, graduate student



Read the PHD web comic. It's funnier when you are grad student than when you're an undergrad (because it's true).

Graduate student



AND FINALLY.....

If you were to ask a thousand different people the question, “What would you tell yourself if you were starting graduate school over again?”, you would get a thousand different answers. Graduate school is by its nature a highly individualistic endeavor, and our answer to this question is in large part shaped by our own personal trials and tribulations. So while I would take heed of what others have to say, at the same time, I think it is most important that you never stop asking yourself how YOU would answer this question. The answer will evolve drastically, but I think continuing to be reflective of the process and the bigger picture will help you keep things in perspective, and make for an overall more fulfilling experience.

Tahir Yusufaly, graduate student

