SO YOU'RE STUDYING PHYSICS AT BROWN...

WELCOME!

The Physics Departmental Undergraduate Group (DUG) is happy to welcome you to Brown Physics! We sincerely hope you enjoy taking classes and getting to know the folks in our department. DUGs exist to foster community and interest in their respective departments and to help students build connections with professors and alumni. Each semester the Physics DUG organizes a variety of events designed to achieve these goals, from social events to advising sessions to research talks with faculty. Although our events are open to all concentrators, we focus specifically on providing resources and support to physics students.

INFO AND RESOURCES

There are 4 concentration tracks in the physics department for the B.A. degree, and 6 tracks for the B.Sc. degree. To get more information about these tracks and their requirements please visit: www.brown.edu/academics/college/concentrations/. Alternatively, you can email our concentration advisor, Professor Dell'Antonio at Ian_Dell'antonio@brown.edu.

*** If you are taking an introductory physics course this semester, your email will be added to the Physics DUG listserv. If you're interested in Physics DUG events but are not taking physics this semester, you can either add yourself to the listserv at listserv.brown.edu or you can email physicsdug@brown.edu and request to be added.***

You may also consider getting involved with Physics WiSE (Women in Science and Engineering). This is a separate organization from WiSE in general and is run by undergrads in our own department. You can sign up for their listserv at the same website (listserv.brown.edu) or by contacting wise@brown.edu.

ADVICE FROM OUR CONCENTRATORS

Finally, we want to give you some advice as you start out in physics. A year or two ago the DUG asked concentrators for their advice for first-time physics students. Here are the responses we got:

"Start your homework early in the week! At the very least just look over each problem so you understand what you have to do. The assignments will end up taking you less time since you'll figure things out about the problems while they're in the back of your mind. By asking questions early, you also won't end up confused about a problem at midnight the night before it's due.

Reading slightly ahead is your friend – it's very useful & feels great to be one of the few people in class who have seen the material already so they understand what the professor is doing. At the very least, sit down and read the book. It doesn't matter if you only need a few equations for the homework, you need to understand the concepts & hone your intuitions. The material is difficult and a second (or more) look at it will help you understand it better (even if you feel like you already get it!).

When you get your first test back, be prepared to see a low score. Often everyone or almost everyone in a class "fails" tests. The curve is your friend :)

Lastly, these classes are not your high school physics classes. If you don't understand some of the material you need to learn it now, not the night before the test because you're going to have plenty to focus on at that point without trying to figure out something that confused you before."

"Physics can be hard, but don't let that deter you from giving it all you got. I suggest you read the book (possibly in advance, so read material before going to lecture) and figure out how you learn best by experimenting. Don't be afraid to ask for help from peers and from professors (if you don't understand something that is ok! Don't let that stop you from trying to understand it!)

Some tips on how to do this: go to the study sessions and actually talk to other students (I didn't do this and regret it) and try to make study groups. Professors may be intimidating but they are human, some have kids your age so go to office hours, raise your hand in class, talk to them after lecture; one of their major purposes is to help you! That is why they are teaching the class! I found going to office hours in a group helps, bring a friend or another student.

If you are interested in research, the easiest way to start is a cold email. Physics professors are very open and will love to talk to you and give you ideas. Also it does not hurt to look up what they are researching and maybe glance at a paper or two so you have questions and can make a conversation.

Also go to physics DUG events to meet upperclassmen who can give you tips and are overall just fun to hang out with!"

"So, you want to do physics? You may encounter difficulty and self-doubt after choosing one of the hardest disciplines in the world. Yet, a genuine interest in physics and some determination is all you need to be successful. Physics may be difficult at times; not everything that is beautiful is simple. Believe it or not, there are still many, many gaps in our knowledge of physics. Just remember that you are more than capable of closing some of these gaps. As you progress through the courses here, be aware of the resources available to you. Almost all professors are more than willing to go above and beyond to help you understand the material, no matter how strong or weak your background may be. Do not hesitate to ask a professor any question you may have during or after class, even if your question is about something as simple as notation. Do not let your failures instill self-doubt; some of the best physics students I know failed their first midterms here as freshmen. Be fearless and confident; you and your peers are at the beginning of a path that has been traveled by many and you will have no trouble doing the same. It is up to you to determine whether you will go above and beyond and leave your legacy in the world of physics. (PS: Do astrophysics!)"

"Your mind is a muscle! In college, you will be strengthening it. Physics ability is NOT inherent-- it is something that you can work on and improve at.

Things that worked for me:

- It is incredibly hard to learn material just by reading it. Before every test, ask the professor for last year's exam. Do that, and redo as many of your old homeworks as you can. If possible, take turns with a friend "teaching" each other the material. It will make a huge difference in your grades.
- Do warm ups: Leave 20 minutes before an exam to sit by yourself and redo a bunch of problems that you are confident you know how to do. Make sure all relevant equations are at your fingertips, so you don't start out the exam thinking, "how does this start again?"
- Do problem sets with other people if you can-- learning how other people approach problems is invaluable.
- Professors are great sources of advice. Don't be afraid to email them to ask to chat- they will say yes! Make an appointment with your professor a week before each exam to go over questions, even if you

don't think you have questions at the time-- this will force you to study and really figure out which parts you find challenging.

Ask yourself why your classrooms look the way they do from day one. Physics is a wonderful field, but it has a lot of problems (for example, where are the women and people of color?). Learning about these issues early in your physics career will help make the community more inclusive. If you are a member of an underrepresented group in physics, you are not alone! Reach out to upperclassmen (go to DUG events!)-- a lot of them have gone through similar experiences as you may be having.

Acknowledge variation in high school preparation before being too hard on yourself. Freshman year puts together a lot of folks with very different backgrounds.

Start asking professors about research early! They love talking about it, and you will start learning about how the physics community is organized.

Science has its own language, and there can be a learning curve if you didn't have too much exposure to it in high school. Don't worry-- it will get easier.

Get plenty of sleep! Have fun! Explore other classes too!"

"Go to conference, go to conference, go to conference, go to conference."

"Besides staying up on your studies and coursework, it will definitely pay off to become very acquainted with the resources at Brown and in the physics department. You may be bombarded with resources right when you get on campus like advisors and help but take the time to get to know Brown inside and out. The writing center in JWW is critical to take advantage of even as a science major.

Getting to know your professors and making connections with them is huge. You never know when one may really want to help you down the road. Take advantage of the network you already have sitting here at Brown. You might find that you sit down to talk to one, chat a little and they say "Let me know when you want me to write you a recommendation letter."

Research is key to take advantage of here. Brown is a unique place because it offers so many opportunities to undergraduates compared to other schools. Do not fret if you do not do research every summer or have other interests too. Explore something and make a project about something you want to pursue."

"Establish relationships with professors, both those teaching your classes and who work in the department through research and symposia.

Get outside. Physics is not the only thing in the world, in no small terms. Your other interests will both act as a break from and a new perspective on your scientific work. You can pursue these in parallel or in conversation with your physics work.

Take some science studies courses/feminist critiques of science. They will help you develop humility as well as figure out the best ways to present yourself as a scientist, as a communicator, and as someone who engages within a society.

Become conversant with programming, but also recognize the physical basis of all programming for physics."

"It can be difficult, but make time in your schedule for office hours! At times (often, for me, since I had almost no background in physics before Brown), you may feel like the other physics students are much smarter than you are and don't struggle with the material as much. For some people, this feeling of inadequacy makes it even harder to learn. Know that more of your fellow students than you think are in the same boat as you - talk to each other and help each other out!"

"Be open and honest with yourself and others about your study habits and your study goals. Don't underestimate your own ability to sit down in a quiet room and learn and practice the material, even if it's a slow process. But also don't hesitate to reach out to others for guidance and support--including upperclassmen, tutors, and academic advisors (contact the DUG for more info about different academic advice available).

Outside of your coursework, when it comes to research it's up to you to take initiative and contact professors. Don't feel like you need to know a lot about their work to start working with a professor. And don't be discouraged if you are rejected -- if you keep trying you will find something."

"Keep going- it gets better!"

"When I got here, I didn't really know how to learn, and was a pretty mediocre student as a result. But I've gotten a lot better at it since then. If you are trying to learn better and do better in your courses, my one piece of advice would be: be honest with yourself when you don't understand something. A lot of times it's easy to gloss over something and convince yourself that you "kinda get it." But if you do that, you won't learn very much. If you really want to learn physics, you have to put in a lot of time on your own simply asking yourself if you actually understand things. And you have to be honest with yourself when you don't. When you are honest with yourself about what you don't understand, then you're able to work to understand it, by thinking about things yourself, asking a friend, or asking a teacher. Also, when you're struggling with something, don't be afraid to ask questions. I still struggle with this, because I still sort of worry about asking "dumb" questions. But after sitting in lectures in both physics and engineering for 3 years, I can confidently say that MOST people in class aren't understanding everything, no matter how smart you think they are. So do yourself a favor and don't be afraid to ask questions.

If I could say one more thing, I guess it'd be to remember that the stuff you're learning really is fascinating if you think about it in the right way, and it's a true privilege to be able to spend time thinking about this stuff. Have some fun with it."

"If you're looking to get started with research, look on the physics website to see which professors are doing research that you might be interested in, then email them or go talk to them. They're all pretty nice about it, and, worst case, you can always ask another professor. Try and find at least one or two people (if not more) to study with or talk about the material with from time to time-it's really helpful. Don't overload yourself. I did so freshman year, and, while I handled it decently well, I don't think I got any more out of my classes than I would have if I'd taken a more reasonable course load (basically, just because you can do it doesn't mean you should). And, of course, make sure you take time to relax occasionally. You'll start to get diminishing returns after a while. Anyway, enjoy your time at Brown!"

"Doing homework in a group, and finding that group as early as possible, can make a huge difference in how you feel about your own capabilities. If you're having trouble finding a homework group, go to conference sections and DUG events to meet other potential concentrators. If you find conference intimidating or inconveniently timed, professors are happy to walk through some individual problems or concepts with you (making an appointment or just letting them know that you'll be by during office hours

can help). For tests, reading over notes and textbook sections is helpful but doing practice problems is usually a lot more so. Find people to work with you and go through problems together, out loud, so you learn all of the different ways to approach a problem and have the chance to teach your method to others, which will help to cement it in your own memory. The physics undergraduate community at Brown can be a major support group if you intend to concentrate, so find ways to meet other undergrads and you may be surprised at how much of a difference it makes to have that encouragement."

"Don't worry about your first semester grades! Keep chugging through your math and physics courses and learn as much as you can. There is a really wide variety in high school preparation for physics, but eventually you and your classmates will all be on the same page. If you feel behind (like I did), give it time! Learn how to learn physics and again, don't sweat the grades. Failing your first midterm gives you street cred later when you're acing your courses.

How do *you* learn? I find that the amount of time I spend reading a textbook chapter is not nearly as important as the *number* of times I read that chapter. I also find it really crucial to verbalize what I'm learning, so I like discussion-style study groups. Find what works for you. If lectures and self-study aren't your thing, that's okay! Whatever your style, it's definitely helpful to go to conference- you will get a chance to meet your classmates and interact with your professor more casually. Of course, before an exam you will definitely want to do heaps of problems on your own somewhere quiet so you can simulate the test-taking environment.

Exams may feel very scary. If you experience test anxiety, know that you are not alone. During my first year, I was so flustered on exams I could barely read the questions! As I became more confident, my anxiety decreased. Keep in mind that one poor test performance will not condemn you, and treat the test problems as fun brain teasers rather than building them up to be monsters.

Be friends with other physics students! It's common to feel lonely or inadequate during your first year- combat these feelings by sharing them with your classmates. You will find out that they feel the same way. I've met some of my closest friends in physics, but it took some time. If you don't immediately bond with your class, it doesn't mean you never will.

Some physics textbooks are quite old and use default "he" pronouns (they always refer to physicists, mathematicians, etc. as "he"). This is frustrating and it sucks. Know that there are fantastic women in this department and that more recent textbooks do not use this outdated convention. It feels good to know other physicists who look like you or share your identities, so reach out to them.

Finally, don't be afraid of your professors! Ask them about their research, their kids, their undergraduate experience, whatever. They are people first and professors second, after all.

Physics is difficult, but if you stick with it you *will* get better at it. Good luck!"

What other departments have courses that are useful to physics majors?
At some point in your physics career you will almost certainly need to know how to code. CS classes are a way to learn that, but you might also be fine learning on your own or online. Brown has a pretty good engineering school, and there is an abundance of cool courses there. In particular, the electrical engineering courses have been extremely relevant to my physics education. They also provide you with lots of practical tools (like oscilloscope techniques) that will give you a leg up in future labs and research positions. Lastly I would give a shout out to the DEEPS. There are some incredibly cool people in that department doing some really interesting research in physics-related fields, especially planetary science.

How do I choose which physics track to pursue? Does it matter which one I do?

First know that all of the tracks are essentially the same during your first two years, apart from perhaps an astrophysics elective or two. It's okay to take a look at the requirements for each track now and ask yourself: which of these classes do I want to take? It may sound obvious, but your major should consist of classes that you are genuinely interested in. If there are multiple tracks that interest you, don't fret! There is plenty of time to switch tracks later in your career (some even do it senior year) and you will have a better idea of which trajectory best suits you after taking a few more classes. For example, are you interested in the Mathematical track? Try taking Abstract Algebra at some point in your sophomore or junior year to test it out. And remember, you don't need to declare until your sophomore spring and there is no limit on the number of times you can change your mind about your concentration..!

---

1) What is the difference between proof-based and more computational math classes? More generally, how do I decided which math courses to take? What are the benefits of calculus, linear algebra? 2) What are the benefits of learning computer science?

How do you get summer research positions?

Networking is really important! In addition to filling out online applications for programs like REU, you should talk to your professors and TAs for sure, but also seek out anyone you know -- through family, friends, school, neighbors, or a community organization -- who are involved in or connected to your field. Having an "insider" who can personally recommend you, or at least get you a face-to-face introduction, can go a long way towards snagging you that research opportunity.