I. MOTIVATE THE PROBLEMS

On the first day of class, I normally ask students to introduce themselves (name, year, major, last math course taken and anything else they’d like to add); although this is available on the roster, I feel a proper introduction develops an immediate relationship between the student and the instructor. As a consequence, I try to choose exercises and create examples that are tailored for their interests; for instance, in a Calculus I class of engineers, one demonstrates the use of derivatives by studying orthogonal trajectories of electric and magnetic fields modeled by implicit differentiation of simple equations such as $xy = c$ and $x^2 - y^2 = k$. In general, I start each period with brief review of the last class and a written example or graph labeled “motivation” to transition into the definitions and results of the day. Often, after completing a difficult computation, or the proof, I pose the question “what does this mean and why the heck do we care?” This is usually greeted with many nodding heads or at least a smile, giving me a chance to return to the motivational example. I can then also mention how it arises from a classical or historical problem, and how the principle is used later in the course or in physical applications. In this way, the various examples following a theoretical portion of class are not just mechanical application of the results obtained. I have been encouraged by reading teaching evaluations which indicate this approach keeps the material “real” without sacrificing analytical details.

II. PROVIDE A LEARNING STRUCTURE

Students need to learn how to devise effective study skills. If I want to have them improve their habits by being organised, it seems fitting to lead by example. One simple technique I have successfully employed is to arrive early and write down reminders and the main results or definitions from the previous class; I find this assists them in recalling the material and puts them in “learning mode” from the start of lecture. For large multi-section courses with a fixed syllabus and departmental exams, I have found that by setting up a website, students can plan their busy or free weeks accordingly, catching up from a missed lecture quickly. This has also proven to be a useful place for adding supplementary material (graphing calculator use, challenge problems, etc.). I have also experimented with sending weekly emails, reminding students what is in store for the upcoming week and to visit my office hours, particularly if it is a freshman mathematics course.

In courses having recitations, I have created worksheets and mock quizzes for the extra period. Additional applications of theory discussed in class are reinforced and in working closely with the TA, one can demonstrate different techniques and written solutions than those presented in lecture.

I also want to convey to my students the importance of post-exam reviewing. One year, my class had an exceedingly poor first exam average, so I thought I would try something new. I set some evening office hours, during which students could visit. I asked them to re-prepare their examinations, so that I could choose one of the problems for them to present; after this, I would give them some pointers for the next test. Not only did 58 of my 60 students visit, but they genuinely seemed appreciative of the chance to review their work with me.

III. HELP DEVELOP STRATEGIES

Students’ strategies for studying differ. As an undergraduate, I found the most effective courses were the ones which held me accountable on a weekly basis and demanded that I synthesize the material for exams. I have used a combination of quizzes and homeworks, in order to be able to give immediate feedback of two kinds. First,
by using homeworks problems of increasing difficulty, I can see how reasonable my demands are and make comments on the organization of their writeups. Many students seem to be untrained in the skill of making an argument combining words and mathematics. By working examples in class where I write “thus the equation of the tangent line to the curve \( y = f(x) \) at the point \((1,1)\) is ...” instead of just deriving the equation, I have been able to inadvertently get students to emulate this style of solution. Second, closed book/notes quizzes have served as excellent reminders that strong homework scores do not reflect that the material is internalized.

Finally, I have found that students are happy to provide valuable input, given the opportunity. I have made a point of assigning the following homework every term after the first exam or midterm:

1. What can I do to help you learn the material better (e.g. more office hours, harder/easier examples in class, longer/shorter homeworks, more/fewer quizzes)?

2. What can you do to learn the material better?

In fact, I have been pleasantly surprised at how implementing a few of their suggestions increases their confidence in perceiving me as a teacher helping them obtain strengths, rather than as an evaluator of their weaknesses.

IV. ASSIST IN TRANSLATION

As a recitation TA, I found since I was not accountable for the students’ marks, they were more willing to vent their general frustrations about the course and discuss mathematical problems in their own language (“I don’t really understand what that limit thingy of 2 is”). I would also show them some neat tricks and applications to what they were learning, for general culture, not just in conjunction with the course material. It occurred to me that those were tasks I should carry out when I become a lecturer as well.

The post-exam survey previously mentioned gives them a chance to assess how much their frustrations are based in reality; I also find that it is a positive outlet, since I try to acknowledge and implement their suggestions in the following classes.

In teaching students how to translate words to math and how to process math back into words, I have employed the technique of working in small groups, during recitation, in class, or as group quizzes where they present problems to each other and myself. In this way, they practice using the mathematical terminology themselves, not just listening to it. Mathematics does not become a solitary activity anymore, contrary to many students’ preconceived notions.

Sometimes I take a “storytime” break between concepts to equip a newly discussed theorem with an anecdote on the mathematician(s) who struggled to prove it; I have noticed that not only do students identify with the difficulty of expressing an intuitive notion precisely, but they appreciate knowing a bit about the person behind the theory and are more likely to remember the result the next time it appears. This also presents the perspective that historically, mathematics has been closely tied with countless subjects, including possibly their own.

V. BRING HUMAN QUALITIES

On the first day, not only do the students introduce themselves, giving their background, but I must do the same as well. As an icebreaker, I like to have the students guess my favorite sport, whose season typically begins in conjunction with the semester; with a hint each day, like “it is not a team sport,” or “the season lasts 15 days, with six tournaments a year,” it usually takes them about four classes to guess[1].

Honesty has also been welcomed by my classes, even when they were on the receiving end of “you’re going to need to work every day to get this!” In a similar vein, if I give a quiz which is too difficult or draw a complicated graph on the board poorly, I announce this fact shamelessly, by saying “wow, that was much harder than it should have been,” or “let’s squint and use our imaginations to see this (clearly crooked) line as a straight today,” and it is a reminder that we make mistakes, especially in front of an audience.

As a student, I found that when I knew the professor as a person, I felt compelled to do a better job in the course and was more interested in not only my studies, but also on the research my professor actually did. In telling students about something interesting that I am stuck on, or showing them the cover of the Notices of the AMS to discuss the kinds of problems mathematicians are currently working on, I hope mathematics comes to life as more than just a course they are attending. I hope I am reflecting the quality that I found to be the most influential in my mathematical career: conveying a passion for what I do and a sincere interest in teaching them the skills needed to pursue theirs.

[1] Still wondering? Much to the amusement of my Japanese students, it is Sumo.