Leaping Into The Physical Sciences
A First Year Course Selection Guide
Life is not easy for any of us. But what of that? We must have perseverance and above all confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained.

Nothing in life is to be feared. It is only to be understood. Now is the time to understand more, so that we may fear less.

— Marie Curie
1903 Nobel Laureate in Physics
Many people experience a whirlwind of emotions as they enter college. You may be excited to move out and begin life on your own, as well as meet new people and try new activities. However, it is perfectly natural to be a bit nervous, too, as college is a completely new experience. You may feel pressure to choose a course of study. The Undergraduate Women in Physics (UWIP) and Princeton Society of Physics Students (PSPS) have come together to demystify course selection and the physics and astrophysics majors. Drawing on the wisdom and experience of current and prospective majors, we are here to help you overcome any confusion or academic doubts and guide you through your first years at Princeton.

After working hard in high school, it may seem like the only viable path to a challenging major such as physics or astrophysics is to take the hardest, most advanced courses as early as possible. The goal of this guide is to convince you that this is not the case. Just as there are a plethora of research fields within physics and astrophysics (atomic physics, cosmology, biophysics, nanotechnology, etc.), there are a plethora of ways to pursue the physics and astrophysics majors. While your junior and senior years give you the opportunity to explore your research interests, your first year allows you to choose your fundamental physics base. The important thing to take away is this:

It is more important to get a solid understanding of physics than to push oneself to take a course that is too advanced.

All come from different schools, states, and countries, and therefore we approach our studies with different backgrounds and perspectives. With this in mind, it doesn’t make sense to compare yourself to your peers; rather, it is more important to ensure that you build the unique foundation that you need to be successful.

To figure out which courses you want to take, think about which subjects most interest you. If you are reading this guide, then your interests probably involve some combination of physics, astrophysics, and math, although they may also involve chemistry, biology, poetry, music, or any number of other things. When looking through courses, invest some time in thinking about them, but remember that your first year is not going to make or break your Princeton career. There are plenty of students that begin in one field, and, after their first year, decide to move on to something else. The liberal arts system ensures that your first two years are open to explore your academic interests, so don’t restrict yourself.

Once you have some courses in mind, look at course reviews. At the end of each term, students are asked to review the courses they took. You can find these reviews either on the Registrar’s page or through a variety of student-built course selection websites (one favorite being Princeton Courses). It is also very important to think about scheduling. The easy part of this is to ensure that none of the courses you want to take, including elective classes, overlap (a good resource for mapping out your schedule is Recal). You should also put some thought into the kind of life you want to have at Princeton. Are you an athlete? Which clubs or activities do you want to try? Do you want more downtime to relax, or do you thrive off intense academic work? Remember that college courses tend to require significantly more out-of-class time than high school classes. Keep in mind what is important to you and choose a level of academic engagement that fits how you want to structure your time.

If you are debating between classes, remember that Princeton has a 2 week “shopping” period. This period is designed for you to sample the classes you are deciding between. With the exception of a few courses, it is much easier to switch to the “easier” course than the “harder” course. While shopping classes, pay particular attention to (for example) how accessible the professor seems to be, and how the pacing of the class feels to you. Any issues that you have with these things in the first two weeks will likely persist. The most essential part of shopping, however, is to take both courses seriously while you are trying them so that you can get an accurate gauge of which is a better fit for you.

Finally, once you are in a class, take advantage of opportunities and resources. If you are struggling in a class, seek out the help that you need. Don’t automatically assume that your struggles are a weakness or sign that you are not fit for the class. Talk to your professor, your peers, your advisers, a mentor, upperclassmen, and/or your dean to help determine if a course is the right one for you. In this guide, you can find a “Campus Resources” section at the end, which can be a starting point for what is available.

Don’t be afraid to ask questions, whether it be during lecture, in precept, office hours, or at a problem session. It can often feel as though silence is a sign that everyone understands the concepts, but the reality is at least one other person probably has the same question as you.

We hope that you will stop by the physics and astrophysics tables at the academic fair. We look forward to meeting you!

Sincerely,
Undergraduate Women in Physics
uwip@princeton.edu

Princeton Society of Physics Students
psps@princeton.edu

Welcome to Princeton!
CONTENTS

06 ASTRO/PHYSICS
COURSE SELECTION HELP AND FACULTY & STUDENT INSIGHTS

12 MATHEMATICS
APPLICATION VS. PROOF COURSES AND STUDENT INSIGHTS

16 INTEGRATED SCIENCE CURRICULUM
COURSE OVERVIEW, STUDENT INSIGHTS, AND FREQUENTLY ASKED QUESTIONS

22 CAMPUS RESOURCES
ACADEMIC, PSYCHOLOGICAL, AND MENTAL RESOURCES

26 USEFUL LINKS
FACULTY CONTACTS, TOOLS, AND ORGANIZATIONS

28 ACKNOWLEDGEMENTS
AUTHORS, DESIGNERS, EDITORS, CONTRIBUTORS, AND SUPPORTERS

07
Welcome to the Princeton Department of Physics! We on the faculty are eager to meet you and to discuss physics together. If you are interested in majoring in physics, then there are a variety of course options for the fall semester:

- **PHY 103:** This introductory mechanics course is a great place to start if you have not previously taken a college-level physics course with calculus.

- **PHY 105:** If you have a 5 on both the Physics C Mechanics and Physics C Electricity and Magnetism exams, then PHY 105 may be the better fit for you. It presents a more advanced treatment of mechanics and includes an introduction to Lagrangians.

- **ISC 231/232:** The Integrated Science Course is a double-credit course that provides an integrated introduction to physics, chemistry, molecular biology, and computer science.

- **PHY 205:** If you have already covered the material in PHY 105, then you may request to take PHY 205, the sophomore-level mechanics course. Placement into PHY 205 is by examination only on Tuesday, September 10, 3-6pm, in McDonnell 108; note that you must sign up for PHY 105 in the initial course registration process.

In deciding which course is the best fit for you, keep in mind that the most important thing is to build a strong foundation in the core concepts as opposed to over-stretching towards the most advanced option. Feel free to sit in on the first week of a class, study its syllabus, flip through the required textbook in the library, and/or try your hand at the first problem set. This will give you a feel for what any given course will be like, and will help you decide if it is a good fit. And of course, never hesitate to reach out to a faculty member for advice!

Looking forward to meeting you,

**PROFESSOR MARIANGELA LISANTI**  
PHYSICS UNDERGRADUATE REPRESENTATIVE

For students interested in Majoring in Astrophysics — the study and exploration of our Universe — the important courses to take are the following:

- **PHY 103 or 105 (Fall) and 104 or 106 (Spring) of Freshman year.** The PHY105, 106 sequence is a more advanced level (for those who have 5 on AP Physics C).

- **PHY 205 will be taken Fall of sophomore year, and PHY 208 in the Spring of sophomore year.**

- **AST 204, “Topics in Modern Astronomy”, is highly recommended for all students interested in an Astro Major.** It is offered every Spring, and can be taken the Spring of Freshman year if you have Calculus and AP Physics; otherwise take it the Spring of Sophomore year.

- **MATH 103-104 (Calculus) and 201-202 (or 203-204) are prerequisites for becoming an Astro Major and should be taken during Freshman and Sophomore year.** (AP Calculus is used to determine your MATH placement).

Students are welcome to consult with the Astro departmental representative, Professor Neta Bahcall (neta@astro.princeton.edu) if you have any questions.

**PROFESSOR NETA BAHCALL**  
ASTROPHYSICS UNDERGRADUATE REPRESENTATIVE
“I took only the lowest levels of all of the math ([MAT 201/202] and physics classes ([PHY 103/104]) and was still able to make the transition to [PHY 205] just fine (back when it was the more intensive of two [sophomore year] Mechanics options). I had to work hard, but eventually came to realize that I was not that much further behind my peers and that, in a tough class such as [PHY 205], everyone has to work hard to practice and understand.

The self-awareness and confidence you gain from putting in that work, pushing your limits, and surmounting that obstacle will carry you through Princeton.” — Madelyn Broome (AST, Class of 2019)

### FIRST YEAR PHYSICS COURSES

#### PHY 103/104 VS PHY 105/106

The quick answer is: if you didn’t learn physics in high school or your physics classes weren’t calculus-based, then PHY 103/104 are probably the better classes for you. If you have a very strong physics background from high school, then PHY 105/106 or ISC (or a combination of the two) might be better for you. This answer, however, is limited, as it does not reflect some of the experiences of students who have passed through these classes.

The biggest misconception students have when choosing between 103/104 and 105/106 is that “true” astro/physics majors take 105/106, and an astro/physics major is not realizable if you take 103/104. Your choice of first-year physics courses is not a reflection of your ability to do physics; rather, it is a consequence of your high school physics preparation. Just because you have a different level of preparation does not mean you can’t study physics or astrophysics.

The official recommendation says that you should take PHY 105/106 if you received a 5 on both parts of the AP Physics C exam. However, you should not be discouraged to try PHY 105/106 if that doesn’t apply to you. When speaking with the department and other students, keep in mind that these are only recommendations. Their statements should not be interpreted as restrictions or pressures to take these courses. There are students who have very little physics background who jump into PHY 105 and love it, and there are students who have taken AP Physics and AP Calculus classes in high school and feel much more comfortable starting in PHY 103 to cement their understanding of the material. PHY 103 is structured to introduce students to calculus-based physics, whereas PHY 105 assumes a base level of experience with calculus-based physics.

If you are unsure which class to take, many students strike a balance by starting in PHY 105 and then switching to 103 if they feel out of their depth. The choice is very different from person to person.

Taking PHY 105 does not lock you into taking PHY 106, nor PHY 103 to PHY 104. The first semester (PHY 103 or 105) is mechanics, and many people have a stronger background in mechanics than electricity and magnetism. Thus, when it comes to electricity and magnetism second semester (PHY 104 or 106), many students feel less prepared and decide to take PHY 104.

“Do take PHY 105 if you took AP Physics C and got a 5. However, know that although it does start out deceptively similar to AP Physics C material, it picks up REALY fast after the midterm and it’s going to be very new material (although as the physics department continues to update the new course plan, it will probably be less chaotic than it was for us). You will likely spend a very significant part of your time working on these P-Sets. That said, I feel like the new material does give you an amazing introduction to what higher level physics is about, so I thought it was worth it.” — Connie Miao (PHY Class of 2021)

“PHY 103 was a good fit for me since I took AP Physics B [an algebra-based physics class equivalent to taking AP Physics 1 and 2] in high school. With my preparation, the class was somewhat easy. But I doubt I would have been prepared for PHY 105. There’s plenty of time to take rigorous courses in the future, but during the first semester, it’s nice to be in a manageable course.” — Bhaskar Roberts (ELE, Class of 2019)

“My adviser recommended [PHY 105]. I think that, with its introduction to Lagrangians, coupled oscillations, etc. it was way too advanced for my first calculus-based mechanics class. It was an incredibly intense class, but I did learn a lot from it. PHY103 may give you a better foundation if you have never taken calculus-based physics before. I am still unsure whether or not PHY 105 was the right choice for me, even though I ended up with an okay grade. I decided to take PHY 104 instead of PHY 106 my second semester.” — Anonymous, (PHY, Class of 2021)
SKIPPING AHEAD & ALTERNATIVES

SKIPPING TO PHY 205 (CLASSICAL MECHANICS)

If you have an exceptionally strong physics background and think that you are ready to jump past the general introductory sequence, you can consider going straight to sophomore-level physics courses, starting with PHY 205 (Classical Mechanics). In order to do this, you must take a placement exam (Tuesday, September 10, 3-6pm in McDonnell 108). For some students this is the perfect place to start, but for others, they decide to take 105/106 even though they have a strong physics background.

“I was certain that I wanted to be a physicist and thought I was ready and willing to jump into 205. I ended up loving it — totally worth the hard first semester.”
— Jonah Herzog-Arbeitman (PHY, Class of 2019)

PHY COURSES VS. ISC 231/232

Choosing between one of the general physics tracks or the Integrated Science track is a bit more difficult. The Integrated Science Curriculum (ISC) is geared towards students with strong STEM backgrounds who are interested in research in biology-related interdisciplinary fields (biophysics, computational biology, biochemistry, etc.). It gives students a combination of intense theoretical lectures, delving into physics and math relevant to biological systems, and unparalleled lab experiences. Keep in mind that ISC is double course, which, at the end of both semesters, gives you equivalent credit for PHY 103/104, MOL 214, COS 126, and CHM 201/202.

When trying to decide between general physics and ISC, it is useful to think about what topics you are more interested in. PHY 103/104 and 105/106 will give a deeper understanding of mechanics and electricity and magnetism, while ISC will give a broad interdisciplinary understanding of mechanics and electricity and magnetism, in addition to an introduction into quantum mechanics, statistical mechanics/fluid dynamics, and computer science. For more detailed information on the content covered in ISC, read the Integrated Science Curriculum section later on in this guide.

“I was unsure about what area of science I liked the most and I also wanted to have a good foundation on all of them to support a career as a researcher. I think [ISC] was a good fit for me because the course was challenging but also manageable given the preparation I had. The lab part of the course was also really exciting and exactly what I was looking for as an introduction to scientific writing, reasoning, and data analysis.”
— Gabriel Toneatti Vercelli (PHY, Class of 2020)

“ISC is time-consuming (no one in my year managed ISC alongside MAT 203), but for me it was totally worth it (in fact, I partly regret not staying on second semester). The labs are unlike most other first-year labs that students can get, you get a great first look at thermodynamics and statistical mechanics. I would say that the physics majors complained about there being “too much” bio (the labs felt very bio-heavy) while the MOL majors complained about there being “too much” physics (the lectures are very physics-heavy, as is the homework), and first semester didn’t have too much chemistry at all, but this is an excellent course for anyone with interdisciplinary and applied interests in the natural sciences.”
— Sara Anjum (PHY, Class of 2019)

“ISC is best for those interested in interdisciplinary work or undecided about major; I did not feel left behind relative to those in 105/6 when I got to sophomore year.”
— Christopher Russo (PHY, Class of 2020)
Choosing a math course can often be harder than choosing a physics course because there is a broader spectrum of options. Most students leaning towards physics take MAT 201 or MAT 203 (multivariable calculus) their first semester, as the material covered in these classes is the best preparation for PHY 104/106 in the spring. Students leaning towards math take MAT 215 or MAT 216 (honors analysis: the official first steps in the introductory math sequence). The overlap between the two majors in the first year is large, even though the recommended classes may be different. You can be a physics major if you take 215 or 216, and you can be a math major if you take 201 or 203. Furthermore, you can also be a physics major starting in MAT 103 or MAT 104 (Calculus I and II).

If you are unsure which class is best, spend some time looking at the syllabi for the different classes and maybe even take the calculus placement exam. By reading the syllabus for a class, you can learn which topics are covered and identify interesting or repetitive parts of the material. It is important to keep in mind that college math courses are not all the same and the depth that you cover a topic in high school (or even at a local college) may not be sufficient to skip over the class at Princeton. To better gauge this, the Math Department has provided practice problems for each of the classes. These questions can give you a sense of whether the style and difficulty of problems is right for you.

The most important thing is that you find a class that fits and that you communicate any concerns with the department in order to ease your worries and find the best path for you. 1

With all that said, the next few pages include a summary of the four main options. For more detailed info and FAQs curated by the Math Department, follow the links.

1 The undergraduate representative for physics: Prof. Mariangela Lisanti (mlisanti@princeton.edu)
And for astrophysics: Prof. Neta Bachall (neta@astro.princeton.edu)

“Find a branch of math you like and take a lot of it, there will always be unexpected uses.”
— Jonah Herzog-Arbeitman
(PHY, Class of 2019)

“Find a teacher you like. If you don’t like your teacher, move to another section. This can make all of the difference in the world.”
— Madelyn Broome
(ATT, Class of 2019)

“Expect the physics and math courses at Princeton to be very different than anything you took in high school. If you struggle in the first semester of Princeton math and physics don’t necessarily take it as a sign that you won’t be a good physics major. It probably just means you need to rethink how you go about doing the homework and studying for the exams. Also try to work on the homework problems in groups. It will make the problem sets much faster and help you see how your classmates approach difficult problems.”
— Hudson Loughlin
(PHY, Class of 2019)

“Don’t be afraid to ask for help! The best way to make the most out of classes is working with other people and talking to professors for help.”
— Sam Cohen
(PHY, Class of 2021)
"PROOF-BASED" CLASSES: MAT 215/MAT 217 OR MAT 216/MAT 218

MAT 215/217 is the standard first year curriculum for incoming math majors, providing an introduction to real analysis (MAT 215) and linear algebra (MAT 217). MAT 216/218 goes faster than 215/217 and covers more (and slightly different) ground: introduction to real analysis, linear algebra, and then a little bit of differential geometry. Neither sequence is perfectly geared towards aspiring physics majors (students in 215/217 will never learn any multivariable calculus, for example), but most students who opt for this route end up learning what they need to from their physics classes and are perfectly fine. MAT 216 assumes prior experience with proofs, whereas MAT 215 tries to ease students into this new way of approaching math — although the pace is anything but slow. It is especially worth considering one of these options if you are interested in theoretical physics. A lot of higher-level classes that are important to theory (Algebra and Differential Geometry in particular) list 215/217 or 216/218 as prerequisites.

"APPLICATION-BASED" CLASSES: MAT 201/MAT 202 OR MAT 203/MAT 204

MAT 201/202 are the standard multivariable calculus (201) and linear algebra (202) courses that physics majors take. MAT 203/204 extends past the material covered in MAT 201/202, venturing into slightly more abstract territory. Whereas 201 tends to stick to calculus of 3 dimensions, 203 generalizes concepts to n-dimensions. Similarly, 202 focuses on linear algebra computations confined to matrices, while 204 extends the same principles to more abstract object types such as functions. 204 also places a stronger emphasis on how the material covered in lecture can be applied to other fields (computer science, physics, etc.).

The 203/204 sequence is generally recommended for physics majors, but 201/202 will definitely suffice, especially if you are not interested in in-depth theory. Most of the core physics classes use 201-level multivariable calculus and 202-level linear algebra (the linear algebra used in physics classes is fairly basic matrix multiplication and eigenvalues/eigenvectors), so don’t hesitate to take 201/202 if your background and/or interests make those classes a better fit.

"THE MOST IMPORTANT RESULT OF THE FIRST SEMESTER IS THAT YOU COME OUT OF IT CONFIDENT. NOBODY CARES WHAT YOU TOOK, AND TAKING A HARDER CLASS DOES NOT PUT YOU AHEAD IN A LONG-LASTING WAY. BUT IF YOU’RE CONFIDENT, YOU WILL WORK HARDER AND TAKE MORE RISKS. I FELT BURNT OUT AFTER MAT 203 AND STARTED AVOIDING MATH. I’VE SINCE VENTURED BACK AND DONE WELL IN MATH COURSES, BUT MAT 203 SET ME BACK. IF YOU’RE INTERESTED IN MAT 203, I RECOMMEND ENROLLING IN IT (IT’S REALLY INTERESTING), BUT DON’T HESITATE TO DROP."

— Bhaskar Roberts (ELE, Class of 2019)

"MAKE SURE YOU START EARLY AND TRY THE PROBLEMS FIRST BEFORE ASKING FOR ANSWERS— HELP WILL BE THERE IF YOU NEED IT ONCE THE DUE DATE IS ON THE HORIZON. YOU’LL LEARN MORE THIS WAY!"

— Anonymous (MAT, Class of 2021)

"I CHOSE MAT 203 BECAUSE I HAD TAKEN AP Calc BC and also a [multivariable calculus] class in high school. I originally wasn’t going to take math my first semester but my advisor recommended it for me as a physics major. Because I had taken multi before the material wasn’t that new, but the problems were still very challenging and this class definitely took a LOT of time. Overall, though, I found the class very engaging and interesting and thought it was completely worth the effort that it required."

— Connie Miao (PHY, Class of 2021)

"THOUGHT I WOULD BE TOO OVERWHELMED IN 203 WITH MY OTHER CLASSES, [201] WAS NOT THAT INTERESTING, I SHOULD HAVE STAYED IN 203."

— Anonymous (PHY, Class of 2020)

“You will probably find physics and math to be very hard here. That’s okay. It might seem like you’re struggling much more than everybody else, but the truth is that everyone else is struggling as well. Don’t let imposter syndrome get you down, keep pushing forward and you will succeed.”

— Anonymous (PHY, Class of 2021)
A MESSAGE FROM THE HEAD PROFESSOR OF THE INTEGRATED SCIENCE CURRICULUM

Welcome to Princeton!

I wanted to let you know about an exciting educational initiative at Princeton, the Integrated Science Curriculum (ISC). A little about the program:

• Integrated Science is an interdisciplinary curriculum for students excited about learning science. It presents a mathematically-sophisticated, integrated view of the sciences that will allow you to tackle the problems of the future.

• Integrated Science is challenging and time consuming. Ours is a double-course that will account for roughly half of your workload for the whole first year. It might just be the hardest academic experience you’ve ever had. However, if you stick with it, you will gain proficiency in introductory Chemistry, Computer Science, Molecular Biology, and Physics, allowing you to major in any science (and most of the engineering) disciplines.

• Another important feature of the Integrated Science Curriculum is the extensive opportunity for independent research. We encourage students to start research early, during their first years at Princeton, and we think the Integrated Curriculum provides a particularly good preparation for that research.

I encourage you to learn more about the program by checking out our website (http://lsi.princeton.edu/integratedscience), and by attending the Academic Expo in the Frick Chemistry Lab, where we will have faculty and current students available to answer your questions.

We all hope to see you in the fall!

Best wishes,

PROFESSOR JOSHUA W. SHAEVITZ
PROFESSOR OF PHYSICS AND BIOPHYSICS
DIRECTOR, GRADUATE PROGRAM IN QUANTITATIVE AND COMPUTATIONAL BIOLOGY

AN ISC GENERAL OVERVIEW

COURSE GOALS

ISC motivates students to approach science with a research mindset: problems and topics tend to be open-ended and exploratory rather than procedural, collaboration and seeking help is encouraged, and concepts are combined in creative ways. The course is not organized into biology, physics, and chemistry sections, but rather by mathematical concept. Each unit newly introduced a math concept and then put it into the context of multiple interdisciplinary science problems. Lectures introduce a concept and then precept reviews and expands on the concept. The fall begins with basic, single-order differential equations, followed by second-order differential equations and oscillators (damped and harmonic) and then statistical mechanics. Spring introduces multivariable calculus, examining problems in electricity and magnetism, quantum mechanics, and more. The time commitment is challenging and peer collaboration is crucial; the course isn’t designed to be completed alone, and one gains a lot from collaborative discussions.

1This overview was edited by Bryan To (Class of 2022) and Josh Eastman (Class of 2022) from a Principedia article authored by Milena Chakraverti-Wuerthwein (PHY, Class of 2020) and Shiye Su (PHY, Class of 2020).

“One important thing about ISC is that it is possible to complete all of the assignments and “finish” the course without really understanding how everything works and just scraping by. If you’re already putting in the time and commitment to the course, take full advantage of all of the resources available: from the professors, textbook, and your peers. Make sure that you really understand what’s going on every week and can work through the P-Sets/additional textbook problems more or less by yourself because the level of proficiency that you will need for the midterm and final is not something you can just cram before the exam. I know you’ll hear about how hard ISC is and have a ton of other time commitments once you’re in the course, but if you truly want to take ISC, know what you want to get out of the course and be ready to work for it.”

— Anonymous
A CONTINUED OVERVIEW OF THE INTEGRATED SCIENCE CURRICULUM

LEARNING FROM INSTRUCTION

The first half of the fall semester (until fall break) follows the COS126 curriculum as well as the ISC-specific lectures. COS126 lectures are on Tu./Th. ISC lectures are on M/W/F and are taught by one professor most of the time, but sometimes other professors will come to expose you to their research or problems/topics related to what they research. Precepts are half COS and half ISC. After fall break, you will switch to entirely ISC lectures and precepts.

For the spring semester, you will continue where you left off in COST26, except assignments are every other week and separate COS126. Assignments are even more geared towards a computational biology theme.

During the ISC lectures, it is most important to have a conceptual understanding of the larger picture rather than necessarily following all the details of the derivation. Do not get discouraged if you are lost in a derivation, just try and take a step back to see the larger concepts, because you can get the finer points from the lecture notes. Often, reading over the lecture notes and working through the derivation slowly on your own will clarify or reinforce understanding significantly.

Precepts will expand on what was missed in lecture to reinforce one’s understanding of the current material. A good way to stay engaged is by asking questions. When faced with a silent room, it is easy to assume that everyone else understands and therefore feel as though your questions are somehow naive, but, in reality, your question is probably something that your peers are confused about as well. Once you shift into exclusively ISC precepts, there will be breaks halfway through precept. These breaks are a great time to talk to the preceptors one-on-one about the larger concepts or specific steps in the derivations that you didn’t understand. The preceptors also hold office hours.

ISC labs are fantastic. The lab modules expose you to a broad range of laboratory techniques and acquaint you with deriving data from a variety of experimental setups. The instructors are dedicated to helping you through procedural difficulties and clarifying any conceptual questions. Take advantage of being able to talk to them about the science behind the labs, because it can be really interesting and sometimes can help with lab write-ups. Bi-weekly lab reports are large time commitments, but they teach you to carefully scrutinize data, write scientifically, and present findings in a clear and concise way. Many students after completing ISC say that labs were their favorite part and that they felt prepared to begin research on campus.

"[ISC is] often a miserable amount of work but in higher-level classes that’ll probably be the norm so I’ll prepare you better for the grind. The labs also forced me (a noob) to quickly learn scientific writing skills and MATLAB, which I’ve found very useful post-ISC."

— Anonymous (NEU, Class of 2020)

LEARNING FOR /FROM ASSIGNMENT & ASSESSMENTS

Collaboration is essential for problem sets. Get started early, as they are time consuming and you learn a lot more with time to think over the questions, than you do with a solution hastily explained in an hour of desperation. There are problem set sessions, which are held on Wednesday evenings with a grad student TA who is also your grader for that week. If you are uncertain about what a question is asking, by all means ask them! They are there to help you. It is helpful if you have at least looked through the problems, and possibly started them, before the problem set session so that you have some concrete questions to ask. The TAs are also typically very open to meeting with you one-on-one and going over specific problems or questions if you are still confused on Thursday before the problem set is due on Friday.

Lab reports are typically MATLAB heavy, but don’t forget that neither MATLAB nor programming experience is a prerequisite. Many tips, techniques, and built-in functions for extremely specific objectives exist online (Google it!); both the documentation and informal platforms like MATLAB Central are great. Using LaTeX is very common with lab reports, but this is not a requirement. There is no grading advantage to LaTeXing your lab reports; the content is far more important, so stick to whatever word processor you are most comfortable with. Lab office hours can be great opportunities to ask questions about lab report guidelines or data analysis, but are also a really good way to force yourself to start working on the lab report and prevent procrastination. Lab reports take A LOT of time. Do not procrastinate on them—start early.

In preparation for exams, it’s more important to have an understanding and intuition of the concepts than knowing formulae and minutiae. Do the problems in the notes, including review problems or questions if you are still confused on Thursday. The TAs are there to help you. It is helpful if you have at least looked through the problems, and possibly started them, before the problem set session so that you have some concrete questions to ask. The TAs are also typically very open to meeting with you one-on-one and going over specific problems or questions if you are still confused on Thursday before the problem set is due on Friday.

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EXTRA INFO & FREQUENTLY ASKED QUESTIONS

WHAT STUDENTS SHOULD KNOW ABOUT ISC

ISC is indeed challenging and a substantial time commitment, but don’t be put off by its reputation. If you have a true interest in biology-related interdisciplinary science and are willing to invest the effort, you can succeed in the course while maintaining balance. The class is immersive and there’s much to be gained from the social experience. Furthermore, remember that Princeton has a 2 week “shopping period.” Plenty of people start out in the class before deciding it’s just not for them and then take other classes. If you decide to drop ISC, make sure you are treating the course as if you were actually taking it. Putting in half the effort because you are unsure will only set you up to drop it later. Enjoy, because some beautiful ideas are presented.

FAQS

Q. What math background do I need for ISC?
A. Successful completion of AP BC Calculus or equivalent is highly recommended for the class. It can be helpful to take multivariable calculus (MAT 201 or 203) and linear algebra (MAT 202, 204, 217, or 218) concurrently.

Q. Do I need to take AP Bio/Chem/Physics (or equivalent) for ISC?
A. While more advanced coursework in the natural sciences (especially physics) will help, AP science courses are not necessary for success in ISC. The course does assume some basic knowledge in all 3 areas, but not at the AP level.

Q. Will I be behind when rejoining the main physics major path?
A. Many ISC students will continue on to become astro-/physics majors. Most of these students do not feel disadvantaged within the major, but the way that the two paths are structured, gives each different advantages. ISC covers a broader spectrum of topics, so you will have exposure to quantum mechanics and statistical mechanics/fluid dynamics, which the general physics track does not give you until sophomore year or later. PHY 105/106, however provides a stronger preparation for advanced mechanics / E&M courses, because they have a stronger, narrower focus on those topics than ISC. In the grand scheme of things both classes prepare you to be a physics major, but in different ways (and with different strengths). You have to choose based on (1) whether you want a solid pure physics foundation in mechanics/E&M (PHY 103/104 or 105/106) or a broader biology-based interdisciplinary foundation (ISC) and (2) what kind of work environment you want and how you want to balance that with extracurriculars.

Q. I’ve taken AP Bio/Chem/Physics (or other advanced courses). Will I get anything out of ISC?
A. In most cases, high school courses are not as challenging as ISC. Many people enter having taken any combination of such courses and still exit feeling as if they were exposed to a lot of new content from a new perspective. ISC synthesizes the disparate course content in a unique way, introduces students to potentially more advanced – or at least different – biology than was covered in the high school / AP curriculum, and introduces students to thermodynamics from a statistical mechanics perspective, which is not something that is on the standard AP curriculum. The labs are also, very likely, not ones a person would have done in high school (e.g. Brownian motion, chemotaxis, building a solar cell, and more), and they involve heavy lab report-writing as well as extensive data analysis via MATLAB.

Q. What kind of student is ISC meant for?
A. ISC is meant for students in the natural sciences who enjoy seeing the connections between things. The course content really reveals how disparate natural phenomena are all, at the roots, explained similarly. Students from ISC filter into a variety of majors including: EEB, PHY, CHM, MOL, CDS, etc.

Q. What if I’m still not sure if I want to take ISC?
A. “If you want more in-depth answers or have additional questions, ISC alumni/i are more than happy to answer your questions. Drop by the ISC table during the academic expo to learn more!”

EXTERNAL RESOURCES

This class has an amazing support network, both due to the small class size and to the many enthusiastic alumni. It is easy to develop close relationships with instructors and upperclassmen mentors. Check out when group tutoring is scheduled (several days of the week); these are led by past students who can not only provide academic help (MATLAB/LeiTeX tricks, problem-solving approaches, etc.) but also general advice on the course and Princeton. Make friends with the tutors and TAs! Lab office hours are great for image/data analysis and other problems. If you are struggling a lot with lab, reach out to John Gold (jgold@princeton.edu). She has in the past worked one-on-one to go through lab reports (ideas, writing, figures, etc.) or to give more support and instruction with lab techniques (pipetting, plating cell cultures, using a microscope, etc.)

One thing that students in general do not take advantage of in this class is the amazing faculty. ISC is lucky to have multiple professors on staff, in addition to the 4 TAs (2 lab, 2 problem set) and 2 preceptors, every one of whom is doing interesting research. All of these people are more than willing to set up one-on-one meetings with you if you need help with material, or just want to learn about what they do. Professors are very helpful after lecture, or if you make appointments with them to talk through the material. This is especially true for the professors who may only teach one week of lectures and then have a few problems specific to their field of research on the problem set for that week. The problem set graders may not be acquainted with this specific field, so it can be useful to go to that professor and ask about topics covered in lecture or about the problems in particular. Most of all, take advantage of the amazing opportunity that ISC gives you to interact with an extremely wide spectrum of brilliant researchers.

It’s also important to know how to seek out resources independently on the Internet, especially for MATLAB and LaTeX tricks. If something interests you, read up on it!
ACADEMIC HELP

For many people the academic shock is huge and it takes a semester (or more) to adjust study habits to match the Princeton academic pace. This is very strong in STEM classes because most students have not had assignments that are as involved as Princeton problem sets. Nevertheless, there are a lot of different ways that people adjust within this environment.

PROBLEM SET SESSIONS & STUDY GROUPS

Collaboration on problem sets and assignments, when allowed, is key. Physics and math professors typically encourage students to collaborate on assignments because it builds camaraderie and enhances students’ learning. There are three main methods through which students collaborate: course-organized problem set sessions, self-organized study groups, and the McGraw Study Hall (details later).

Course-organized problem set sessions provide a time and space wherein students can drop in to collaborate on problem sets and ask questions supervised by an undergrad or graduate student course assistant, so they are helpful / in touch with course expectations. If your course organizes a regular problem set session, it will often be a few days before the assignment deadline, so they go a long way to helping you finish a problem set, but may not be ideal for learning entirely new concepts.

While problem set sessions are great, don’t underestimate the power of forming your own informal study group. Working with others in the course provides a peer group that you can compare answers and solving methods with. Such life-saving attachments, when mutual and constructive, go a long way to better understanding the material and different ways to approach problems. Before seeking help of any form, be sure to have made a solid attempt!

RESIDENTIAL COLLEGE 1-ON-1 PEER TUTORING

Peer tutors are undergraduates who have performed well in the courses they support. This is a less frequently used resource, and supply and demand varies more widely between courses. This resource is a great way to get persistent help throughout the semester through a more personal tutor/mentee relationship with one peer tutor. To request residential college tutoring, make an appointment or meet with your college dean / director studies. Depending on supply, residential college tutoring can be an alternative to office hours for help in PHY 105/106 and PHY 205/208 (as well as MAT 215/217), which do not have McGraw counterparts (unlike PHY 103/104, MAT 201/202 and 203/204).

OFFICE HOURS

Office hours are organized by the course staff and a schedule of the hours and attending professor/preceptor are published either in the course syllabus for a given semester or announced in lecture. Typically these are informal meetings where students can turn up within the time slot with particular questions or to discuss general concepts, directly interacting with a single professor or graduate student preceptor. It’s a format that lends itself to more deeply understanding a concept or exploring tangential ideas beyond the more general bare-bones coverage provided in lecture.

“Go to office hours” is one of the most common pieces of advice students give. The utility of office hours can be highly dependent on the supervising professor or preceptor. Past students give good suggestions on which ones are life-savers and which are “okay”; you can also try a few different ones. Office hours are also the easiest way for you and the professor to get to know each other. Not only is this a good opportunity to build connections for future recommendation letters, but getting to know your professors can expose you to completely new research areas that previously you didn’t know existed.

“I would say not to worry if you feel like you have no idea what you’re doing. You will eventually. TALK TO YOUR PROFESSORS. GO TO OFFICE HOURS. I wouldn’t have done nearly as well as I did (in PHY 105) if I didn’t get extra help at office hours.” — Michelle Baird (PHY, Class of 2020)

MCGRAG CENTER FOR TEACHING AND LEARNING

McGraw Center tutoring is frequently cited as a helpful resource that is free and available to anyone enrolled in the course. More than 50% of students take advantage of tutoring; it is not necessarily a sign that one is struggling. Tutoring can help reinforce and explore concepts.

Group study halls are drop in hours that create a study group environment supervised by a few tutors. This is a good space to come with specific questions, get help working through a problem, or collaborate with others on problem sets while having access to immediate feedback / aid. These are most commonly offered for introductory courses such as: MAT 103/104/201/202/203/204, PHY 103, etc. MAT 201/202 and 203/204 students will especially preach the importance of McGraw Group Study Hall for getting problem set’s done.

Individual peer tutoring is appointment-based and allows for more focused and individualized assistance. These are particularly good for those who need more involved guidance working through problems, want to enhance their foundational knowledge of course material, identify areas of weakness, or have a broader range of concepts to discuss. Availability will be on the McGraw Center website during each term. Tutoring is offered mainly for introductory courses, but is not limited to just the courses offered for group study halls (e.g. PHY 105 is not included in McGraw Study Hall, but students in the past have made use of 1-on-1 tutoring through the McGraw Center).

In addition to tutoring, McGraw hosts academic strategies workshops which aid students in learning and applying strategies for purposeful and efficient learning, exam preparation, planning, etc. Princeton students can also make appointments with McGraw learning strategies consultants.

For full descriptions of the McGraw Center resources, visit the website.

“Doing problem sets with friends was definitely the best thing to do for me. It’s not like at office hours or tutoring because nobody knows the answer! But in my opinion that makes it so you learn the material better.” — Sam Cohen (PHY, Class of 2021)

“Going to the problem sessions and making friends to work with was invaluable.” — Anonymous (PHY, Class of 2018)

“Finding a group of friends to compare answers with is a must (they’ll last you years to come) but I recommend working on the P-Sets alone so you know what you actually understand.” — Jonah Herzog-Arbeitman (PHY, Class of 2019)

“The McGraw center has tutoring for MAT 203 and it saved me every week. It was the only reason I finished any of the P-Sets for that class.” — Camille Liotine (AST, Class of 2020)
INSTITUTIONAL SUPPORT

Freshman year can be a difficult transition period for many, and this process is complicated by Princeton’s rigorous academics. The University offers many support systems to connect students who might be having similar experiences in addition to professional counseling for those who want to talk through their problems.

RESIDENTIAL COLLEGES

The pastoral care from your Residential College is often the first point of support. Residential College Advisors (RCAs) are upperclassmen students who understand Princeton’s challenges as an incoming first-year, and have undergone extensive training to help you as much as they can. Likewise, Peer Academic Advisors (PAA) are trained to answer academic-related concerns such as: degree major requirements, academic planning, or adjusting to coursework. Peer Health Advisors (PHA) are also open for conversation around any concerns or stresses you are experiencing and can point you to further resources if you wish, including those in CPS (see below). Of the Residential College staff, the Director of Studies and Director of Student Life deal most directly with student concerns. Feel free to check in with your Academic Advisor through the semester, who is often associated with your residential college.

WOMEN’S CENTER

Women’s Center, located on the 2nd floor of Frist Campus Center, is an inclusive space and community. It hosts interesting events throughout the year with a mission to develop leadership, promote holistic health, build community, mentor and empower, advocate for students, and educate students and staff. The Women’s Center is a great resource for women and men who want to better understand gender issues, improve equality, and develop healthy academic environments.

STUDENT GROUPS

Student organizations can provide a great community, advice, and source of information about research and opportunities. Also, these events often come with free food! There are two main student groups most directly concerned with physics/astrophysics: the Undergraduate Women in Physics (UWiP) group and the Princeton Student Physics Society (PSPS).

UWiP

The goal of Undergraduate Women in Physics (UWiP) is to offer mentorship, academic enrichment, and a welcoming community to students majoring in physics or related fields. We invite all students, regardless of gender identity/expression, race, socioeconomic background, and/or sexual orientation, to become members. As a joint collaboration between students in physics and the astrophysical sciences, we aim to provide guidance in order to aid students in their strides to achieve their academic, personal, and professional goals. To join the UWiP email list-serv please email uwip@princeton.edu, or fill out this form. Follow us on Facebook! @PrincetonUWIP

LGBT CENTER

The LGBT Center supports and empowers lesbian, gay, bisexual, transgender, queer, questioning, intersex, and asexual students and employees by providing community-building education, events and initiatives. It is also located on the 2nd floor of Frist Campus Center and puts on a range of programming such as speaker events, socials, workshops, and dialogues. Check out their website for further details. The LGBT Center is a great way to build a support network or to get to know more members of the Princeton community, and while some events are only open to students in the LGBTQIA+ community, the center itself is always open to anyone who wants to come hang out or chat with the great counselors on staff.

COUNSELING & PSYCHOLOGICAL SERVICES

Counseling and Psychological Services (CPS) is free and available to all students. It is easy to set up an initial appointment through the web portal, phone, or visiting McCosh Health Center. Princeton’s challenging academic environment can feel isolating; CPS counselors are experienced with such problems and sometimes simply talking through such thoughts can help. CPS also offers group counseling. You do not need to have a diagnosed mental illness to take advantage of CPS counseling. Students are trained to handle problems ranging from the short term to the long term, and this definitely includes any issues you may be facing related to academics.

MATH GROUPS

The Math Club (listserv Null-set) and the Noetherian Ring may also be of interest to physics students.

The Math Club (website, FB) is active in hosting colloquia from various Princeton professors, typically from the Mathematics but also Physics and Computer Science departments. Its course selection information events can also be relevant to physics/astrophysics majors, as are the social events. They also advertise recruiting events from software, trading, and other companies geared towards STEM majors on Handshake, a Princeton App.

The Noetherian Ring (website) is focused on women in math, particularly in creating mentor/mentee relationships. Many of its resources are helpful to all and even more so for math-leaning physics & astrophysics majors.

PRINCETON SOCIETY OF PHYSICS STUDENTS (PSPS)

The Princeton Society of Physics Students (PSPS) is the Princeton chapter of the national Society of Physics Students, “a professional association designed for physics students and their advisors”. Along with hosting talks by physics faculty, the PSPS aims to provide a broader perspective of physics by hosting talks from faculty members of other departments who perform applied or mathematical physics research. It also aims to aid with the academic and professional development of physics majors at Princeton by hosting professional development events by peers about summer and on-campus research opportunities, certificates that complement the physics degree well, provide peer mentoring, and more. We look forward to meeting you all and welcoming you into the PSPS and broader Princeton physics community.
This document was a collaboration between the undergraduate women in physics and the Princeton Society of Physics Students. Special thanks to the departments of physics and astrophysics for their support of UWiP and PSPS.