

This TA Manual combines resources and pointers you might find useful while TAing at Caltech. It is organized under various headers, and you might find different sections relevant depending on your role as a TA.

We will discuss ideas, tips and tricks to hold engaging and wholesome recitations and office hours. Followed by a section which will detail out some broad points to help you in your role as a Head TA to keep the logistics of the course together. The final section will discuss strategies and ideas for effective grading.

If you have any further questions, always feel free to reach out to the current TA Fellow or head to <https://pmatas.caltech.edu/> where we have an extensive FAQ section.

This document has been prepared by the past and present TA Fellows with the input of TAs, teaching staff and support staff. It will continue to be revised every year and we welcome your input too.

1 Introduction and responsibilities

Welcome to the Physics department! In this document, you will learn about your responsibilities and expectations when it comes to teaching. In the US, your teaching role is called 'Teaching Assistant' or TA for short. This will be you! This document aims to provide some guidance and recommendations for how you can complete each task in your role as TA.

Undergraduate Courses

In undergraduate courses:

- there is a group of TAs teaching (first year courses can even have 8-10 TAs!)
- typical minimal TA job expectations include:
 - recitations
 - office hours
 - grading
 - answering student questions via email or other online message boards
- typical additional tasks:
 - writing solution manuals to problem sets/exams
 - review sessions
- the professor may ask you to do other relevant tasks.

Graduate Courses

In graduate courses:

- there is generally only one TA
- there may or may not be a recitation
- typical minimal TA job expectations include:
 - office hours
 - grading
 - responding to student questions

Responsibilities

- It is important to understand that this is a job, so unlike a course, you cannot fail or do poorly
- The professor makes the rules and expectations, so be aware of what the professor expects - this may vary between courses
- In general, when responding to students (particularly to questions about administrative aspects of your course) please consult with the professor or Head TA of the course first
- All TAs in a course are employed as a group to complete all tasks, DO NOT expect to necessarily do an exact fraction of the tasks - you may be asked to help cover for another struggling TA

Other Notes

- You are paid for 20 hours of teaching work a week, which is a lot more than students expect!
- You and your students are expected to follow the Caltech Honor Code
- If you have concerns about your students, fellow TAs, your professor, or your work conditions, please speak to the TA Fellow or the PMA Undergraduate/Graduate Affairs and Course Coordinators (currently Belen Maria Hernandez and Nam Ung)
- Remember that you may inadvertently help inspire students in their future study or career choices - so be aware that you are a potential role model
- Teaching is never a solved problem - continue trying to improve every year. Your students will really appreciate this as will your professor!
- Teaching experience is amazing (and necessary) for your future career:
 - for academia: essential as you need to submit teaching statements
 - for industry: teaching skills are transferable - management, collaboration, mentorship etc.

2 Checklists for Teaching a Course

Before/beginning of the course

In general, at the beginning of the course (a week or two before it begins) your professor will contact all the TAs and organise a meeting to pass on their expectations for the course. Tasks for you to do:

- ☐ Find a copy (electronic/hard copy) of the textbook - often the department will have one for you
- ☐ Read the syllabus and re-familiarise yourself with the topics that you will be teaching
- ☐ Double check when your recitation time is and think of a good time for your office hours (you will have some leeway to pick this)

Each week during your course

Throughout the course, you are expected to always be aware of what was taught in lectures. Attending the lectures is an option although not mandatory. Before your recitation and office hours

- ☐ read the relevant parts of the textbook / lecture notes
- ☐ familiarise yourself with the problem set / exam (maybe even take some notes for office hours)
- ☐ prepare notes (for yourself) for your recitation
- ☐ complete any expectations set by the Head TA or professor - this may include completing any relevant grading, preparing solutions for the problem set, preparing recitation notes for the TA group.

If you have any questions about teaching

- ☐ If your questions are about course content, please consult your Head TA or professor.
- ☐ If your questions are about TA expectations, teaching advice, or interpersonal problems, you have the following resources:
 - the TA Manual (this document)
 - the PMA TA website: <https://pmatas.caltech.edu>
 - the TA Fellow
 - other TAs (particularly your course Head TA)
 - the PMA Undergraduate/Graduate Affairs and Course Coordinators

3 Recitation Sessions

The Recitation structure at Caltech is very unique! Unlike many other schools, where recitations only involve doing practice problems or discussing the homework, here at Caltech, you can get the chance to actually engage and be instrumental in full “lecture-style” classes. While each person has a different style of teaching and engaging the class, some tips and tricks can go a long way.

- It is often thought that recitations should only consist of problem solving and discussing examples. But the essence of a recitation is much more wholesome. You are teaching the students how to be a physicist and tie together everything that they have learned within one unified framework.

Tying concepts, with subtleties, backed by problems should be done in a holistic manner. While you do want to make sure that you are not verbatim repeating material from the lecture, but rather engaging the students in a way that touches upon the basics while adding a new perspective on the topic, be it through a problem or a different approach.

- Interaction with the students forms a cornerstone of effective recitations. You want to try and engage everyone in class. Stop often, take inputs. Make sure everyone is following. Encourage them to ask questions and make comments in the class.

Be patient to wait for their response when you ask for a prompt. Get comfortable with the class and think of the recitation as an interactive discussion facilitating learning. The CTLO prescribes many “Active Learning” techniques you could try in class, such as “Think-Pair-Share” or Flipped Section formats, amongst others. Make the students feel a part of the process rather than you going and just writing/showing a bunch of things at the board/zoom mechanically.

- Often, going on short, quirky tangents related to the subject matter during the recitation adds an exciting and orthogonal perspective to the topic. It breaks the monotony of the class and going outside the confines of the textbook/syllabus is something which students often appreciate.
- Being prepared is key! A good recitation is more than just knowing your material, it is showmanship and engaging the class with the power of physics. Being prepared not only includes being adept with the material, but also having thought about the best way of presenting it in a novel, exciting way, yet connecting it back with the bigger picture. Homeworks will often teach the students how to do the math correctly — you also want to convey the intuition behind those equations.
- Make sure your board work is descriptive enough, legible for students to connect with. Make sure you write big, with good spacing and organization. This can be hard at first and practice helps! Make a detailed plan before the recitation on how and what you want to cover. The math you present should be consistently done, for example, the notation, flow of thought etc. Again, remember, you are facilitating students help think like physicists.
- Make sure you have a good internet and that all the tech you are planning to use during the session is running without flaws.
- Sending your section a weekly email at the start of the week about what topics you will be covering is a great idea. Students can connect better as they can feel the continuity in things and already have a sense of what all is going to be covered. Helps connect with your section better.
- Introspect after each recitation session to get a sense on what you could improve, what was taken well by the class, what wasn't and what changes you could implement to connect better with them. Doing an amazing recitation doesn't come in one-day. Take your time and build up to it.

- Flipped Sections are a great way to engage the class in Active Learning. The format includes splitting the class in small groups of 2-4 (breakout rooms) and having them solve and brainstorm on a set of previously prepared problems. They work together in their group, actively discussing on a shared board. The TA moves from room to room, talks with different groups, helps them work through challenging problems, nudging when it's needed and fostering an inclusive, engaging environment. Ph1 already has seen successful implementation of Flipped section formats and resources are ready for you to use. The CTLO also has some logistical resources one could tap to help you more comfortable in such a format.
- Ending the term, the last recitation with something memorable is always good. Maybe coming up with a very exciting application or something very counter-intuitive to rapture your audience and make them remember your recitations for times to come!
- Light humor (bonus points if they are connected to physics) in class is always welcome! Just make sure it's nice, clean humor and not at the expense of anyone or any group.

4 Office Hours

- The key is to help the students think their way through their own questions.
- It is very important to be prepared. Go over the homework problems and solutions beforehand. Do not attempt to solve things for the first time when asked a question by a student. You might understand everything but the idea is how clearly and holistically you are able to help the student solve their own problems.
- You neither want to very easily give away solutions nor do you want to be to "strict" in helping. Having a balance where you help the student think and work their way through their question by nudging them in the right direction is important. Make them think about the basics and how it connects to the problem and build from there.
- Communicate your office hours time and location well in advance to the class. Do not have office hours between 5-7pm since that is dinner and sports time for many undergrads.
- After the office hours, make a note and distill topics/concepts you felt a lot of students had problems with. These topics could be taken up again and strengthened in lecture or recitation.

5 Head TA and TAs for Advanced Courses

As Head TA for a large undergrad course, or a TA for one of the advanced courses (undergrad or grad), one of your main roles is to be the bridge between the instructor(s) and the students and make sure the course logistics are flawlessly run. A few pointers/bases you might want to cover in your role:

Course Website

- The course website (now canvas) is one of the mainstays for having strong course logistics. Make sure the website is in place before the term starts, has all the information a student would like to know, including but not limited to lecture/recitation/office hours schedules, homework submission policy, collaboration policy, textbook details, lecture notes etc.
- The website should be regularly updated to keep up with the pace of the course, including posting homeworks and solutions. Timeline of posting should be discussed with the professor and other TAs.
- Having a course calendar (marked with homeworks, due dates etc) online is a good idea since it allows everyone a sense of the structure of the course.

Graders, Grading et al.

- You will also be responsible for managing the grading logistics for the course. Always recommended to ask for your grader's schedules, preferences, conflicts etc. before making grading assignments.
- Make sure graders are comfortable with using gradescope.
- The solutions should be made available to the graders if they already exist (such as for homework problems from previous years). If solutions do not exist, coordinate amongst the recitation TAs, graders and yourself on how to divide up writing the solutions.

- Lay out a clear late homework submission policy, and communicate it both to the graders and students.
- Have a homework extension policy in place in discussion with the professor and other TAs and make sure the students are aware of it.
- As head TA, you should also guide the graders to be consistent - i.e., lay out total number of points per problem in the solutions, and also talking with graders about course-wide expectations for full credit, half credit, no credit, and glancing through early graded sets to make sure graders are not interpreting grading in vastly different ways (More pointers in the Grading Section below)

Student Interaction and Online Forums like Slack or Piazza

- Encourage a discussion forum for the class on an online platform like Piazza or Slack or Canvas. Students can ask questions here, and instructor(s) can post announcements etc.
- As head TA, you will also receive a flurry of emails from students regarding a whole slew of matters (misplaced homeworks, extension requests, disputing grading etc.) — try to be proactive to respond and/or point them toward the right person/resource. It helps the students stay connected with the course.
- You can get hold of the class roster through Regis. If you don't have access to it, email the Registrar's office and they'll provide you with it.

TA and Ombuds meetings

- As head TA, you should also plan — in discussion with the professor and other TAs — periodic meetings for the course where you all can sit together and discuss the progress, report any updates and do course corrections along the way.
- For the larger courses, you should also ask for Ombudspeople from the class. Ombudsfolk are student volunteers who represent the students of each of the undergrad houses. They collect suggestions, comments, complaints, etc, and discuss them with the course instructor and TAs at periodic meetings. Usually one ombuds from each undergrad house.

Welcome Email to the Class Before classes begin, it is a good idea to send a Welcome email to the whole class to get everyone on the same page with the course logistics and structure. It helps answer most of the initial questions students have and helps them get oriented. An example of such a welcome email is charted below (only to be taken as a template)

Hi class,

Welcome to Ph2a – we have a bunch of interesting topics in Waves and Oscillations lined up for you in the coming term, and we hope you will enjoy it as much as we will enjoy teaching it.

I will be the head TA (and also a recitation TA) for the class and as we gear for the term start, here are a few announcements to help you get acquainted with the course logistics:

1. The course website is available at <https://www.its.caltech.edu/phys002/> where you can find the latest announcements, course calendar, textbook details, homework, and other resources as we go into the term.

2. Lectures will be engaged by Prof. Frank Porter as per the following schedule: T 11:00 AM - 11:55 AM in 201 BRG R 11:00 AM - 11:55 AM in 269 LAU

We have 3 recitation sections which meet as per the following: Section 1 : Ashmeet Singh : WF 11:00 AM - 11:55 AM in 269 LAU Section 2 : Jeremy Brouillet : WF 11:00 AM - 11:55 AM in B111 DWN Section 3 : Eugene Tang : WF 1:00 PM - 1:55 PM in B111 DWN [There has been some shuffling over the last few days so I recommend checking your Regis to make sure which section you are in]

3. The first lecture will be tomorrow, Tuesday, October 2 and the first recitation will be on Wednesday, October 3.

4. Homeworks will be due on Tuesdays at 11 am in the drop box outside 201 E. Bridge. Graded homework will be returned for FERPA waived people in the cubbies in Bridge Annex and non-FERPA waived ones can be collected from Mika in B161 W. Bridge.

5. We will be following a novel grading structure (includes both the structure of exams and how grading is done) this term for Ph2a! Please check the course website for more information.

6. Office hours for the TAs are available on the website: <https://www.its.caltech.edu/phys002/ta.html> The grading schedule will be finalized and posted on the website later this week.

7. We are looking for ombudspersons for the class. Ombudsfolk are student volunteers who represent the students of each of the undergrad houses. They collect suggestions, comments, complaints, etc, and discuss them with the course instructor and TAs at periodic meetings (free lunch!). Please select (at least) one ombuds from each house and let me know about it by end of this week.

8. We will be using Slack as a collaborative and interactive online workspace where you can ask questions, discuss concepts and brainstorm with the course instructors and your fellow classmates. Don't slack in using Slack! To join our Slack workspace, register with your Caltech email (The restriction is that you must have a Caltech IP address (use VPN if needed).) at <https://join.slack.com/t/ph2a2018/signup> and after which you can access it at <https://ph2a2018.slack.com>. You should also download the Slack app on your phone and stay connected with all the awesome physics Ph2a has to offer!

And finally, I'll be the head TA for the class and you are most welcome to approach me with any concerns/questions regarding grading, recitations or the class in general. As we strive to make the course interesting for you as possible, feel free to communicate your concerns and suggestions to us.

That's all for now, folks – looking forward to a great term! Let me know if you have any questions.

Best,
Ashmeet Singh
Head TA, and Rec TA for Section-1
(on behalf of the Ph2a team)

6 Grading

The main thing to iterate for effective grading is that you should grade as you would have wanted/want your graders to grade your submissions.

Some pointers (by no means exhaustive) include:

- Before beginning to grade, making a short summary of the key points/flags where you expect to give or take away points, and updating it as you go along the actual grading. Because many-a-times, as graders, our perception on how many points to take away for a problem changes intuitively by noticing trends in the class' solutions.
- It's a good practice to grade homogeneously i.e. one question for the entire class before moving on to the next. It ensures uniformity in the grading.
- If you are not sure about certain aspects in a particular answer and how to grade it, leave it till the end after you have gained more perspective on the problem based on other students' solutions.
- If you have any doubts or questions about the physics in a solution, best to first communicate with the Head TA or other graders to sort it out and then get on to the grading.
- Not taking off points repeatedly for mistakes which propagate through a question (and mentioning when this happens in a submission).
- Mentioning clearly how many points were taken off along with a few keywords or a sentence outlining why so and/or referring to the appropriate part of the solution. Usually, at least in physics, mistakes can be pointed out by just mentioning a few "buzzwords". If the mistake is more algebraic or something more trivial, that can be mentioned too.

Effective Grading Strategies

Before Grading

- Check in with instructor and fellow TAs about grading policies, e.g.:
 - how many points each problem is worth?
 - how much should be taken off for mistakes?
 - is it about process more than the final answer?

Grading

- Work through problem yourself first before you look at solution key / rubric / begin grading
- look over a few submitted p-sets / labs first before you begin grading
- create a grading scheme (rubric)
- grade one question at a time for all p-set and then move on to the next question.

Team Grading

- ensure consistency among TAs by having one question/ assignment per TA to grade
- OR create a rubric and calibrate TA grading expectations before you begin grading

Feedback

- use short-hand feedback (e.g. SW = show work)
- send group email to students with feedback about general problems
- sometimes easiest to send students to office hours or have a chat
- ensure feedback is meaningful - give directions to where their logic failed or make connections to concepts / next line and be constructive (and positive too!)

Time Management

- slot time for you to grade with goals for completion
- grade at least one question for all p-sets in a sitting
- consider that feedback is most effective when students can still remember doing the p-set and can implement constructive feedback for the next p-set or lab report (i.e. get it back to them ASAP)

Communication

- talk to the course instructor and / or section TA if you notice common errors or important misconceptions in the student work you are grading
- be clear to fellow TAs and students about expectations and how you will grade
- ask professor if you can share grading rubric or solution set with students

Homework/Quiz Pick-up and Return

- As you grade your assignments, please maintain an accurate and up-to-date version of the grade-book. Mention (using color codes) if the assignment was late and/or add any comments you have about any peculiarities you might notice.
- If you suspect a possible honor code violation, please get in touch with the head TA or professor immediately. In Physics, the head TA or professor will normally coordinate reporting of honor code violations to the Board of Control or Graduate Dean's Office. As always, be sure to keep copies of any relevant materials, and grade/return the work to the student as usual so that the proper Honor Code investigation procedure can occur without interference.
- Please grade the assignment within one week of its due date.

More on Homework Rubric and Feedback

It's good practice to mention in the solutions (or separately if you like) some feedback on the grading such as common errors, subtleties students might have missed etc. and also a brief rubric as to how and where you took points away for common mistakes.

Attached next with this document are some common abbreviations one may use while grading.

Common Abbreviations

These are the abbreviations the graders can use to more efficiently provide feedback:

- **SS** - See Solution. The student has made a number of errors here, and should look at the online solution to see what they did wrong.
- **AE** - Algebraic Error. The student has made a mistake in their algebra, such as missing parenthesis, losing parts of equations, etc.
- **NE** - Numerical Error. The student's equations might be right, but when they plugged in numbers, their numerical answer is incorrect.
- **SE** - Sign Error. The student has written $+$ when it should be $-$, or vice versa.

Feedback Guidelines

These are the guidelines that graders should be following for giving feedback when grading:

- Correct steps or answers should be marked with check marks. These should go directly next to the text that is receiving points, not on the side of the page.
- Even if you don't take off points, written feedback should be used to explain if the student did something wrong/inefficient/non-standard but still arrived at the correct answer or correct intermediate step. (e.g. Dimensional Analysis instead of full derivation of a equation).
- When you are giving points for some intermediate step, underline or box the specific thing you are looking for, such as words, phrases, or expressions, particularly if a simple check-mark doesn't make it clear.
- When something is incorrect, put an X through it, and write a comment. Use the abbreviations we came up with if you want, but if you come up with a new one that you need often, do let us know too.
- When you are taking off points, write the deduction (Ex: -1 or $-1/2$) right next to what is losing the student points and write a comment. -1 pt or less can use an abbreviation. When you are taking off more than -1 for a single mistake, there should be a written explanation of what is wrong/missing.
- Each problem should be given a subtotal (Ex: $4/5$ or $10/10$). The total points for the entire quiz/HW should be written on the back of the first page and circled.
- If a student's answer is incorrect, write in the correct answer or correct phrase, or explain why the student's answer is incorrect.

7 Student Support

Higher education and Caltech in particular can be a very stressful environment for students at all levels. Statistically, close to 50% of Caltech students utilise mental health services at some point in their time here. Your students may be suffering and it is important to know what you can do to help. Before we continue, it is important to remember that you are not therapists or doctors, so it is highly encouraged that, where appropriate, you refer students onto professional support. Equally, it is highly discouraged that you should try to solve problems that are not strictly speaking mathematical in nature.

When students struggle it may be very difficult to notice. Symptoms of struggling often include the following behaviours:

- marked drop in grades/participation, especially if it puts them at risk of failing
- not submitting problem sets with no explanation
- regularly late problem sets (even if the excuses seem valid on their own)

Of course, if you additionally learn of any struggles via other means, be mindful that they may need help. However, ever you come to suspect that a student may need support, please be encouraging and accommodating and let them know that you are concerned and that they may want to consider getting extra help. In such cases you should feel comfortable to give extensions, but such accommodations are only temporary.

Last piece of advice, before we look at the resources available to you:

- **DO NOT ASSUME** students are trying to take advantage of the system. Mental health issues are often invisible and present differently in different people.
- **BE RESPECTFUL** and understanding.
- Caltech is small and so we expect TAs to follow up with students rather than just let them fail - this is very different to most universities.

Resources at your disposal

There are many resources that you can call upon. If a student is really struggling, you can submit a CARE referral (either anonymously or not) at <https://caltechcares.caltech.edu/care-referrals>. This alerts the Undergraduate Dean's Office and professional support staff will check in with the student.

They will then have access to the following resources available through the Caltech Health and Counseling Center and the Undergraduate Dean's Office:

- Caltech Health and Counseling Center:
 - therapists
 - occupational therapists
- Undergrad Dean's Office:
 - the Dean can approve extensions at the highest level
 - the Dean can approve exam extensions
 - the Dean can approve various forms of incomplete grade (allowing a student to take more time or retake the class later)
 - the Dean's office runs a program of tutors that can give additional course help

8 Resources

Some resourceful people at Caltech whom you could reach out to for your TA questions and discussions:

- Belen Maria Hernandez
Graduate Affairs Coordinator
Division of Physics, Mathematics, and Astronomy
West Bridge B161, belenmh@caltech.edu
- Nam Ung
Director of Student Programs
Division of Physics, Mathematics, and Astronomy
B161 W Bridge, namung@caltech.edu
- Brody Wyman
Undergraduate Affairs and Course Coordinator/Options Manager
Division of Physics, Mathematics and Astronomy
B122 West Bridge, bwyman@caltech.edu
- Melissa Dabiri
Associate Director for University Teaching
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Happy TAing!