The Harvard Physics Department's

Guide to

The Hidden Curriculum

("Unwritten" advice for physics students from the Department, with thanks to the many students who have contributed their input)

Version 1, 8/24/22

The "Hidden Curriculum" is the term used for pieces of unwritten advice that students should be aware of. Of course, since we're writing them down here, the "unwritten" part of this description doesn't apply. A better definition might therefore be "Important things you should know, but might not." For the items below that you do already know, and even for the ones you consider completely obvious, it's still good to hear someone else say them. We all sometimes need a nudge to take the proper action.

The bits of advice fall into various categories, indicated by the headings below. Most of the advice is factual, but a few bits are just our opinion. There's a lot of material here, so you definitely shouldn't feel like you need to memorize it all. For now, just read through this document so that you know what's there. And then occasionally refer back to it, to see if there are any specific pieces of advice that will help you in any particular instances.

Take care of yourself

College can be wonderful, but it can also be overwhelming, and the following advice will be helpful in maintaining your own emotional health. Some of the items here will be revisited in later sections.

College should be an exciting adventure, intellectually and personally. But there are so many interesting things going on at Harvard that it is easy to try to do too much too soon and lose the joy. One of your most important jobs is to love this precious time of your life and avoid burnout. Don't get overcommitted in your courses or your extracurriculars. This has many corollaries:

- If you jump into advanced courses too quickly, even if you are good at them, they can become a dry exercise in symbol manipulation. Take your time and relish the physics.
- You should pick one or at most two student organizations or teams that you *really* care about and *don't join any others*. If you somehow magically end up with loads of free time, it is much easier to join a new organization than it is to quit one if you find yourself overwhelmed.

- When choosing courses, think about your whole schedule, both curricular and extracurricular.
- Don't worry if you don't have your entire academic plan figured out in your first or second year. It is important to think about it, but putting pressure on yourself to set it in stone can be counterproductive. You have more time than you think to get it all worked out.
- Your peers can be a wonderful source of emotional support. Some of them may become friends for life. They often give good advice, but not always. Don't let them pressure you into taking the wrong courses. And watch out for the glorification of masochism ("I stayed up later than you did to finish the homework").

Although the vast majority of your peers will be a pleasure to interact with, it is possible that a few of them may have their own problems and insecurities and respond by being arrogant or demeaning – that is, by basically being a jerk. If someone tells you that you aren't smart enough and don't belong here or makes fun of your questions, they are being a jerk. Don't let such people get you down. Their comments reflect badly on them, not on you. You just have to ignore them until they grow up.

If you feel yourself losing control, don't ignore the issue and hope it will go away. Talk to your Resident Dean or advisor or professor or resident tutor or proctor. They want to help you, but they can't do it if they don't know there is a problem.

Collaboration

We very much encourage you to collaborate with each other on your problem sets! An all-too-common mistake is for students to think they need to do everything by themselves, and that it's a sign of weakness if they work with other students. Nothing could be further from the truth. Professors write their problem sets under the assumption that students will work together. In high school, perhaps you did most of your problem sets alone, but that's not how things are designed here.

The main benefits of collaborating are:

- It can be extremely inefficient to work entirely on your own. You might find yourself staring at a problem for 8 hours, getting nowhere. There are only so many hours in the day, and although you might *really* understand a problem *if* you solve it after 8 hours, the cost is simply too high. You have other classes and responsibilities, and they will suffer.
- In addition to being productive, collaborating is fun! The line between socializing and academics takes on a pleasant blurriness when you're having fun studying with your friends. Although you will certainly learn a great deal from your teachers, you might very well learn more from your classmates while doing homework with them.
- Not only will you learn things if a fellow student gives you a hint or explains something, but you will also learn things if *you* are the one doing the explaining. The act of

explaining something solidifies your knowledge and clues you in to any gaps you might have. It's a universal truth that being able to explain something is a sign that you truly understand it.

To know if you're truly retaining
The things that you've learned in your training,
We do recommend
That you seek out a friend
And assess how you do at explaining.

- In addition to helping you understand things, collaboration also gives you the opportunity to practice your communication skills.

Having said all this, it's important to note a possible serious downside of collaboration: Be careful not to go overboard with it. That is, don't rely too much on your friends. You *do* need to spend a significant amount of time pondering problems on your own – just not 8 hours on a single problem while getting nowhere. There's a happy medium; either extreme is bad. Spending only 10 seconds alone on a problem isn't good, because you won't learn where you might have gotten stuck. Conversely, 8 hours also isn't good. The amount of struggling you should do lies somewhere between these extremes. There's a proper number of hairs to rip out in frustration – it's not zero, and it's not your whole head. (Glad we narrowed that down!)

Ten seconds is not a good scheme.
Many hours just might make you scream.
But it's not a hard riddle –
Just aim for the middle,
And steer clear of either extreme.

The best balance between working alone and working with other people is to: (1) work on the problem sets alone until you get stuck on things, then (2) work with other students or get hints in office hours, and then (3) finish things up alone where you can collect your thoughts in the peace and quiet of your own brain. If you skimp on the first and third of these, it will definitely show up on the exams.

Be sure to use the Wednesday Physics Night study session wisely. It's great for cleaning up loose ends, but if you wait until Wednesday night to start your homework because you know there will be lots of help there, things won't end well.

Study groups often form naturally. But if they don't, just ask your professor. They can easily connect students. Some courses require you to list your collaborators. And some have additional rules, so be sure to follow whatever rules are stated. Note well: Unless it is explicitly stated otherwise, the work that you hand in must be in your own writing (or typing). Ignoring this can get you into trouble quickly.

Office hours

You are strongly encouraged to go to office hours (the professor's and/or the TFs'). *Everyone* should go. As with collaboration, office hours are not a sign of weakness! In high school, perhaps you viewed office hours as being for students who were struggling. This is most certainly not the case here. *Problem sets are designed so that you'll need some help*, so you should take advantage of the help that is offered. That's what the teaching staff is there for.

Office hours might initially seem a little scary, but in reality they're quite chill. Professors and TFs are expecting students to come by with questions. Don't be worried about asking naive/simple/"dumb" questions, because (a) the saying "the only dumb question is one that you don't ask" is actually true, and (b) professors have heard pretty much every type of question over the years, so there's no chance you're going to shock them.

> The queries that spin in your head
> Can produce many feelings of dread.
> Will your questions be dumb?
> Will you feel like a bum?
> Sadly yes, if you leave them unsaid.

Office hours often involve students working together on homework problems and then asking for help if they get stuck. So in addition to providing you with assistance, office hours are great for getting to know other students.

They're also great for getting to know the professor and TFs! Courses are much more fun if you see your instructors as actual people. TFs can give you advice on all sorts of non-course-related topics like grad school and research, and also general undergrad matters they experienced not long ago. Professors will sooner or later be writing letters of recommendation for you, and it's very hard for them to write a letter if they didn't get to know you. So help them out!

In addition to using office hours for homework help, you should also use them to clear up any course content you're confused about, and to clean up any loose ends. There are few things more efficient than generating a list of questions from lectures/sections/reading/etc., and then running through them in office hours. If you do a weekly sweep of the material like this, you can't go wrong. Even if you have the homework completely under control, you can always learn something more.

If you feel lost in a course, a handful of questions in office hours can clear many things up. As long as you ask them in a timely manner, you'll discover that you weren't as lost as you thought. Conversely, if you let things slide and get out of hand, then eventually you *will* be as lost as you thought.

Homework

Here are some bits of advice on homework:

- Start the homework early! Of course, schedules inevitably get busy, so this is easier said than done. But the bottom line is that if you start your homework early, it's hard to go wrong. And if you start it late, it's hard to go right. Starting it early will actually save you time in the long run.
- As mentioned above in the Collaboration section, the ideal strategy is to (1) start the homework alone, then (2) work with others, and then (3) finish up alone where you can calmly collect your thoughts. If you start the homework late, this last step is the one that will suffer. You'll probably still get the homework done, but it won't sink in. If you finish at 3:00 am, you're just going to want to go to sleep instead of polishing things up and solidifying what you've learned.

    It could hardly be said that they thrived
    As another all-nighter arrived.
    Please start homework early;
    You'll learn more, and surely
    You won't be so darn sleep deprived!

- Write up your homework neatly, with clear explanations involving *words* as opposed to just a string of equations leading to the answer. You don't need to overdo it and write a book. But a few words can go a long way. A good rule of thumb is to ask yourself if a classmate would be able to understand your solution.
- Important: Review the lecture notes and the readings before starting the homework! You need to be aware of all the basics before jumping in, otherwise you might get stuck on a simple definition or concept which you are assumed to know, and which isn't even the point of the problem.
- Be sure to read the questions carefully! Countless hours have been wasted by students answering the wrong question or trying to solve an impossible problem because they missed some of the given information.
- There are many helpful problem-solving strategies that will show up again and again in your physics classes. There are too many to discuss here, but the introductory courses usually provide you with a nice list. Make good use of it!
- When finished with a problem, reread the question to make sure you've answered everything. And then write down a summary of the main steps. There are only so many possible problems, so you'll soon find yourself writing down many of the same strategies over and over. They'll definitely sink in this way. Also, if you initially took a wrong turn in a problem, write down how you fixed it, so that you'll remember next time.

General course strategies

It's common for students to think that everyone else is smarter and picks things up more quickly. Some do, some don't. Don't let your conjectures about other students affect your outlook in a class. You control how hard you work and how much you take advantage of the various resources. So concentrate on those things. The hard work and persistence will pay off. Besides, doing things quickly isn't the goal. Learning things deeply and learning how to ask additional questions to dig even deeper are the goals. It's better to take longer and learn more. This is all the more true if you choose to head on to grad school, where it's a long haul and nothing much happens quickly.

College is very different from high school, and it takes some getting used to. It can be a bit overwhelming at times. In general, college is more difficult, the course content moves faster, and overall things are more stressful. The "little fish in a big pond" saying is *half* true: Harvard certainly is a big pond. However, you are all big fish, whether you know it or not. And more importantly, *you're all in it together.* After a week or two, most of the shock will wear off and things will settle down, and at that point all you need to do is work together.

> It's common for first-years to note
> The challenge of staying afloat.
> But the way to respond
> To this rather large pond
> Is to know that you're in the same boat.

If it turns out that taking advantage of all of a course's resources isn't enough, it's possible to get a tutor through the Academic Resource Center. But note well: If you get a tutor, it should be *in addition* to the teaching staff and all the resources, not instead of. Tutors can't perform magic, and they're beneficial only if you put in the time beforehand. You can't just say "teach me such and such." That's rarely productive. Instead, you need to do the pre-work by making a list of concrete questions, and then you can run through them. That's extremely productive. And you should already be doing that with the teaching staff, anyway.

A number of other pieces of advice on courses:

- Know your resources. You should occasionally click through all of the course materials in the left sidebar on Canvas, to make sure you don't miss an announcement or any new material that was posted.
- In particular, be sure to carefully read through the entire syllabus at the start of the semester. You *really* don't want to miss anything there.
- Do the reading! Yes, this takes time, but it will save you time in the long run. Without the reading, you might end up floundering and wasting countless hours on the homework. There are plenty of other helpful resources out there on the web too, so don't hesitate to search around and use them.

- Get to class on time! Important announcements are often made at the beginning, and you don't want to miss anything. Even better, get to class early, since that's a great time to mingle with your classmates.
- By all means ask questions in class. How do you go about asking a question? Simply raise your hand!
- Find some nice study spaces. There are many wonderful rooms/halls/lounges/libraries/ common areas scattered across campus. In the Physics Dept, you can use the Physics Library (Jefferson 450) and the Undergraduate Study (Jefferson 251). Definitely do some exploring in other buildings too. There are lots of gems out there!
- If there's any one skill that dominates how well your classes go, it's time management. Different people have different mechanisms for how they keep track of their schedule/calendar. Do whatever works best for you, but just be sure that it does indeed work.
- Set aside a sufficient amount of time to study for exams. Although scurrying to get a homework done can sometimes produce a result that vaguely resembles success, cramming for an exam rarely does.
- There are many little snippets of time – 10 or 20 minutes – that pop up during the day, and you need to make sure you use them properly. They add up. You don't have to use *all* of them productively (you need to relax now and then), but if you don't use *any* of them, there are going to be problems.
- You have many technological advantages over students from 20 or 30 years ago. But correlated with these advantages comes the distinct disadvantage of having the most efficient waster of time at your fingertips. Use it wisely. Decades ago, people had to at least make the effort to stare at a wall if they wanted to waste time.
- Have some fun, but not all the time. Beware of FOMO. If you want to socialize at every moment that at least one of your friends is having fun, things won't end well. Although any given person isn't socializing all the time, the overlapping Venn diagram of fun-being-had-by-someone probably fills up the entire day. So concentrate on the quality of your interactions, not the quantity. But again, as mentioned earlier, working on homework with your friends can be quite fun. So on that front, have all the fun you want!
- Don't forget to sleep! The first semester of college might very well be the first time you don't have someone actively reminding you to go to bed. You're already going to lose enough sleep due to your coursework. Don't lose any more because of FOMO.
- If you encounter any problems in a course and start to get behind, be sure to promptly *communicate with the teaching staff*. They can be very accommodating, as long as you keep them informed. However, if you simply fade away, things can get problematic. The staff can't help you if they don't know what's going on. So stay in contact. Even just a "I'm really behind and I don't know what to do" will get you headed in the right direction again.

Choosing courses

A main failure mode in choosing courses is succumbing to peer pressure to take courses you're not ready for. You might get by and receive an adequate grade, but you probably won't learn as much as if you were in a course you were prepared for. Additionally, there will be gaps in your knowledge from what you missed in the course you skipped. We've seen peer pressure lead to far too many poor course decisions over the years, so please be careful.

> When pushing your learning frontiers,
> You should weigh your ambitions and fears.
> Then choose what to do
> Based on what's right for *you*,
> And ignore all that pressure from peers!

But on the flip side, don't sell yourself short. Being overprepared and bored in a course can also lead to trouble. It *is* reasonable to take calculated risks and stretch yourself in a course now and then, if you are very interested in the material and are prepared to work hard. Just be sure to discuss things with your advisor(s) early and often.

Further bits of advice on choosing courses:

- Consult the Q guide. Be aware that a course can be very dependent on the instructor.
- Discuss courses with both your advisors and older students who have taken them.
- Be careful not to overload your schedule. Even if each individual course is appropriate for you, taking them all together might simply be too much. Think about how many pset courses you want to take; the million-dollar question is 2 vs. 3 pset courses in your first semester. Definitely err on the side of caution in your first term. There will be plenty of time to ramp things up in later semesters if desired.
- Try out various courses in the first week or two, and then settle down to the ones that are the best fit. Although it's very difficult to tell what a course will be like from the first problem set and first few lectures, that's the best you can do. It's reasonable to run along with five courses in the first week or two, and then drop one. Definitely have a backup plan if one of the courses is a stretch.
- Don't judge the difficulty of your schedule by the first few weeks! Things *will* pick up. Keep this in mind when choosing extracurriculars. Even if things run smoothly in the first few weeks, you could get into a pickle later in the semester.
- It's much better to get good grades in four courses than mediocre grades in five. A correlated and even more important fact is that it's much better to master the material in four courses than to just get by in five.
- It's usually best to spread out your General Education requirements. If you delay them until later semesters, you'll probably regret it.

Advisors/mentors

There is no shortage of advisors/mentors at Harvard, ranging from academic to residential to research to peer to extracurricular. The amount that a student gets out of their advising relationships is highly dependent on how much they put in. It is therefore imperative that you take the initiative and reach out regularly to your advisors. With all the advising resources available, it would be a shame not to take advantage of them. If you don't actively maintain contact, the good news is that your advisors will generally still reach out to you at some baseline level. But the bad news is that if you wait for them to reach out, there is no guarantee that the timing and level of the advice will correspond properly to your needs.

The point persons for all things related to Physics and Chem/Phys are Prof. Howard Georgi, Dr. David Morin, and Hannah Belcher. You can reach out to them at any time throughout your four undergraduate years. Even for questions that are only tangentially related to physics, if these advisors don't know the answer, they can point you to whoever does. You can therefore contact them about pretty much any topic/issue. When you officially sign up for a concentration in your sophomore fall, you will also be given an individual concentration advisor.

Additionally, the point person for *any and all* problems that come up is your First-Year Dean or House Residential Dean. You should talk with this person right away (along with your other advisors) if any issues/problems come up. Err on the side of caution and over-communicate, if anything. If you delay, things can start cascading and go off the rails. Exponential growth is great for investments and such, but not for the severity of problems. So if things start looking bleak, reach out right away.

> When life is so far from serene,
> And trouble is all that is seen,
> Growth exponential
> Is quite consequential,
> So *make* sure you talk with your Dean!

A few other pieces of advice:

- Be sure your advisors and teachers know the name/nickname you like to go by, and how to pronounce it (if not obvious), and your pronouns.
- Reach out to the officers of the Society of Physics Students (SPS), Women in Physics (WiP), and the National Society of Black Physicists (NSBP); and also your Polaris mentors if you're part of that program. They are here to help! A wealth of information is out there, so there's no need to reinvent the wheel.
- Get advice from older students. They can give some of the best advice, because they've seen things firsthand. But beware that not all students are the same, so some advice might not apply to you. Likewise, beware of rumors.

- In the end, it's best to get multiple bits of advice (some of which might be contradictory), and then somehow take an average. Everyone's advice is based on their own experiences, so you have to put it together and figure out how it applies to you. Someone might present many perfectly valid reasons for doing something, but the final conclusion is incorrect because those reasons are outweighed by other valid reasons supporting the opposite conclusion. It's your job to weigh everything.

Concentration

Be sure to stay up to date with all department email lists, documents, organizations, and events, for any department you are interested in. For Physics and Chem/Phys, the most critical thing to do is get on the Society of Physics Students (SPS) email list:
https://web.lists.fas.harvard.edu/mailman/lists/sps-list.lists.fas.harvard.edu/
All SPS and departmental announcements are sent to this list, including information about fun events. You don't want to miss out!

Don't fret over your concentration choice; you can always switch. What really matters is that you talk with advisors in all of the concentrations you're interested in. They can tell you what courses/research/etc. is important, and which things need to be done when. It's quite possible to keep the door open to many concentrations for a while, as long as you get the proper advice.

When pondering your concentration choice, it's important to think hard about your plan(s) of study. Not because you're going to stick to them exactly – there's almost zero chance of that. But rather because you'll be more aware of all the possible issues that might come up (prerequisites, the timing of courses, overloaded semesters, etc.). You'll be better able to deal with any wrinkles in the plan if you've thought hard about things beforehand. To paraphrase Eisenhower: Plans themselves are often useless, but planning is priceless.

> When your plans end up shredded in tatters,
> And you strike out like blindfolded batters,
> You can fix how you erred
> If you've thought and prepared,
> Since the planning is what really matters.

Research

The myriad opportunities to do research in cutting-edge labs is one of Harvard's greatest strengths. If you're planning on heading to grad school, research is an absolute must. Two summers at least, plus a few semesters is a good rule of thumb for most students. If you're not heading to grad school or something similar, then research isn't necessary, although it would be a shame to pass through your undergrad years without doing some sort of extended project and working closely with at least one professor.

There is no need to get started with research during your first year, and in particular we strongly advise against research in your first semester. There are enough other things to get used to at Harvard, and it's best to concentrate on your classes and on getting your footing. The summer after your first year is a great time to start research, although your first summer isn't an absolute necessity. If you want to gently slide into a lab in the spring semester of your first year (without a large time commitment) so that you can hit the ground running in the summer, that's a reasonable tactic, but definitely not necessary.

In the summer, you can do research here at Harvard, or elsewhere – REUs, government labs, etc. Virtually all of our experimentalist professors have undergrads working in their labs. The Physics Dept guarantees summer funding (in combination with the Harvard College Research Program) for its concentrators for on-campus research.

In the late fall of each year, information is sent to the SPS list on how to go about finding a lab. But in a nutshell, you'll need to peruse the faculty webpages to see what sorts of things you're interested in, and then you can reach out to professors (don't forget to cc their staff support on your initial email). Introduce yourself and give your background; keep it short. Send a second email after a week if needed. You can email one or two profs at a time, and then move on to one or two more if those don't work out. But don't email 10 at once. If you're having trouble finding a lab, see Dr. Morin and/or Prof. Georgi. Things always work out in the end.

Professors know that students will be contacting them out of the blue, asking to do research. So although it might seem intimidating to reach out, just plow ahead. There's really nothing to be scared about.

> Though profs may seem scary at first,
> Reach out and your fears are dispersed.
> You'll find it enlightening;
> They're really not frightening.
> There's no need to fear for the worst!

First-years shouldn't worry about the small number of courses they've taken. Most professors have projects available for all backgrounds. Note that you of course don't need to think of a project yourself; the professor will do that. In general, you'll be paired up with a grad student or postdoc. You'll learn the ropes and then gradually become more independent.

Some of the funding deadlines (PRISE, Herchel Smith) are early (in February), so start looking at the end of the fall semester if you're going to apply to those. The deadline for Physics/HCRP funding is later (in mid/late March), so you can start looking over winter break or early in the spring semester. In any case, get started early enough so that you have sufficient time to learn about your project, to enable you to write a coherent proposal for the application. (By "proposal" we mean a description of the project the professor has in mind.) PRISE and Herchel Smith are competitive, but the Physics/HCRP combo is guaranteed, as long as a professor offers you a spot in their lab, and you write a coherent proposal and hand it in on time.

A few more bits of info on research:

- Term-time research can be done for credit (via Phys 90r) or for pay (HCRP, Faculty Aide, lab funds), but not both. Phys 90r can be one of your four courses. Sometime students take 90r as fifth course, but be very careful about that. The 90r can get squeezed during crunch times in the semester.
- Some students work in a lab for their work-study earnings, but be wary of the larger time commitment and required mental energy.
- The Physics Dept strongly encourages students to do research, but it doesn't require a thesis. Only a handful of our concentrators write one each year. In contrast, students often get to the point in their research where they can write a paper for publication.
- See the Physics Dept > Undergraduate Studies > Summer Research webpage: https://www.physics.harvard.edu/undergrad/summer for further information on research. Also visit the Undergraduate Research and Fellowships (URAF) page: https://uraf.harvard.edu

Grad school

If you think you may be headed to grad school, let Prof. Georgi, Dr. Morin, and your concentration advisor know. And keep them updated on your plans for courses and research. There are many pieces of advice on the grad school front that are covered in advising conversations and SPS panels. There's plenty of time to take it all in, and there's no way to cover everything in this document, so we'll just mention a few items here.

If you are planning on going to grad school, you'll need to take more courses than the concentration requirements stipulate. There isn't a firm number, but something like 4-ish more. And you'll need to do lots of research – at least two summers and a few semesters.

You should get to know your professors well for the sake of learning, of course. But in addition, you'll need to know at least a few of them very well (from courses and/or research) so that they can write informative recommendation letters. For rec letters from courses, make sure you go to office hours! That way, you'll get to know your professors, and they'll get to know you, which will enable them to say something substantial in a rec letter. If you simply do well in a course but don't get to know the professor, there's not much they can write. Most grad schools require three letters, and a common regret that students have is that they didn't get to know three professors well. It's painful for a letter writer to sit down to write a letter and not have much to say. So be nice to them and give them something to write about!

> To be in an ideal position
> For grad school to come to fruition,
> When it comes to those letters,
> You'd best be go-getters,
> And give your profs good ammunition!