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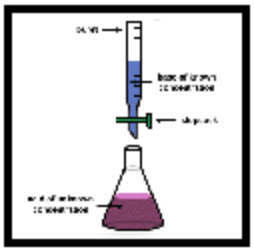

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#pltlproblems

SAM Course, Fall 2012

Cover design by Nicole Applebaum

Introduction by Regina Frey

Edited by Bryn Lutes and Regina Frey

Introduction

Peer leading requires patience, empathy, humor, leadership, discipline, giving structure….learn, lead, and enjoy!#PeerleadingCentral

My mantra has always been "never say never." This is becoming more important the older I become. For the second year in a row, the peer leaders in SAM (and Dr. Lutes) have encouraged me to learn about something I vaguely understand. I have heard about Twitter for a long time; I see it on TV when I am watching the political commentary shows in the evening; I never was going to tweet! (I still have not yet tweeted, but it is now in the realm of possibilities. I think I am going to get an account!) Being pushed to new avenues (adventures) is good for you – that's what I tell my general chemistry class. It seems that the peer leaders are forcing me to follow my own advice. All I can say is "Thanks!"

In researching about Twitter, what did I find? Below are listed some characteristics I discovered: Twitter is social with numerous followers. It allows people to discuss one topic and tweets grouped by topics encourage people to understand more about the environment around them. Twitter communicates information in real time and connects one to the latest ideas, opinions, and news; it has been called the "virtual watercooler." [1] Twitter forces one to communicate one's own ideas concisely. Research has found that using Twitter in college courses can increase communication, promote informal learning, increase student engagement, and improve course grades when used effectively. [2,3] "Twitter has become the perfect social-messaging tool." [4] Hmmm…sound familiar? PLTL, anyone?

Everyone is nervous about leading the first session of any class; no matter how years you have taught or led. It is exciting also; that first session is the start of a brand new experience for both you and your PLTL group members. What can you do to ensure a terrific start? The leaders who have written essays for the first section **#yourfirsttime** have great advice for this first session.

One of the main tips is to come prepared. You want your students to feel comfortable with each other, so that they will discuss ideas together. Jeffrey Kallen correctly points out that "Students are very perceptive of how you feel… exude confidence." Quiet confidence encourages students to open up. Meera Basu says to "think back to that first day of heading to chemistry lecture, that first day of heading to PLTL, that first time preparing for a quiz, and that first time preparing for an exam. These memories… help you to relate to your students on a more personal level." Eliot Low encourages you to "Make yourself seem 'real' to the students."

Aaron Lim mentions the worst fears that all instructors and leaders have when he writes "Will the students like me? What will I do if nobody starts talking? How will I handle the arrogant students?"

Remember, you are not alone in these fears; all peer leaders have them. How do you handle these fears? As many peer leaders suggest, follow the advice given in SAM and PAM. Make sure that you stress structure during the session: start on time, do an ice-breaker, develop group rules, and use the collaborative-learning strategies. Most importantly, as Dana Middleton urges you "make sure you go over the PLTL philosophy with your students. This could save you a lot of hassle later."

What is the PLTL philosophy? The hardest rule that is an intrinsic part of the PLTL philosophy is the "no answers are given" rule. Experienced peer leaders know that having students discuss whether the solution is correct or not furthers the development of the students as independent learners. But as Wendelyn Oswald correctly acknowledges, "If you're a PLTL leader, you're likely a good student and like any good student, you answer a question when asked and generally try to explain a concept or problem if someone asks for your help. Not doing this will be extremely difficult—especially at first—but you must resist this answering questions reflex."

Okay, so you are ready to 'not tell the answer," but remember how much you and your group members initially wanted some reassurance. Danielle Tsevat warns "They've resorted to guessing. It seems like the only option they have at this point….how are they going to be able to take the quiz next week…You want so badly to run up to the board…but Dr. Frey's haunting words about sticking to the PLTL philosophy keep replaying in your head." Elizabeth Lotsof remembers "in my first few sessions, I learned…how a simple change in facial expression can give away so much…Before I could even respond, one girl goes, 'ha, she smiled! We got it right. Let's move on to the next question.'" The peer leaders in the second section **#Tellmetheanswer** give you great suggestions and encouragement to help you keep the PLTL principle rule. Ideas discussed in SAM such as Danielle Bloch' suggestion can help: "Sometimes simply asking other group members if one of them could explain *part of the topic* can help enlighten the confused, enhance the understanding of the explainer, and engage other group members in discussion."

Wendelyn Oswald and Danielle Tsevat remind new peer leaders that the "no answer" rule applies to the peer leaders also, and tell you not to bring your answers to the problems with you. Danielle gives a suggestion about how to prepare –"I like to take [separate] notes during PAM to bring to the following session, writing down key points that I want to be sure to emphasize or ask about after certain problems."

Henry Lather describes the essence of being a peer leader. "Twitter (if you don't know, like me before this essay) is designed to let people communicate in 140 characters or less. It's basically the same deal as a PLTL leader – the goal is to be a PLTL leader and only say 140 characters per session." I agree with Henry; we should all reach to attain this goal.

One of the main objectives of PLTL is for students to learn to work together in groups to solve problems. We can accomplish this goal by using the collaborative-learning strategies. The third session **#Dontmakemethescribe** gives advice on how to use these strategies effectively.

Gabriel Hassler says "The collaborative learning strategies are there to help you. They work." He also reminds us that "At the beginning of the year it's very important to enforce the PLTL rules, even if things seem to be going well conversations work well organically during the first few sessions. As the semester progresses, problems will arise and many times round robin can digress into a large group problem with one or two people doing the entire thing. It's a lot easier to enforce the rules and establish an expectation earlier in the semester than it is to fix it later."

When you are teaching your group members the collaborative-learning strategies, Vivian Tsang encourages you "to make your instructions clear, especially for first few sessions." Margaret Lewis reminds us that even though the students initially follow all of the strategy methods, "As the semester goes on and they become bolder and they may even try to convince you to swap out certain learning strategies for others or try to turn all of them into one big group discussion. If your group is really having good full group discussions this may seem like a good idea, but in general the different strategies are in there for a reason." I encourage you to try not to let students persuade you to change strategies; Dr. Daschbach selects these strategies for specific reasons.

Ross Passo has a great suggestion with how to deal with persistent students. "Your job as a leader is to make [those strategies] fun, engaging, and productive. If you act like the strategies are enjoyable and important (which they certainly can be), your group will be more inclined to follow your lead."

The first sessions are finished, your PLTL sessions are moving along smoothly, and the students are learning and using the collaborative-learning strategies - Katie Chin describes the moment perfectly – "In the beginning of the semester, you probably thought that you had the perfect PLTL group. All of your students showed up on time, came prepared, participated with the rest of the group—everything was working out just fine." Then the mid-semester slump hit, and Katie says "If you are not preparing for your session, why should they?"

In the fourth section **#3pmistooearly**, the peer leaders aptly describe the mid-semester slump and give advice on handling it. Nicole Applebaum encourages you by reminding that "You are a vital part of the PLTL process, and even though you cannot control a lot of the conditions that lead to the mid-semester slump, your creativity can help alleviate the problem." Timothy Lin says "One of the most important things a PLTL leader can do is to be diligent and disciplined. Being a diligent, disciplined PLTL

leader means rejecting the temptation to cut corners even when they seem harmless, because these small, seemingly innocuous shortcuts add up and negatively affect your students' PLTL experience." Kala Schwartz suggests that "If you have found that your students are starting to rely on the PLTL session as a time to learn the material from the past week, it may be time to send out an email just gently reminding them to continue to review their notes and at least attempt the problem set from that week before PLTL."

Lawrence Yen accurately and succinctly says "The best way to keep their spirits up is to make them want to come to PLTL." Timothy Lin gives some good suggestion for keeping them coming – "If it's around Halloween, thoughtfully consider wearing your Halloween costume to PLTL." Doesn't everyone want a peer leader who "knew just the right questions to ask to facilitate discussion, and dressed up as a comic book superhero when culturally appropriate?"

The last section **#apphysicskidwontshutup** describes the importance of group dynamics in PLTL. How does one develop the dynamics such that everyone contributes during and learns something at each session?

Phillip Hsu gives an excellent suggestion to encourage everyone to participate by "taking a 'vote' during problems." Leah Weintrub reminds us that "It is important to realize that although the group dynamic feels great and your students are getting along, you cannot become complacent as a leader. It is called "dynamic" for a reason. Your group is going to continue to change and grow and it is never going to become static." A peer leader needs to keep alert, especially as the semester progresses.

To assist your group members in understanding the topics more deeply, Lucy Huo reminds us that "there's something that all PLTL leaders will come to realize—that one of the biggest challenges of PLTL is to provide an environment where a topic/concept will be able to be conveyed to everyone in a way they all understand." Phillip Hsu suggests "to make sure that everyone leaves the session having learned something, it is crucial to approach the same problem from many different angles because everybody learns differently."

In addition to helping the students start to understand the content in Chem 111, Rahul Jaswaney correctly points out that "PLTL represents the first structured study session students experience as college freshman. The types of problem-solving methods and heuristics developed during PLTL sessions determine the type of learning strategies that students will be practicing with other courses at Washington University in St. Louis."

Tony Sun reminds the students that "part of working hard in chem111 involves attending PLTL sessions regularly…and being prepared to participate regularly at each session."

You will be discovering the intricacies of peer leading and PLTL just as I am starting to discover them about Twitter. And just as last year's peer leaders helped me continue to learn, we will work together as a community to learn about peer leading. You will be joining the wonderful community of General Chemistry peer leaders (both new and experienced); we all work toward common goals while learning from one another – and we have fun while doing so. Use the SAM and PAM classes as you develop your own peer-leading persona. I look forward to growing with you this semester.

Regina Frey

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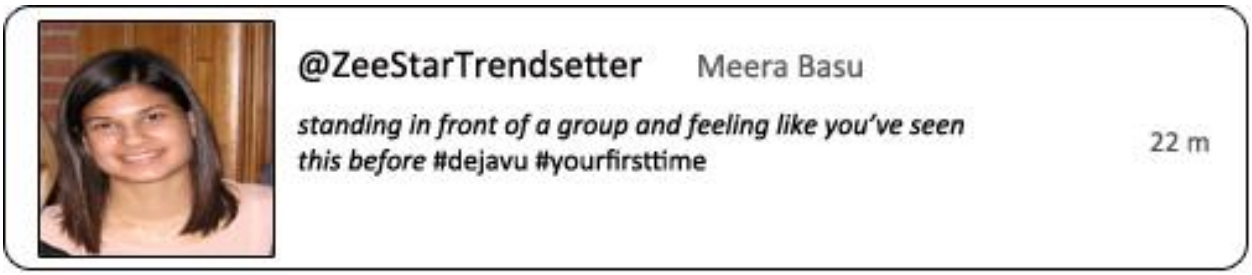
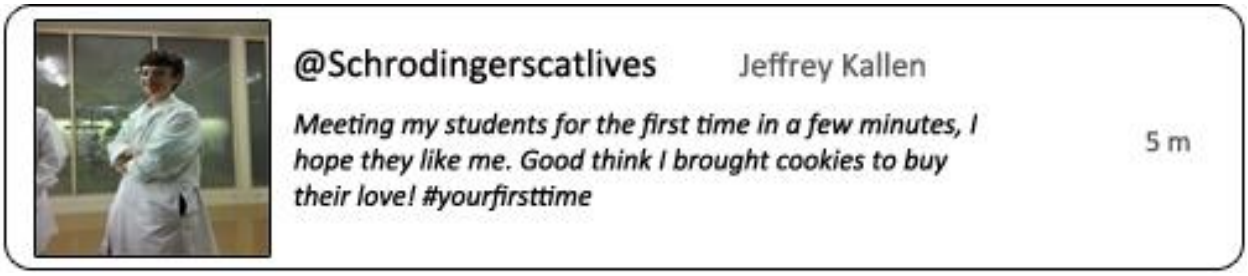


This is your first time as a facilitator of a PLTL session, but take comfort in knowing that you've been through general chemistry before! You already have a full year of experience under your belt. One year ago you were in the same shoes that your students are currently in. Use this recent experience to your advantage: along with preparing for the chemistry material that goes along with your problem set, take a moment to remember what it was like to be an incoming freshman. Think back to that first day of heading to chemistry lecture, that first day of heading to PLTL, that first time preparing for a quiz, and that first time preparing for an exam. These memories can be some of your most useful tools as you head into your first PLTL session because they help you to relate to your students on a more personal level. I have a few tips of advice in preparation for your first session:

1. Look through your notes from last year before heading out to your first session. Reviewing material covered in the problem set by looking over your own notes will really help refresh your memory, especially about parts you found difficult. You can focus your discussions around these areas.
2. Bring food! I found that when I had food for my group they were more social and willing to collaborate on the problem set. Food is always a great way to break the ice, especially your first session. After that, you can use a sign-up sheet so that each week a different student brings food for the group.
3. Check to make sure you have everything you need before heading out the door. This includes copies of the problem sets, as well as dry erase markers and an eraser (essential items for a session – don't underestimate the use of the dry erase board for showing work on problems).
4. For the first session I recommend you bring some paper and markers for everyone to make nametags. This gives students who come early something to do in passing the time, and it really helps you and your group learn everyone's names. Learning names is extremely important in establishing strong group dynamics.
5. Have a fun icebreaker to start off the session with.

6. Be confident! Your students will be able to smell any lack of confidence. Don't let a few mistakes get you down during your first session! You aren't expected to be perfect – you're coming to S.A.M. every week so you can learn from the experiences that Dr. Frey and other students share with you.

As I stated earlier, trust in your own experience to help direct you throughout your session. One of the first questions students asked me was: "Is the quiz hard?" I did not get a perfect score on my quiz, and I found that by sharing this I was able to ease their fears. Outside of mentoring in a purely academic way, I used personal anecdotes to help my students confidently face some of the big "first experiences" of the class.



There are a lot of firsts as a Peer Leader, none of which are more important than the first session. I remember being incredibly anxious prior to my first session, thinking of all the ways it could go. I had always been on the other side of PLTL, never once thinking how it felt to be the leader in charge. What kind of approach should I take in my sessions? What kind of leader do I want to be? Will the students like me and find me helpful? Will all my chemistry puns be met with silence? All of these thoughts rushed through my head. However, everything changed when the first of my students walked in. I instantly knew how I wanted to present myself and acted accordingly, and everything during my first session felt completely natural and unforced. The same, I guarantee, will happen to you.

Once the actual first session begins, there are many things to be mindful of. Students are very perceptive of how you feel, so it is important to exude confidence, even though this is your first time being in the leader's position. In addition, confidence is infectious, and students will always feel more comfortable when you yourself are confident. One way to accomplish this is to always be prepared! Look through old notes and be mindful of what is being covered in lectures that week. Keep in mind things from your own first semester of PLTL from way back in freshman year, like being sure to bring food (nothing keeps students focused like the promise of munchies). Start off this first session by introducing yourself, and then proceed into an icebreaker of sorts: find out a little bit about your students. (Odds are they will all be pre-meds). Trust me, a group works so much better when everyone knows one another's name. Follow that by covering rules and how things will operate every week. Establish clear rules for things like arrival so that you do not have cases where students trickle in over the course of an hour, disrupting the workflow.

Some other important firsts pertain more to your students, but are things you play a big role in. When the first quiz and first exam come rearing their ugly heads, your students are naturally going to be apprehensive and filled with thoughts of self-doubt. It is your duty to instill in them the confidence that they need in order to kick some butt! Tell them that the rumors always build the first quiz and exam to

be far worse than they actually are. Remind them that they have been exposed to all the types of problems they will see, things they already know how to do. You are there to quell their fears and give helpful advice (such as how exam problems might be the reverse of what the students are used to). All that is left for the students is to go into assessments with a positive outlook, while you sit knowing you have done your duty.

The last advice I would like to leave you new leaders with is this: Relax! Being a leader will become more natural with time and your facilitation skills will improve with each passing week. Even if you make mistakes, it is all right. Have confidence in your abilities as well as a positive outlook, and you will end up having a great experience helping others conquer Gen Chem!

It is the night before your first PLTL session, yet you decide to tweet because you cannot fall asleep. You keep thinking of all the worst possible situations that could arise during your session: will the students like me? What will I do if nobody starts talking? How will I handle the arrogant students? These fears are natural, but here are some tips to calm those butterflies in your stomach.

Be prepared. You have already attended PAM on Friday, so you have seen the problems on the PLTL problem set for this week. Make sure you understand each concept that is being tested in the problem set and start anticipating questions students may have. For the first session, go a little bit earlier than usual to rearrange the classroom to your comfort and make sure that you are familiar with your surroundings. Do not forget those dry erase markers!

Remember what it was like for you as a student going to your first PLTL session. The students will probably be more scared than you, the leader, for the first session. They do not know what to expect, and after attending the first few lectures of General Chemistry, they are most likely already intimidated by the material. Send an email to your students the night before reminding them of the location and time of the session and what materials they should bring. Have a set of questions ready to ask them to get conversations started. As they enter the room, talk to the students and get to know them. Reassure them that although General Chemistry is a difficult course, you got an A in this class and were able to get through it. Emphasize the role of PLTL and how it has been a proven technique to raise students' grades.

Bring snacks. Your students are college students, just like you. They like free food just as much as you do, so bring some Oreos to share!

Prepare an icebreaker. An icebreaker is the perfect way to get your PLTL session started. The students need to know a little bit about each other in order to work together on Chemistry problems. After all of the students have settled in, start with a fun icebreaker. The purpose of the icebreaker is to get the

students comfortable working with each other so that you can start building good group dynamics from the start.

Outline expectations. This is the most important part of the first session. As the PLTL leader, you must make it clear to the students what is expected out of them. Have the students read the PLTL philosophy, then explain to them in your own words what it means. Each student should be willing to contribute ideas to the group and share their knowledge of Chemistry. Foster a friendly environment by reassuring them that everyone makes mistakes and that harsh criticisms will not be tolerated. Emphasize the importance of attempting the problem set before each session and coming on time. Two hours of PLTL can be a waste of their time if they come unprepared, text on their cell phones, or are unwilling to contribute to the group. Most importantly, make sure they understand that you are not there to give them the answers or teach – you are there to facilitate. Although this idea may seem frustrating to the students in the first few sessions, reassure them that they will soon see how this component actually contributes to the success of PLTL.

Learn from your mistakes. During the first session, it is natural to slip at times and answer their questions directly instead of deflecting them back to the group. Recognize your mistakes, attempt to correct them during the session, and take note of them so that they will not happen again.

With these tips in mind, you will be well on your own to leading the perfect PLTL group. Soon, you will start tweeting about how great your group works together instead of its problems.

Your first PLTL will undoubtedly be an adventure; perhaps students will not show up on time or they may be unprepared, perhaps they will uncomfortably shift in their seats in a room full of strangers or maybe they will be talkative amongst friends. Perhaps you'll look up to a room of seven freshmen girls and one lone boy, as I did my first day. The first day is arguably the most important one of all, and the first sentence you speak may give a lasting impression that can stay with them for weeks to come. For this reason, it is imperative that you give the best first impression possible to facilitate the environment you are striving to create in your group.

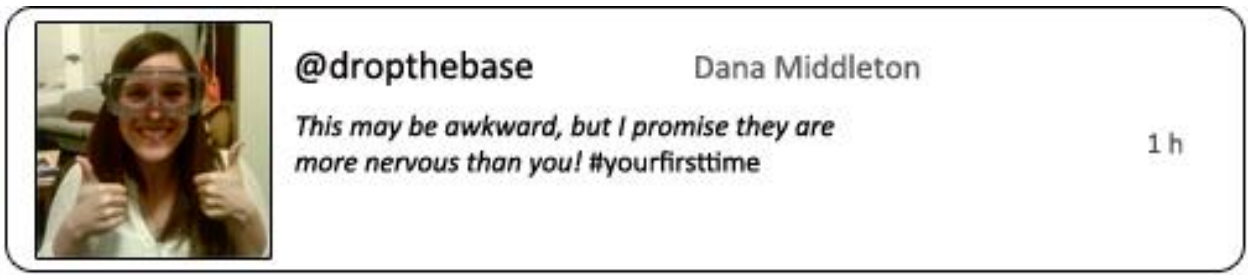
Luckily you have an opportunity to make a pseudo-first impression with an email before your first meeting. It is important to carefully craft this email in order to not only welcome your students to PLTL and inform them of how to prepare, but more importantly this email serves as a way to assert yourself in your group as a focused, goal-oriented leader. This way, as your students enter your room on the first day, they know to expect a program that focuses on the chemistry and can benefit them in their learning. Once this focused, assertive email has been sent, the students will undoubtedly recognize you not only as an exceptional chemistry student, but also as a leader who will not tolerate poorly behaving students. You can become an authority figure to the students simply by choosing the right words in a simple, one paragraph email.

Because you have established yourself in such a manner, there is far less pressure during your first session to affirm any sense of authority to your group. They know you are taking your job seriously, and they know you excelled in the course the previous year. As a result, now is your opportunity to build the proper learning environment. It is extremely important to balance the stern email with a friendly, approachable side of you that allows the students to feel comfortable with the group and comfortable sharing their ideas. Making strangers feel comfortable with you can be difficult and likely will take a few weeks to achieve, but the beginning of the first session allows you to start on the right foot – you only get one chance for a good (in person) first impression.

Make yourself seem “real” to the students. Many of them may have the impression that A+ students in general chemistry are practically a different race of people, people that they will never be like. If you can show the students that you are just another regular student who worked hard and succeeded as a result, they will be able to gain the confidence they need to be successful in the same manner.

How does one make oneself seem relatable? Start with a good icebreaker. Whatever the game/activity/questionnaire is, make sure you participate actively, too. Don’t be afraid to show a goofy side of yourself, as many students will feel more comfortable opening up to you once they see you doing the same. For example, I started every week with miscellaneous fun facts; favorite colors or cartoons, places we’d like to travel, chemistry terms that describe our weekends, etc. By doing this, each student was able to share a few things about themselves and become more comfortable with their peers in the group. I participated as well, and the students quickly learned I had quirks just like they did. Furthermore, this beginning to each week created a jovial, relaxed environment allowing the students to almost feel as though they were sitting amongst friends rather than being forced to sit and learn chemistry for two hours with kids they don’t know.

You will likely find numerous ways to lighten the mood, but it is important that PLTL not feel like a chore, but rather you want your students to enjoy coming to PLTL. Some students may never truly enjoy their time, and for some students PLTL is not the best way of learning. (Having a student drop out can be normal, and it does not reflect poorly on you.) But for the majority of students, they will find PLTL can be a relaxing environment to learn chemistry efficiently with the help of friends. This is possible, however, only if you can properly balance the academically focused side of PLTL with a lighthearted environment that can allow people to unconditionally share their thoughts about general chemistry. When students feel absolute comfort in a group, they no longer worry about “sounding stupid” or asking for help, but rather they feel like a friend asking other friends for help with a smart, sophomore friend present to ask the right questions.



Congratulations! You are about to lead your very first PLTL. Are you ready? If the answer to that question is no, do not fear. There are a few easy ways to ease the unavoidable awkwardness of the first day. Remember, most of your students are going to be freshmen and will think you are awesome just because you are older and got an A in GenChem, so embrace that!

Although this may sound silly, bringing food is one of the most important things to remember for your first session. This will give the students something to do when they show up 10 minutes early, which they will because they are freshmen. Food also helps create a friendly atmosphere so they are more comfortable speaking up, which is key. This does not have to always be your responsibility, however. Make a sign-up sheet for bringing food so that everyone brings at least once. This can also be your attendance for the first day. Another easy thing to fill up possible awkward time before the session begins is bringing paper and markers for your students to make nametags. This is a great trick for two reasons. Not only will this occupy their time for the first few minutes, but it will also help everyone learn names!

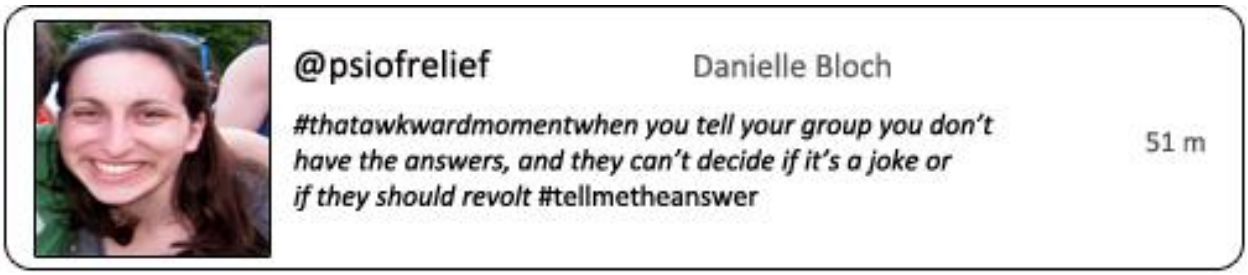
As the leader, it is your job to make sure that everyone in your group knows each other. This will promote talking among your students later in the semester, so make sure you accomplish this before the end of the first session. At the very least, you need to learn everyone's name so that you can address your students by name, which will help them learn each other's names eventually. This can be done by playing a simple icebreaker before beginning the problem set. For example have each student say their name, major, hometown, and an interesting fact. Or you can make it into a competition to see who can learn the most names. If you have fun with it then they will too.

Before beginning the problem set, make sure you go over the PLTL philosophy with your students. This could save you a lot of hassle later depending on your group. Oftentimes students will complain about not getting the answers after they get more comfortable with each other and with you. If this happens and you did not go over the philosophy from the beginning you will have dug yourself into a hole, so do

not forget! Make sure it is also clear to your students that this is a voluntary program and if they do not agree with the philosophy then they do not have to participate.

When you do get to the actual problem set, you need to make sure that all of your students understand the different kinds of problems. This can either be done all at once at the beginning or as you work through the problems, but if you opt not to mention the different collaborative learning strategies now, then it will be harder for you to implement them later. At that point, each question could become large groups, which defeats the goal of PLTL.

As you may see, a lot of things that you do in your first session can have a big impact on the rest of the semester for your group. I do not mean for this to make you nervous, because it shouldn't. You just have to remember a few simple things and you will be on your way to a great first PLTL experience! It will be fun so get excited!



Initially, students new to the concept of PLTL are often baffled and sometimes frustrated by the lack of answers disclosed. But, instead of staging a rebellion, they're far more likely to just question why this is the case. Right from the beginning of the year, you should explain (and re-explain if need be) that the focus of PLTL is on the process of working together to solve problems, and understanding the journey of reaching an answer is more important than the answer itself.

Especially toward the start of the semester, you may have students who flat out ask you, "Is this right?" or who might expect you to explain the entire general chemistry course to them. As neither of these is the essence of PLTL, it's important that from the very beginning, you emphasize your role as a facilitator, not as an answer key. With these types of students, a skill that you will quickly befriend is how to redirect questions pointed at you back at the whole group. For example, if a student asks if their answer is correct, look back toward all group members and ask how they went about solving the problem and if different approaches used led to a common result.

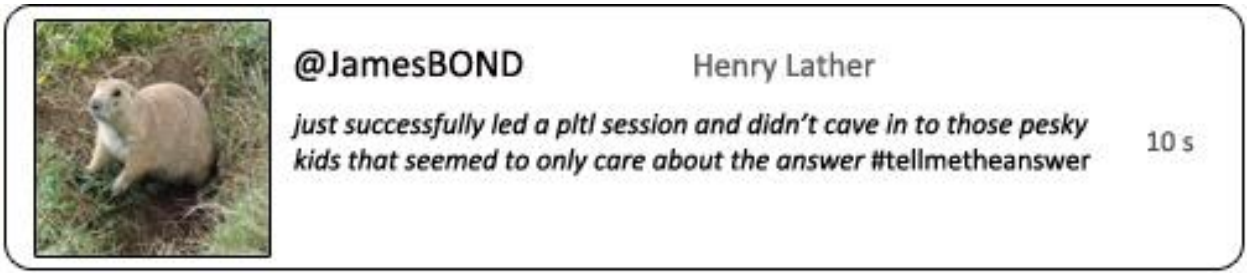
Furthermore, when students ask you questions about material, it provides an excellent opportunity to spark a group discussion. Sometimes simply asking other group members if one of them could explain part of the topic can help enlighten the confused, enhance the understanding of the explainer and engage other group members in discussion. Also, you can respond to a question with a question; if you can make up more basic questions about the subject to ask your group members, you can help the confused build up their understanding.

It can be difficult to determine if everyone is on the same page with the material, since even if group members are nodding their heads along, it doesn't necessarily indicate understanding. So, when one person voices confusion about a topic, there's a good chance that others are also confused and are just not speaking up about it. If you start by asking very basic questions to the group about the subject and building up the complexity, you can initiate and facilitate a discussion. While at first this method of deflecting questions might seem unnatural and you may feel pressured by group members to divulge

the answer, if you keep up with this method, they will begin asking each other questions instead of pointedly directing them toward you, and this will help build their cohesiveness as a group.

As a facilitator, your job is to the grease that helps your group run smoothly, and free flowing discussion about chemistry always seems like a plus. But, in the course of heated gen chem discussion, arguments sometimes form. Your role as a peer leader will be to mediate these conversations; as long as disagreement about subject matter is respectful, these disagreements can be helpful. They cause students to learn to defend, verbalize and reevaluate their thoughts about chemistry. But, it is also your job as a peer leader to make sure that everyone is disagreeing respectfully and to manage the time of your session. If your group is getting caught up about an insignificant minute detail, you should emphasize the importance of the big picture and suggest the group move on to another problem. Also, if some are unsatisfied with the discussion's conclusion, you can encourage them to go to help session to have their questions answered.

Sometimes it can be difficult to entice, engage and encourage your students, especially when some keep asking to just #tellmetheanswer. But, with practice, you—and your group—will embrace strategies that encourage group discussion, participation and thought.



Twitter (if you don't know, like me before this essay) is designed to let people communicate in 140 characters or less. It's basically the same deal as a PLTL leader – the goal is to be a PLTL leader and only say 140 characters per session. While this is somewhat of an exaggeration, there is a bit of truth to it. The ideal leader is one who can lead his or her group to where, by the end of the semester, the leader doesn't do much more than show up, hand out the problem sets, and tell the students which problem solving strategy to use for each problem. After all, PLTL philosophy can be summed up as facilitating, not teaching. This sounds like a daunting task, and it is. Not very many groups reach this mecca of PLTL success (at least mine didn't!), but hopefully this essay can take you one step (or two, or three!) closer to reaching this distant, yet desirable goal.

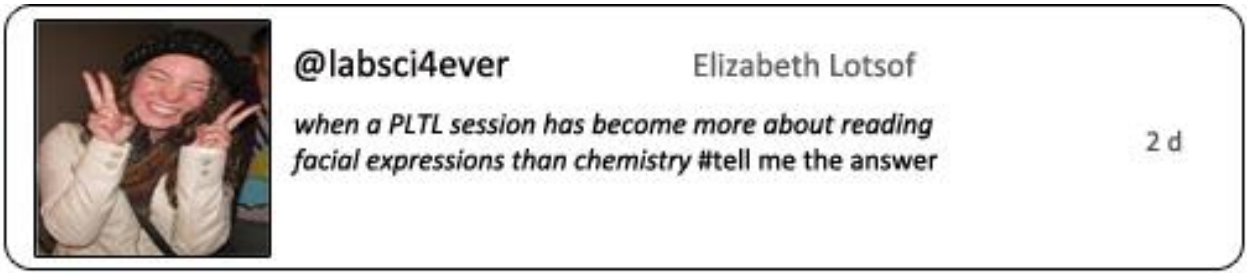
One major challenge is to convince your students that the PLTL philosophy is effective and successful. Selling them on this idea is crucial to PLTL success; otherwise they will just fight you the entire way. One way to do this is by offering several powerful arguments as to why the PLTL model works for General Chemistry and learning in all classes. The first thing is that it teaches you to think critically – and this is a must for exams. Gone are the days where simply memorizing things would let you get an A. Not having the answers, working with others, and working through the concepts themselves all help achieve greater understanding. Also, learning to work collaboratively with others – building on each other's ideas and assessing each other's answers – is an extremely valuable skill that will help in many areas of life. You can also point out that if students want somebody to teach them the material, there are resources available for this – help sessions, RPM's, and tutoring.

Now to discuss the title of this section – answers to PLTL problem sets. The biggest challenge of being a PLTL leader is simply not caving in to the inevitable requests (often pleas) for answers. If you're like me, it will be extremely tempting, as you want them to do well on quizzes and exams. But it's time for tough love! It really is in their best interest if you restrain yourself and let them figure it out as a group. Students will react to your refusal in a variety of ways. Some students grudgingly accept but others may even get mad at you. A common line among the bolder, sassier students is, "If you can't give us the

answer or tell us how to do the problem, then what are you even here for?" At this point, you can refer them to the reasoning behind the philosophy, as discussed above. The bottom line is to STAY STRONG and to not stray from the philosophy.

That being said, you shouldn't let students convince themselves of the wrong concepts, if through discussion, they end up there. Instead, you can ask them open questions and challenge them to work through the concept logically. Since students should be working together, odds are somebody will catch on and help the group arrive at the correct conclusion. The tricky part is to not lead them to assume that the only time you're going to ask follow-up questions or challenge them is when they're wrong. One way to avoid this is by challenging them and making them defend their answers even when they do have the correct answer. This strategy is both fun and effective.

Hopefully, using this collection of essays, you've learned some ideas on how to encourage the PLTL philosophy without going insane. And now you can work towards a session in which the students work together to learn concepts and solve the problem sets. Good luck!



There is a moment in every PLTL session when your students will just stare you down. The room goes silent, the general frustration fills the air like the stench of rotten eggs, and they look for that one twitch, one crack of a smile, anything that will help them believe that they have the right answer. I'm sure you've had it happen when you find yourself in the position where your group is begging for the answer. Trust me, I know it's not easy, and they will never believe you when you say this, but by working together as a group and really adhering to the PLTL philosophy, your group will learn so much more than they ever would if you were teaching the session.

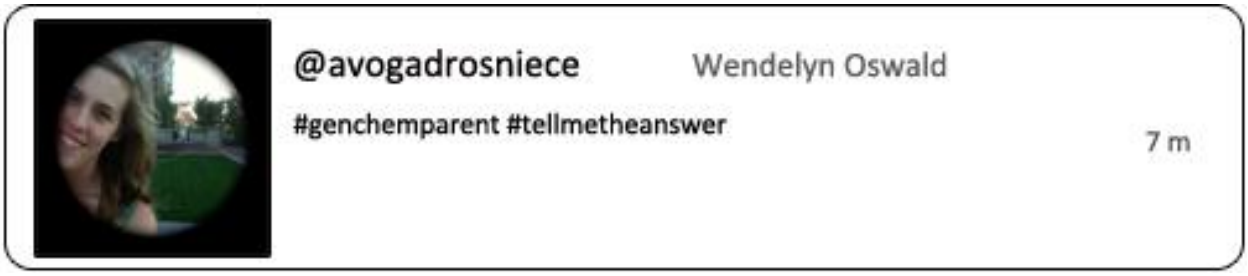
In my first few sessions, I learned really quickly just how difficult it can be to deflect those questions, and how a simple change in facial expression can give away so much. I've had few times when my group had just completed and problem, and they were unsure if their answer was correct. They turned to me and asked, "Is this right?" Before I could even respond, one girl goes, "ha, she smiled! We got it right. Let's move on to the next question." So beware, they will try to get anything that they can from you, but you learn a few tricks. Soon, I started smiling all the time, when they got a question right or wrong, and they stopped trying to read my facial expressions soon after that.

You'll find over time that you will gain an arsenal of tricks to deflect those questions. I suggest if somebody asks you a direct question, throw back at the group. It's as simple as saying, "Hey guys, Jonathan has a question," or repeating the question back to them. Giving back the same blank stare they give you and saying "I don't know" also work wonderfully. You could also remind them that you took the course last year and can't possibly remember everything. You'll find your own way to combat these questions.

By following the philosophy of PLTL the group can learn so much. If you didn't believe or experience it, you wouldn't be in SAM learning so much about it. The collaboration between several people can be so helpful and a group can learn so much from it. Discussing ideas and concepts can address problems that the students have and bring out ones that they were not even aware. Working those problems as a

group really helps everyone even if they have a firm understanding of what is going on. When they struggle with a problem and get the right answer, they learn so much through that process. Those who originally had the question, will now understand, and those who understood it , will have a complete understanding that they can use to face any question that comes their way. It encourages every member to think critically about what they are doing much like they will have to do on exam. By not giving them the answer, it forces them to question their work and their knowledge to see how well they truly understand the material.

Just remember that this is peer lead team learning, and for the team to learn, you need be the leader by facilitating and not teaching. The most exciting part of being a PLTL leader is when the group has progressed to this point of collaborative learning that group runs itself, and they don't even bother trying to ask the leader. It's then that they have created some amazing skills that will help them in all of the college ventures and succeed in everything.



CONGRATULATIONS on recently becoming a brand new parent of approximately 6 to even 10 baby gen chem students!!!! I'm sure you're very excited to get to know them better and to see how everyone progresses throughout the coming semester =]

Even though it's very exciting to be a brand new PLTL leader, you mustn't forget what your "job" actually is. As a leader, your goal is first and foremost to help your students become self-sufficient learners. This doesn't mean they only study by themselves and never ask for help. On the contrary, self-sufficient learners know when to ask for help and where to go; they stay relatively caught up with schoolwork; and know how to work in groups effectively. We are obviously also helping our students with chemistry, but this should not become one's main goal simply to help rein in the urge to explain concepts when the group seems lost.

If you're a PLTL leader you're likely a good student and like any good student, you answer a question when asked and generally try to explain a concept or problem if someone asks for your help. Not doing this will be extremely difficult—especially at first—but you must resist this answering questions reflex. You must become a master at diverting questions back to the group especially at first. Your students need to know that you will in no circumstance give them an answer. This will force them to be more independent as a group and not rely on you as much while also establishing your assertiveness as a leader. Many times, questions are simple like constants or some other factoid that can easily be found in their notes. It might seem harmless to tell them the speed of light, but it's good to force them to use their notes. Their notes are a valuable resource and learning to use them and refer to them will teach them a priceless skill that will serve them well throughout the rest of their time in school.

This is likely your students' first experience with a WashU science course, which places even more importance and value on the PLTL experience. Many will have to adjust and part of your role is to help with this transition. It's always nice to give advice about exams, studying, and even things like other fun

courses to take. This will build you relationship with your students, demonstrate your knowledge, and help them adjust and feel supported. But in addition to your own personal advice, just the structure of PLTL helps students adapt. It forces students to at least moderately stay up to date with their coursework, it makes them learn how to work with a group of people they don't know, and it encourages deep conceptual thinking about the material. By helping them learn to do all of these things, you are effectively helping them become more successful in college. Yay!!!!

Encouraging discussion and thoughts about the concepts behind problems is one of the most valuable aspects of PLTL. Starting out in gen chem, students often have the expectation of simply plugging and chugging when working on problems. They will soon realize, however, that this is not how one becomes successful in chemistry. This is where you come in as a facilitator. If just left alone, the group is highly unlikely to discuss why they took the steps they did or what their reasoning was behind a solution unless you force them to slow down and talk about it.

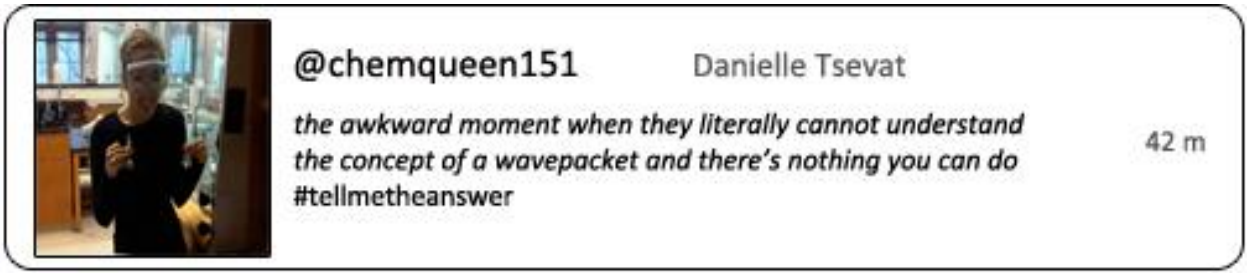
As a facilitator, your job is to keep the group on track and also ensure that they're fully analyzing the problems. You have to put focus on the work and not just the answer because this is how grading will work on exams—a fact you can use to encourage discussion. Often, but really always, students will have a differing level of understanding about a problem even if everyone got the same answer. Play devil's advocate here and become the one asking questions like you don't understand; this will make then defend their answer and possibly clear up any confusions students might have. Use the board; force someone to go up, show all their work, and explain their logic. This, in a sense, forces them to prove their answer while also encouraging confidence with their work and will often help a fellow student. Try to switch up who is chosen; don't always pick the person who is on top of their stuff, choose other people to help build their confidence as well.

You're going to be a terrific PLTL leader. Remain confident in yourself and your abilities; you were hired because you are qualified. Stick to the philosophy and your students will be thankful in the long run. You would only be doing them a disservice by giving in and giving them answers since they need to learn to be self-reliant. After all, you won't be there at exams and quizzes to help them and how would you feel the next week when you see Dr. Frey?

Good Luck!!!

@avogadrosniece

P.S. Since there are no answers in PLTL, make sure not to carry your PLTL sheet around with you. If you have what seems like an answer key the students will be unlikely to believe you when you say, “I don’t know, what do you think?” This is where preparation is key for your ability to facilitate.



They've resorted to guessing. It seems like the only option they have at this point, and it's killing you. If they can't get through one basic double slit diffraction problem, how are they going to be able to take the quiz next week, let alone complete the rest of the PLTL problem set? You want so badly to run up to the board and teach them everything you know about the wave and particle properties of the matter—and trust me, they wouldn't mind that either—but Dr. Frey's haunting words about sticking to the PLTL philosophy keep replaying in your head. And while a lot of the time, resisting the urge to tell them the answer can be difficult, there are many ways to ensure that your group does function well on its own.

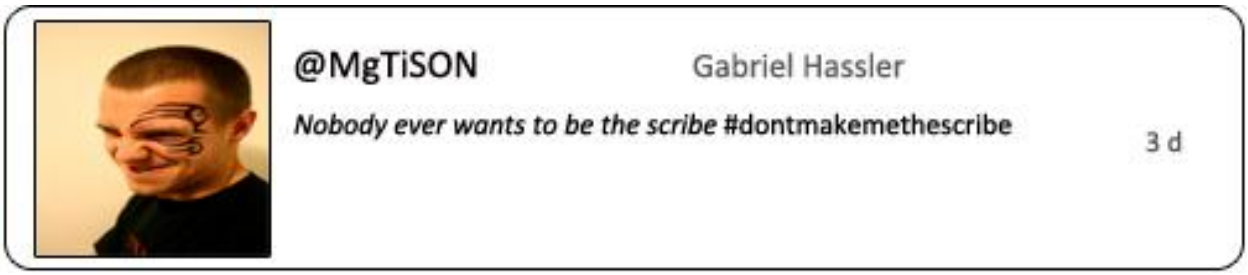
First of all, you should make sure to emphasize the philosophy with your group from the very beginning. Make it clear right away that there is no answer key and continue to enforce this each week. They will most likely be skeptical at first, testing your ability to adhere, but stay strong; if you give in once, they will expect it again. It also doesn't help the "no answer key" rule if you bring your own answer key to the session with you. I like to take notes during PAM to bring to the following session, writing down key points that I want to be sure to emphasize or ask about after certain problems. However, it is important to keep these separate from your actual solved problems. If you're constantly looking down at your own work and comparing it to their answers, how can you blame them for checking if they're right?

But, of course even if you don't have your answer key, they will still ask for the answer. And this is when the repeated "I don't know"s, "what do you think"s, and blank stares come in. And honestly if you do this enough, they should get annoyed and stop. By the end of the semester, I sometimes just looked at my group and laughed if they asked me if they were right (which actually tends to cause the occasional "she's awkwardly laughing—that must mean we're wrong" panic until they realize that they really are confident in their answer). One of the best ways to respond is to ask entire group if they agree on the solution, making sure it makes sense to everyone. Encouraging discussion by questioning why your group arrived at an answer is very important, especially if you disagree with their approach. If you have established a comfortable group dynamic, your students will hopefully not be afraid to speak

up if they disagree or don't understand something, which may even lead to them realizing on their own that their answer is incorrect. And ultimately, letting them find their own mistakes is a much better teaching method than just telling them that they are wrong: primary evidence that the PLTL philosophy does work!

But what happens when they don't even know where to begin? You still can't tell them what to do, but you can try to avoid this problem. First, remind them that they can use their notes! If they claim they were never taught the material in lecture, don't believe them. They were. And if they're all completely unprepared, don't let them get away with it by giving in and teaching them! Instead, allow them time to think critically about the problem, apply what they reviewed in the warm-ups, and brainstorm how to approach solving it. Hopefully your students soon learn that they truly will get the most out of each session if they come prepared and keep up in the class.

Still, remember that while you can't teach them, you can still give advice! While there may be a fine line between giving helpful tips and tutoring, you don't have to be completely silent. Giving exam-taking and studying advice, probing them with extended critical thinking questions, and even suggesting a few helpful mnemonics or shortcuts is perfectly fine, and your students will appreciate it. Ultimately, your job is to facilitate discussion and problem-solving, and the more effectively you can facilitate, the more efficiently your group will be able to function on their own, without relying on you or an answer key.



Nobody ever wants to be the scribe; it puts people in an uncomfortable position where they're both in the spotlight yet (supposedly) helpless to control whatever is going on. It's particularly awkward when it's the first few weeks, when your group members probably haven't become comfortable enough with each other to voluntarily stand out from the crowd. In these situations, it's natural to think "why don't I be the scribe this one time just to show them how they're supposed to do it. Once they get the hang of things they'll be more than happy to take over." But you'll quickly figure out that, like I said, nobody ever wants to be the scribe. As much as they hate it, it's your job to make them do it.

The collaborative learning strategies are there to help you. They work. Every PLTL leader modifies them in his or her own way, and you'll hear a lot about them as the semester goes on, but remember: the collaborative learning strategies, and the PLTL philosophy as a whole, has been studied by the university and shown to work. It's important to try each one as it's been taught to you this semester for at least the first few weeks before you start experimenting. There are strengths and weaknesses to each strategy and a lot of times they're difficult to see in just the first two sessions.

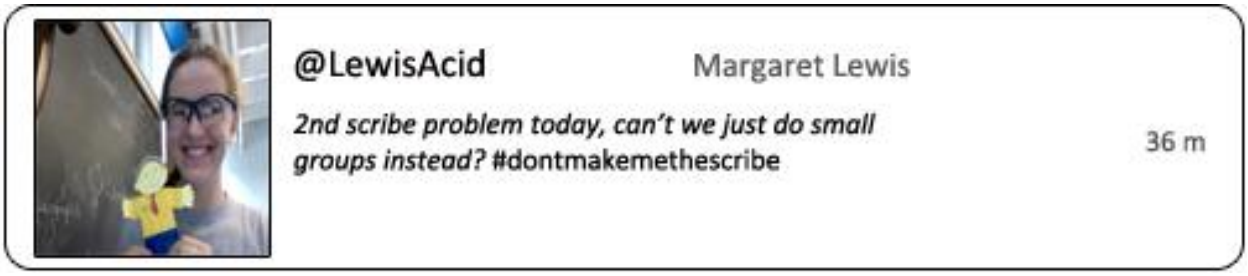
Scribe is the most feared (or disliked) of all the collaborative learning strategies from the students' perspectives. As I said above, it requires one student to separate from the group and subject her or himself to the often contradictory instructions of the rest of the group. Depending on your group dynamics, scribe can be used in a variety of different ways that make it a unique tool to facilitate your group. In every group there are people who like to talk and people who don't. This isn't always a problem, but in many cases one or two students dominate group conversation at the expense of others. In this case, make the dominant student scribe. It forces him or her to listen rather than speak, and gives other students an opportunity to voice their opinions.

Round robin is the simplest collaborative learning strategy in principle, but it is also one of the hardest for the students to do correctly. There are two common problems that arise while doing round robin questions. The first, and easiest to solve, is that when it is a student's turn to give an answer, he

or she won't know the answer and feel embarrassed. It's important to create an environment from the very beginning where it's acceptable to be unsure about things. One way to do this is when they ask you a question that you're unsure about, just tell them you don't know. You're not supposed to give them answers anyway and this helps make students more comfortable about not knowing the answers to questions themselves. The second problem that commonly arises during round robin is that students who know the answer often don't want to wait until it's their turn to answer the question. This happened in my group last year more than I would've liked. At the beginning of the year it's very important to enforce the PLTL rules, even if things seem to be going well conversations work well organically during the first few sessions. As the semester progresses, problems will arise and many times round robin can digress into a large group problem with one or two people doing the entire thing. It's a lot easier to enforce the rules and establish an expectation earlier in the semester than it is to fix it later.

The pairs and small groups strategies were always my favorite. They are much easier to control than round robin and scribe due to smaller group sizes which often made them my fallback when things were getting out of hand. However, the most important thing to keep in mind when assigning groups is group dynamics and the proficiency of each member of the group. When two of your most prepared students work together, they often finish the problem in half the time as other groups. It is important to be deliberate in selecting groups. While it's ok to let them choose their own groups from time to time, remember that it will often take longer than if you chose the groups yourself. This is difficult in the beginning of the semester when you don't know your group particularly well, but it gets easier as the semester progresses.

There is no single best or worst collaborative learning strategy. Use all of them, and follow the rules as best you can at the beginning of the semester. There's plenty of time to experiment later in the semester and it's a lot easier to become more relaxed in the rules as the semester progresses than it is to become stricter. #dontmakemethescribe



As you progress through the semester with your group hopefully you will all become more comfortable with each other and the idea of group learning. However, sometimes things don't work out quite as planned. Adjusting to group learning can be difficult for many reasons. Sometimes students are hesitant to participate while other times they won't stop interrupting each other. These are all problems that can be helped with the proper use of the collaborative learning strategies.

I've found that as students become more familiar with the learning strategies they pick ones they like and ones that they will try to avoid at all costs. As the semester goes on and they become bolder they may even try to convince you to swap out certain learning strategies for others or try to turn all of them into one big group discussion. If your group is really having good full group discussions this may seem like a good idea, but in general the different strategies are in there for a reason.

In my group I found that the students were generally very quiet. They usually had a decent understanding of the material, but I had trouble getting them to share this knowledge. The same three or so students dominated the discussions, while the others sat back and watched. If you let your group work in one large group, this will be hard to fix. Luckily this is where the strategies can be used.

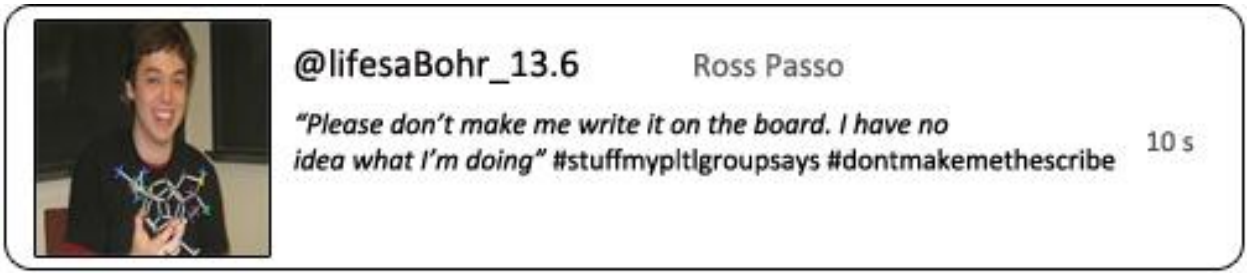
Sometimes getting the quieter students to open up is as easy as just splitting the students up into pairs. This feels less formal and intimidating than a full group discussion. If the students can begin to gain confidence in their knowledge when they are working in pairs perhaps this will encourage them to open up to the full group. I often try to either pair two quieter students so that one of them will have to take the lead, or else pair a quieter student with a student who asks a lot of questions so that they have to explain what they are doing.

As the pairs are working I will walk around and ask everyone what their group is doing. As they finish up I have one member from each pair put a different part of the problem on the board and the other member explain to the rest of the group what they did. This ensures that everyone is involved and will get the quieter students to talk. It also gives you as a leader a chance while you are watching the groups

work to figure out if the quiet students are quiet because they don't understand the material or if it is just because they are shy.

Another effective way to encourage quieter students to talk is to use everyone's favorite method-the scribe. If you have one particularly dominant group member making them the scribe could change the group dynamic significantly. You may have to remind them to stay quiet, but if the silence stretches on for too long one of the other students will have to take the lead. If your whole group is quiet, like mine often was, you can make yourself the scribe. When I did this I often would still ask questions to make sure they covered all of the necessary topics, but it gave me an even better excuse to not answer factual questions because as the scribe I don't know anything!

Of course these are all just suggestions. As you get to know your group better you will figure out what works for you. Every group is different and has different needs so don't be afraid to make your own adjustments to the learning strategies, but remember that they are there to help you maintain a balance in your group dynamics.



PLTL students say some funny things. I have compiled a list of some of the more memorable #stuffmypltlgroupsays moments from my group during my first semester as a leader. Behind each of these Twitter-worthy lines are valuable points that will help you facilitate a strong group dynamic.

Do you actually like chemistry, Ross, or do you just like it 'cause you're not suffering through it now? This comment touches on some PLTL basics. For one, it's important to foster an environment where students aren't ashamed to admit they're struggling. By promoting an honest and comfortable atmosphere, you're allowing students to experience the full effect of PLTL. Make sure you empathize and relate with your group. Chemistry 111 is challenging for everyone—even peer leaders.

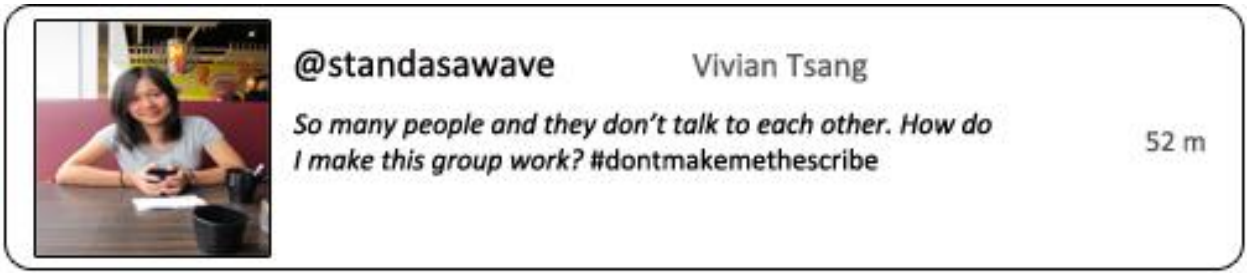
This is the football player on fire example! Although some students claim to learn everything in PLTL, it's far from the only exposure they get to the material. Throughout the session, have students use recitation worksheets, problem sets, lecture notes, and even RPM office hour tips as references. This encourages a productive dialogue and a comprehensive understanding of the material. It can also be fun for students to share stories about their professors. This particular student's reference to the effective nuclear charge example—although slightly off from the actual example—led to a useful discussion that gave everyone a clear understanding of the important concept.

I love being scribe! I still can't believe a student in my group said this. At first, many PLTL students don't like the collaborative learning strategies. My group was this way at first. Your job as a leader is to make them fun, engaging, and productive. If you act like the strategies are enjoyable and important (which they certainly can be), your group will be more inclined to follow your lead. Lucky for me, I had an excellent scribe in my group, who grew to love the role. Throughout the semester, start to notice which strategies work especially well with certain students. When you know that student X handles calculator-heavy questions with ease while student Y excels with various visual examples, use the collaborative learning strategies to get the most from your group: put student X in a small group

with some students who may be struggling, and try making student Y the scribe. Many students lack confidence in their chemistry skills, but when they are put in the right situations, they can shine.

Why do you always make me go to the other end of the room? As a leader, there are various tricks that help you properly execute the collaborative learning strategies. The student in this example obviously didn't like my favorite trick: moving students around the room for small groups and pairs. And even though your group may not like traveling around the room, switching up partners/groups, or writing up all the answers on the board, these strategies greatly enhance the PLTL experience. As the year progresses, feel free to small changes and creative additions to the strategies—your students will greatly appreciate the variety. In addition, your SAM instructors and senior leaders can be excellent resources for these strategy modifications.

You would make an excellent broad wave packet! Let's be honest: two hours of straight chemistry on the weekends can be tiring for most students, especially the freshmen in your group. Making your sessions fun and lively allows you to foster a more comfortable group dynamic. Always be careful, however, of getting off task. Although brief diversions and tangents are occasionally welcome, the PLTL session is first and foremost about chemistry. Creating a positive and conversational environment that is also productive—as seen in this hilarious wave packet example—is perhaps the most important, and difficult, task as a PLTL leader.



So the first session is done. Everyone seems nice, but they are not a group yet. How do you make the dynamics work? Group dynamics is a fickle thing that can change from session to session, but you, the leader, must set the atmosphere and attitudes of the group, and nudge interactions in the right direction to make an effective PLTL group.

First off, you must set a code of conduct in the session. Group rules lay the foundation for how its members interact: make clear that all questions are respected and no demeaning behavior will be tolerated, and students will be much more enthusiastic about asking questions and providing answers. Once the tone of the group is set, each group will have different interactions and atmospheres based on the number and personality of the members, their energy level at the time of your session, the weather of day and/or if they liked their breakfast that morning. Asking the group to behave with outstanding enthusiasm always ("Ohmygod I LOVE chemistry!") or to immediately befriend one another ("You like cheesecakes and pizza too? We're practically twins!") will be unrealistic, but you do want a group that is reasonably focused, happy and can work well together on chemistry problems. After spending their entire high school career working on their own, they are new and unaccustomed to the game of PLTL. You can help them assimilate to the methods of PLTL and to run smoothly as group by using various Collaborative Learning Strategies.

CLS is the tune that you play to help students pick up the dance they are trying to learn, so the first thing you should do is to make your instructions clear, especially for first few sessions. This applies to later sessions as well, when you feel comfortable enough to modify them to your group's needs. Among the different CLS, pairs and small groups come naturally since students are more familiar with these forms. All you need to do is to divide students into suitable groups, and check on them regularly, right? The tricky part to figure out which students complement each other and will work well in groups: pairing an active student with an inactive one may seem well enough, but might end up making the quiet student even more dependent on others. To try out how students interact with each other and get to know them better, you should have students work with new partners frequently early in the semester. In a

pair or small group setting, I like asking students to talk to each other before beginning, and check on them by having a person in the group explain what they are doing. Scribe is particularly helpful when the Peer Leader plays the role. The silence forces a quiet group to speak up and discuss, while it gives you an observer's perspective on student interactions.

I believe Round Robin is the hardest CLS to run since students tend to turn to individual work or certain members will dominate the entire process. This can be helped by using the one-paper-one-pencil strategy, where only one set of writing utensils is allowed in the group or by randomly selecting students to answer the next part of the question instead of going in sequence. Defining what an acceptable "step" is will help Round Robin run smoother, and completing the problem by Round Robin as a group gives your students a sense of solidarity and achievement. Once you and your group get a hold of the pace of Round Robin, you will likely find it helpful as it limits the input of dominant students and encourages quiet students to contribute.

Dominant students are a common issue in group dynamics, as well as overly quiet students who do not engage in discussion. You can make the dominant student scribe, which gives the rest of the group a chance to think on their own, or make a quiet, underprepared student scribe to ensure their participation in the problem-solving process. If a student dominates discussion, you can gently impose the rule of allowing them questions only in discussion. This way instead of blurting out the answers, the dominant student will have to devise questions to lead the group on, and unknowingly helping group discussion. If you say it in a playful manner, the dominant student will usually not take offense – it can be rather flattering even! With underprepared students, putting them under the spotlight, for example during Round Robin, will not be favorable.

The Collaborative Learning Strategies have many uses and group dynamics are flexible and vary from group to group. Remember: if you enjoy PLTL, your students can likely feel it too! Whenever my group gets tired or frustrated, I like telling a bad chemistry joke, giving them a short break or encouraging them to dig in the food we bring to PLTL every week, as these things do wonders on their morale and efficiency. So have fun!

Are you wondering what went awry between week one and now? Does it seem like your students come to PLTL:

A. tired? B. unprepared? C. distracted/disinterested? D. all of the above?

Welcome to the mid-semester slump! Try not to take it personally. Your students are probably stressed with balancing their transitional issues, managing their time, and adapting to college academics. They may feel stressed, anxious, or defeated by the prospect of upcoming exams, both in chemistry and other (probably premed) classes. If they are discouraged, distracted, or unreceptive, there are a variety of ways you can help encourage them. Below are seven things to consider that may help turn things around:

1) Remember your first day? You brought food, most students had slept the night before, they were eager to participate and happy to use the collaborative learning strategies. A great way to remind them of what they agreed to is to email them reminding them to try the corresponding problem set. You can also address the rules you created the first week if they are not adhering to those. My first day, students refrained from looking at their cell phones out of respect for the group. When they were moody, tired, late, and hadn't been to class in a week (or more), they were much more likely to reach for technology. The same applies across the board. Hold them to the rules they created or they will feel free to walk all over you. Make sure you follow all the rules as well, or else students will not be pleased. Remind them that taking time to eat, sleep, and take care of themselves is vital. Sometimes it seemed like my students hadn't slept between successive PLTL sessions! That doesn't bode well for the morale of the session.

2) Many times, the students want to rush through the problem sets. They want to get out early so they can study. Sometimes, a student would say, "I want to get out of here as fast as possible so I

have time to study for Tuesday's chem exam!" I would laugh a little and say, "Aren't we preparing for the gen chem exam right now?" A few other students laughed, and then the stressed students would calm down a bit. Try starting out your sessions by checking in briefly with your students, and try to take a small break during the session to let the students cool off if they seem rushed or stressed. You can also share a joke you heard this week, if appropriate. Try to keep the atmosphere as light as possible.

3) When in a rush, students tend to want to use equations to solve problems as fast as possible and skip the reviewing of concepts. Remind them that the PLTL questions are guaranteed not to be on the exam, but the concepts and principles behind the problems are sure to appear on the test. This will make them more willing to discuss concepts.

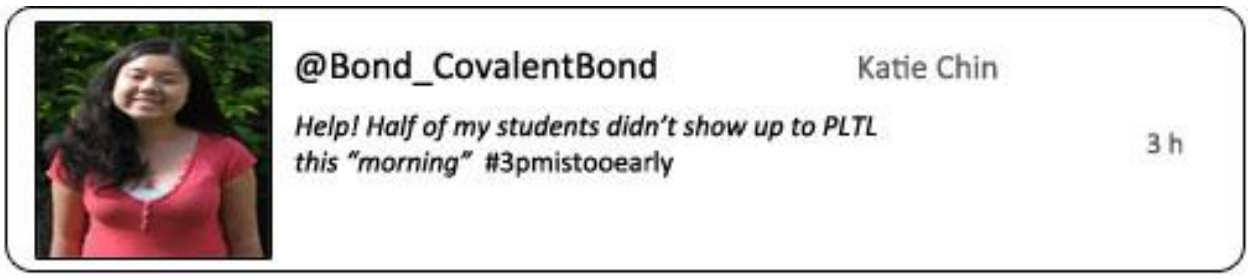
4) It seems hard to achieve equal participation when some students have not been to class in a week (or three). This can make sessions drag on, especially when attendance is low. Let the students struggle through the problem set. It is hard to do, especially when you know you could easily bail them out. Remember, the students will crack before you do, and if they know they can count on you to save them from their lack of knowledge on topics, they will not feel as inspired or compelled to head back to class (or watch lectures online).

5) Some students will probably demand answers of you or get angry or frustrated at you. When it's crunch time, students feel an even bigger need to know the answer. If a student is rude or asks why you are at the session at all, don't let it crush your spirit. It feels really harsh, but remind them that you are there to guide them back on track if they get derailed on the problems, not to lecture at them. Also a good thing to point out: their work is worth a lot more points on the exam (for the most part) than the actual answer.

6) Give them some test taking tips or advice. Chances are your students respect you and know you were successful in the course. They wouldn't hound you for answers if they didn't think you were able to solve for them. When they hound for answers, it isn't about knowing the answer. The students just need validation that they are doing the problem correctly. Deep down, they know they have a great resource and are frustrated that they can't fully tap into it. Giving students advice will make them feel like they are getting valuable information out of you even if it isn't the exact answer they want.

7) Try not to blame yourself if the session is painfully slow or you don't get through many of the problems. Every week is different, and you always have a chance to improve your facilitation and make

next week a better week. If you feel like you are not of any help to your students, that is not true. You are a vital part of the PLTL process, and even though you cannot control a lot of the conditions that lead to the mid-semester slump, your creativity can help alleviate the problem.



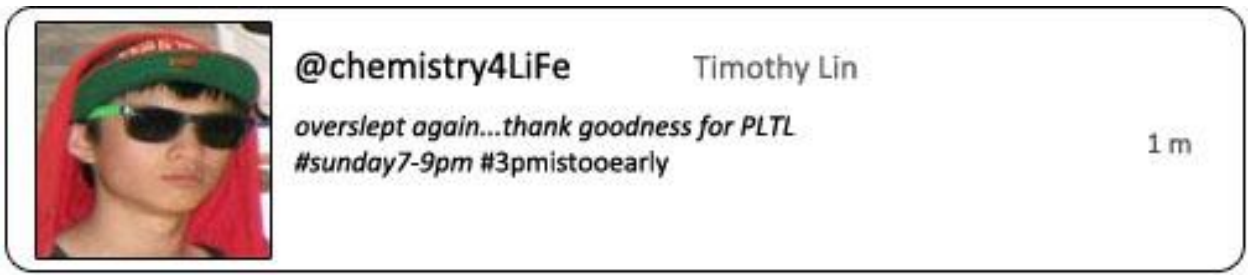
In the beginning of the semester, you probably thought that you had the perfect PLTL group. All of your students showed up on time, came prepared, participated with the rest of the group—everything was working out just fine. But now, mid-semester has come along. Your once perfect students are now trying to juggle their chemistry work with studying for the Calc II exam, while working on their Writing I paper and practicing for their oral presentation in Spanish. They start to participate less. It seems like it is the first time they have read their notes. They guiltily admit to have just glanced at the problem set answers only five minutes before your session. They start showing up later, claiming that their alarm clock didn't go off. 3pm is suddenly way too early to be awake, let alone to be doing chemistry problems. So what are you going to do to end this mid-semester slump?

As students are busy with their other classes, they might feel like they do not have the time to show up for the full session or they might not even show up at all. The easiest way to address this issue is to remind your students that by participating in PLTL, they agree to show up on time and that they are only allowed two absences. The most important thing is to not let their behavior slide. If you let them know that you will actually enforce the policy, students that value their spot will change their schedule to make PLTL sessions a priority. In addition, you can just remind the students that while two hours, especially on a weekend, might sound like a lot of time, in the long run it will save them hours of studying later on. Eventually they will be tested on all of this material, so it will be better to keep up with the material rather than cramming 12 hours the night before the exam. Another thing to remember is to keep the atmosphere during your sessions relaxed and fun. Keeping a positive attitude and bringing food can go a long way in making the PLTL session a good experience, so that hopefully your students will want to come each week.

Another problem that PLTL leaders and peer mentors tend to run into mid-semester is lack of preparation. Even if the students do show up to the session, it is clear that they have no idea what concepts were covered in lecture. One of the most effective ways of dealing with this issue is to send a friendly email to your group a couple of days before your session; don't single any particular student

out, but just send a general reminder directed at the entire group to come prepared and attempt the problem set ahead of time. Another thing to keep in mind is to not cave in and give the students the answers even if they are not prepared and have no idea what to do on a problem. Although it might be tempting to intervene to speed up the group, it will be better for everyone in the long run to let the students struggle—not only will it help with their problem-solving skills, but it will also teach them to come better prepared next time.

Although the students' mid-semester slump may be a common issue, an equally common problem is for PLTL leaders to get overloaded with work during mid-semester as well. While preparing for your PLTL session might not seem as urgent as studying for your orgo test, it is important to put the same time and effort into preparing for your weekly session as you did in the beginning of the semester. Make sure to review the concepts and think about questions ahead of time; if you do not, it will be obvious to your students that you, as the leader, were not prepared and will lead to a very rough session. One thing that is good to remember is that as a PLTL leader, you are setting an example for your students. If you are not preparing for your session, why should they?



At about mid-semester, PLTL leaders and students alike start feeling the effects of the "mid-semester slump." Classes are ramping up, extracurricular commitments abound, and you have resigned yourself to the fact that 9 o'clock in the morning is not always the best time to watch an organic chemistry lecture. To some extent, everyone feels the effects of the marathon that is a semester of college. It is important to acknowledge this fact and see how it affects your ability to lead a quality PLTL session.

Speaking from personal experience, at about the mid-semester point the novelty of leading my own PLTL session had somewhat diminished. Where I might have asked multiple probing questions during weeks 1-4, I gradually became tempted to ask just a single question or even convince myself that the group probably knew the concept well enough. Where I may have once been persistent in my insistence in a silent scribe, I began to let the scribe's occasional verbal contribution to the problem go uncorrected. I realized, partly by reading a collection of essays similar to this one, that as the semester had progressed I had begun to gradually cut corners in PLTL. One of the most important things a PLTL leader can do is to be diligent and disciplined. Being a diligent, disciplined PLTL leader means rejecting the temptation to cut corners even when they seem harmless, because these small, seemingly innocuous shortcuts add up and negatively affect your students' PLTL experience. For example, if you don't encourage discussion during "pairs" problems even just once, it can be hard to get back on that track. It is easier and more effective to avoid bad habits such as these in the first place. For PLTL leaders like me who don't enjoy confrontation, it is smarter to quash bad habits early on rather than wait and have to deal with them later.

Many students at this point also become fatigued by the weekly PLTL routine, and it behooves you as a PLTL leader to spice up each session to hold your students' attention. Try to change things up each session. For example, try sitting in different parts of the room each week so that you and your group members don't feel like they have assigned seats. Bring food occasionally if you have not been bringing food regularly. Even if there aren't snacks on the table every week, the mere possibility of food gives students something to look forward to every week. When appropriate, try to inject humor into

PLTL. If it's around Halloween, thoughtfully consider wearing your Halloween costume to PLTL; I'm sure your students will get a good laugh out of seeing you dressed up. There are plenty of less outlandish alternatives to wearing a Halloween costume, but the point of doing something silly and fun like that is to make PLTL more than about working through a chemistry problem set, though that is one of the main goals. PLTL should be a place where students want to go rather than just feel they must attend. Once they don't feel bound to it by just obligation, they will be more receptive when you remind them of PLTL policies such as the proper way of handling a scribe problem, making rules much easier to enforce.

In general, if you are tempted to cut corners, just remember what you would have wanted from your PLTL leader if you were a student. Would you have wanted a PLTL leader who showed up late and unprepared to PLTL? Or would you have wanted a leader who brought food, knew just the right questions to ask to facilitate discussion, and dressed up as a comic book superhero when culturally appropriate? Remember that you have an obligation to your students as the PLTL leader to provide a safe environment they can grow not only in their knowledge of chemistry but also in their ability to think critically. Try to keep this goal in mind when making decisions that will impact your PLTL group.

At this point in the semester, you're probably thinking "What did I get myself into signing up to be a PLTL leader?" The middle of the semester, usually after the first test is returned, is when your students start to lose their initial enthusiasm. Maybe they didn't do as well as they had hoped, or they are starting to get busy as classes pick up and other activities get in the way. Whatever the reason, this is the time when you really show your character as a PLTL leader and help your students get out of the rut that is the mid semester slump.

If you have found that your students are starting to rely on the PLTL session as a time to learn the material from the past week, it may be time to send out an email just gently reminding them to continue to review their notes and at least attempt the problem set from that week before PLTL. This allows the session to run as smoothly as possible without having to stop to teach half of the group a concept that was taught in lecture. PLTL is supposed to be a time for students to refine their skills and go deeper into the underlying concepts from the lectures and problem set that week. If students are not treating PLTL in this way, don't be afraid to remind them what PLTL is supposed to be about.

By this time, students have also gotten to know each other a little bit better and the chatting starts to pick up around this time in the semester. While some talking can be great and can help students to be more engaged with the group, there is a point at which it becomes disruptive to the group and impedes progress on the problem set. One way that I learned to deal with my group wanting to talk about non-chemistry related topics was to take a break. By setting aside a 5 minute break after completing a particularly long or challenging problem, students get a mental break from the chemistry and come back feeling rejuvenated which helps keep them going for the rest of the session rather than just trudging through the whole thing all at in one sitting.

Food is another great motivator. Sugar always helps students get that extra burst of energy that it takes to get through the rest of a problem set. Don't worry if you did not make a sign-up sheet for food in the first couple sessions, it's never too late to set up a sign up sheet to bring treats. By having the students bring a treat, you don't have to spend all of your meal points at Paws & Go getting a snack for your PLTL session each week, and the students all share the responsibility of bringing a snack for the group. I found that whenever I had food at my sessions, the mood was lighter and happier and everyone seemed to be a little bit more willing to participate and discuss chemistry so if you have found your group to be a little low on energy, definitely try bringing food.

Finally, I found that by the 3rd or 4th session, some of my students started to come into the session 5 or 10 or even 20 minutes late and this is just not acceptable if you want PLTL be the best experience for all your students. It is disruptive when a student decides to show up to the session after you have already started and then have to place him or her in a group or wait for him or her to get caught up to the rest of the group. Especially for earlier sessions, once the semester gets into full swing, it may be difficult for students to wake up on time, especially after a rough night at the frats. This issue can easily be addressed by email; just send a quick note to your students referencing the PLTL philosophy and ask them to please show up at the assigned time. You may not get perfect results, but my students certainly got to PLTL a lot earlier after a gentle reminder.

Although you might want to tear your hair when you first reach the mid-semester slump, all it takes is a few tricks to get your group back on track and running like a well-oiled machine again.

So you're well into the year now and you and your group have come to love each other—or at least know each other. You're not worried about the things you used to worry about. Instead, you are dealing with the dreaded problem of mid-semester slumps. Your primary goal: keep up the good work.

They aren't working as well as they used to and you used to always finish the problem sets with ample time until now. You used to be good at this, but the semester had exhausted everyone. Assuming you're human, don't be afraid to be more relaxed during the meetings closer to Thanksgiving break than you used to be. And if you're superhuman, please remember that your students are simply human and you need to be patient with them. They may feel exhausted at times, but it is important that YOU are NOT. They can smell your laziness, and it can easily translate into a group of unfocused students. Likewise, they can smell your enthusiasm and love of chemistry. Stay energetic and help them realize how fun the subject is. Hopefully your contagious mood can help them forget about their sore brains and writing muscles.

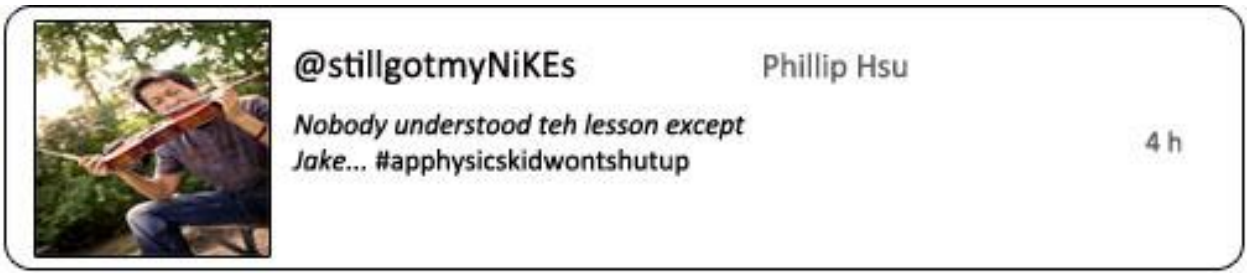
Prevent future problems instead of waiting for them to happen. Everyone can't wait for the upcoming break—including you—and the last thing on their minds is chemistry. It may be tempting to ease up, but this is the most important time to plant the seeds necessary for them to have a successful harvest when their exams come after the break. Otherwise, even your brightest students may fall behind. Harry used to be the one answering all the questions and has a solid "A" so far but don't let him feel too complacent. On the other hand, Hermione has been struggling for the first half of the semester. She wants to improve but may lose motivation if you let your PLTL groups become too lazy. As you know by now, PLTL runs best when it hits that smooth rhythm. Once you break the rhythm, it will be quite difficult to bring it back. Bottom line: try to keep them motivated because preventing future issues is easier than solving them when they arrive.

So how do we keep the rhythm up? The best way to keep their spirits up is to make them want to come to PLTL. It should be a stress-free study environment with collaborative classmates willing to

help each other. Send them email reminders to keep your attendance up, bring food, and be professional. Although they may treat you like a friend, in the back of their minds you're still the leader. If you say "let's move on guys," they will certainly move on. Try giving a soapbox speech about how crucial it is to keep up their good work in order to be successful in the course.

Lastly, remind them of all the help and resources available to them on campus. Many of them have not even attended the help sessions or stopped by Cornerstone. Encourage them to utilize these invaluable resources. If anyone needs extra help, suggest that they find a tutor or attend help sessions.

Don't be a Nazi but don't let yourself lose focus. You're the PLTL leader and your every action can be contagious. If you show your interest in learning, it will remind them why they love learning too. You won't convince anyone that chemistry is fun if you moan-and-groan about your organic chemistry class or your physical chemistry class. As far as they know, you LOVE your classes and LOVE your PLTL sessions. If you do all of these things, you will have a much easier time down the road.



You've probably realized by now that your group of students doesn't always think the same way. Jake, who took AP Physics in high school, might think that he understands everything he hears in lecture and blast through the problems while Meghan has a hard time understanding what's on the board and Juan moves his desk farther and farther away from the group in an attempt to finish the problem set alone. After you've been through a few sessions, you start seeing how each student learns. To make sure that everyone leaves the session having learned something, it is crucial to approach the same problem from many different angles because everybody learns differently.

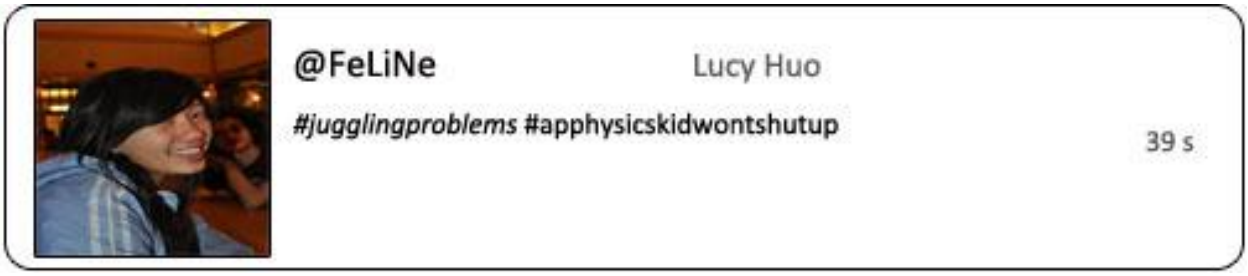
The first step is to figure out each student's personality and learning style so that you can better cater to each their needs. How often does each student talk? When the students talk, are they getting off-topic or participating in the discussion? How is each student taking in the material? By asking yourself questions about each student's personality, you can start thinking of ways to meet each student's needs.

Some students learn better visually while others are auditory learners. To make sure that both visual learners and auditory learners understand what's going on, it would be a good idea to draw or write the concept on the board and also explain it in words or maybe even give a demonstration. This way, the visual learners have something to look at while the auditory learners listen for something that will click in their heads. For example, if I were explaining hyperconjugation, I would draw a hyperconjugated structure on the board, explain what happens during hyperconjugation, and I might even call students up and make them demonstrate hyperconjugation by acting it out so that every student understands what's going on.

How often each student participates in discussion is also very important. By discussing ideas, students not only learn from each other but also gain a better understanding the topic by being forced to explain it themselves. The problem here is that a talkative student might dominate the conversation while a quieter student might zone out or, worse, get the group off-topic. To work through this issue, one can

purposely direct questions at the less talkative students while asking a talkative student to take notes on the board and to draw the concept being explained as everyone else discusses it. To make sure that everyone participates, one can also take a "vote" during problems. For example, if the students are working a cathode ray tube problem and need to decide where an electron would hit the screen, every student can be encouraged to participate by taking a vote for where the electron would hit. Another tip is to make sure that each student is relatively comfortable with everyone else by letting the group interact without discussing chemistry. This can be done by offering a 5-10 minute break in the middle of the session or by simply making conversation with the students as they arrive and get settled.

Keeping different learning styles in mind will definitely help the students grasp concepts more easily. However, it is easy to forget that students do not simply fall into specific categories of learners, but may learn different topics in different ways. By using several different approaches for each topic or problem, the leader can be more confident that the students have completely grasped the concept.



You've survived your first PTL session, and things are going along swimmingly. Hopefully, your group is becoming friendlier with each other, and the majority of them seem to be keeping up with lecture material.

Great!

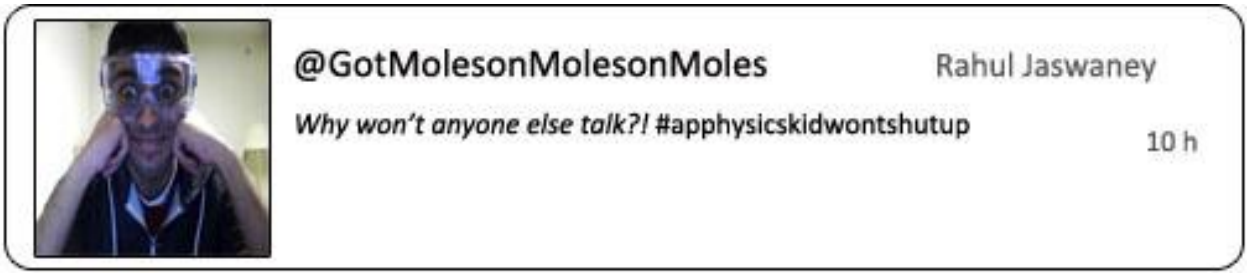
Except…there's something that all PLTL leaders will come to realize—that one of the biggest challenges of PLTL is to provide an environment where a topic/concept will be able to be conveyed to everyone in a way they all understand. The emphasis here is on 'everyone', because you will soon (or you may already have) realize that even though you only have about 8-10 students, they all come from different backgrounds and they bring with them many different learning styles. You will learn in class that there are several categories of learning styles, such as active vs. reflective, sensing vs. intuitive, visual vs. verbal, and sequential vs. global.

Active learners love to participate. They are the ones that aren't shy about answering questions, and they tend to dominate the group discussions. On the opposite end of the spectrum, you also have the reflective learners, who generally like to think about the problem at hand before getting to work. Sometimes, it is hard to know if they are quiet because they don't know what's going on, or if they are just simply thinking to themselves. Sensing students understand the details and facts of every problem, but they have problems utilizing what they know to solve the problem. On other hand, intuitive students blur past the details of a concept and head straight towards the application aspect. Visual and verbal learners you are probably already familiar with—visual learns like pictures, graphs, diagrams, and putting things on the board, but verbal learns prefer discussions. Finally, sequential learners are good at solving problem without actually understanding what they are doing. They just remember you multiply X by Y and that Z=W. Global learners, however, can get an answer, but not really know what they did and can't explain their process to the group. All of these styles are equally important, and they are equally

challenging to balance with each other. As the leader, it is your job to effectively develop and balance all of these styles.

The first step is to figure out which group your students fall in. Keep in mind, these groups aren't mutually exclusive. A student can fall in multiple categories, or even in between categories. Once you have figured this out, you can figure out ways to accommodate everybody. For example, during small groups, you can alternate between paring students of opposite learning strategies together and students of similar learning strategies. By paring them with a different kind of learner allows the students to be exposed to different points of views and strategies. By pairing them up with someone similar during other times, you can ensure that the group doesn't become too frustrated with each other and are still comfortable. Also, during methods such as scribe or round robin, you can purposely choose the active learners to start the problem out, allowing the more reflective students to have more time to think. Also, by making the students write on the board, you can help the global learners keep track of the individual steps, while the sensing and sequential students are in their element and can help the rest of the group keep track of the details of the problem.

In general, though it is difficult at first, once you flirt around with some different strategies such as the ones mentioned above, you will realize what works with your group, and soon, juggling all of these different students would be a piece of cake.



As a PLTL leader, you are responsible for more than just the information covered in General Chemistry 111A. PLTL represents the first structured study session students experience as college freshman. The types of problem-solving methods and heuristics developed during PLTL sessions determine the type of learning strategies that students will be practicing with other courses at Washington University in St. Louis. Due to this fact, it is important to understand the different learning styles students have and strategies students use to be able to maximize the effect of PLTL.

Learning styles are diverse as the students themselves. This diversity is categorized into distinct groups, often thought of opposing learning styles. Examples of these include visual vs. verbal, global vs. sequential, sensing vs. intuitive, and reflective vs. active. Each of these categories of learners has different characteristics when dealing with problems

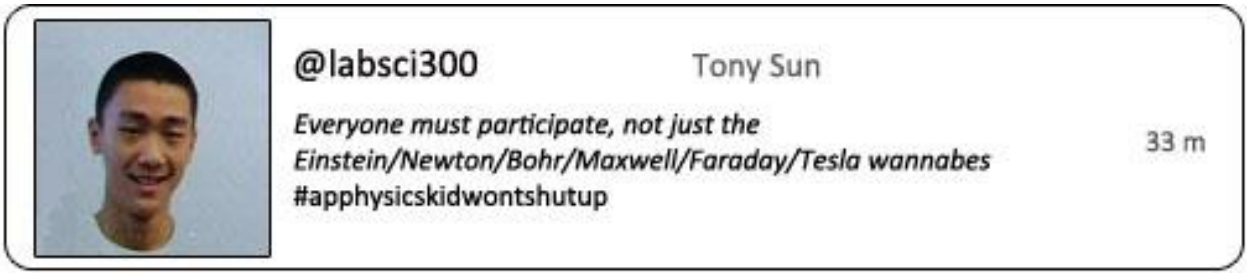
Visual learners can be identified from their preference to draw out solutions and use the board to present diagrams and graphs. These students benefit when they see the solutions presented on the board by writing it themselves or see another student write it on the board. Verbal learners are the opposite in that they prefer to discuss or "talk-out" the solutions. Talking out the solution makes it easier for these students to come up with a sufficient answers and explanations for some problems. Global and sequential learners oppose each other in the same way. Global often can get to a correct answer but have trouble explaining the process of getting there. Sequential learners develop a process, a method that accounts for the fine details of a concept. These students may miss broader conceptual topics that may be required for a topic. Intuitive learners focus more on broad topics, often missing the finer details of a concept that can be crucial to the solution of a problem. On the other end, sensing learners understand concepts firmly, but struggle with broader applications and interconnections between topics. It will be easiest to determine the reflective from the active students. Active students participate quickly and excessively adding ideas to the table that can help progress. The issue with active learners is that they can often dominate the discussion, not allowing other students to participate with new ideas to solving a problem. At the other extreme, Reflective students take longer to answer

questions, contemplating the concepts before giving a definite response. These students do not participate in discussion unless they are absolutely sure of their answer. It is important to not confuse reflective students with quiet or uncomfortable students, a distinction that can often define the PLTL experience for a student.

Though it can be seen as relatively easy to categorize each of your 8-10 students in one of these clearly defined extremes of learning styles, it is important note that this does not represent the reality of the situation. There are several warnings as to how to apply these learning styles to your PLTL group. These learning styles exist on a spectrum rather than at the extremes. Students will not always fall into the distinct categories of global, verbal, and introspective, but will instead lie at intermediates in each of these categories.

It is important to note the generality to which you can apply these principles as well. In no way is it possible to determine one learning style that fits each student. Type-casting your students into specific learning styles may inhibit the extent to which your students will learn the material. The point of PLTL is to allow your students to learn the material using as many learning styles as possible so as to get a complete understanding of the concept. Playing only to a student's strengths does not allow the student to become fully versed in the material.

Learning style is important. It defines the efficiency of your session, the atmosphere of your group, and the comfort of your team. Acknowledgement of different learning styles allows for more group participation and greater understanding of the material. So please, don't let just the AP Physics student do all the talking!



An important goal for peer leaders and peer mentors is to be able to accommodate a variety of students with different learning styles. For example, a student from a science and math based prep high school is likely to be prepared differently for chem111 than a student from a high school that doesn't offer a chemistry course.

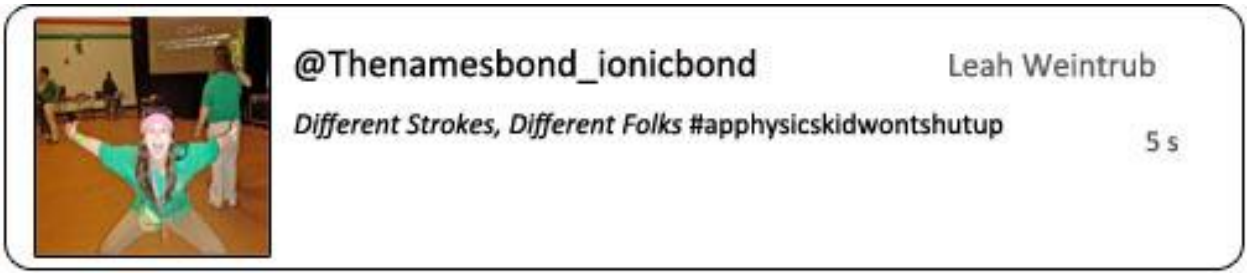
Let's return to the hashtag, "apphysicskidwontshutup." You might wonder why it's the AP physics kid and not the AP chemistry kid who may dominate the discussion. As you may remember, much of chem111 involves fundamental concepts from physics, so having a strong physics background certainly helps. However, this is not to say that students with a weaker background in physics should have problems if they work hard in the course. Remember that part of working hard in chem111 involves attending PLTL sessions regularly (assuming they've signed up for PLTL, of course) and being prepared to participate regularly at each session. This is a point you must stress to students in the beginning, and especially to students with a weaker science background. As you get a better idea of the variety of personalities present in your group, you can be better informed about how to best help your students. I will try to provide some advice about how to deal with different styles of learning.

Even amongst the biomedical engineering/chemical engineering/chemistry/physics quadruple majors who are pursuing double degrees in Engineering and Arts and Sciences, you will encounter differences in learning styles. Some students may prefer to think through a problem individually and quietly before discussion, while other students may wish to think through a problem out loud or on the board. In addition, there are students who learn concepts better when they see it, or when they hear it. Such categories would fit the so-called visual and auditory learner categories. A suggestion to deal with the different styles is to cycle through the different group-collaboration strategies outlined in the PLTL philosophy. Some of the strategies seem to target a particular learning style. For example, one can imagine visual learners prefer the scribe method because they can see the concepts on the board. On the other hand, an auditory learner might prefer round robin because students would be discussing concepts out loud. For the students who prefer to work together to solve problems, small groups or

pairs may be effective strategies for catering to their learning style. As you see, or may remember from your PLTL experience, these different group-collaboration strategies will be useful tools for you to help your students make the most of PLTL.

Another important idea to keep in mind is to remember to encourage students to try and make the most out of each group-collaboration strategy. Just because a student is mostly a visual learner does not mean that auditory learning is out of the question, and vice versa. In addition, students should get used to developing flexibility in their abilities to learn because they may encounter situations when one style of learning is preferred. For example, auditory learners in general chemistry who plan on taking organic chemistry will be doing themselves a favor if they work on their visual learning skills. Therefore, encourage your students to make the most out of each learning strategy and explain the reasoning.

With regard to the AP physics genius who has vocal diarrhea, you may wish to ask that individual to scribe, or you may pair that individual with another student who is quiet. What you should not do is be rude. If things get out of control, then talk to that individual privately to discuss your concerns. Many of these learning strategies are also designed to take of such students so simply using the learning strategies effectively should really help you out in the first place.



By this point in time you have probably started to reach a level of comfortability with your group. You have worked out the initial kinks like nerves and getting your students to adapt to the collaborative learning strategies, so you are feeling like it will be smooth sailing. STOP. It is important to realize that although the group dynamic feels great and your students are getting along, you cannot become complacent as a leader. It is called "dynamic" for a reason. Your group is going to continue to change and grow and it is never going to become static. While most group members will be respectful when they work with other members of the group, as a leader you have to be aware that every student is a different type of learner and worker. As a member of PLTL I would always get so frustrated with a partner that would immediately start working once we sat down. They didn't even need to seem to read the question before they started and they already had 4 possible methods in mind. I am a very, very, different worker. I like to sit down, read the entire question, and write down all the important values before I even start to think about how to solve the problem. I usually think for a while before I start and then I usually end up using just one method to solve. I always just inherently thought that my method was better and more successful until I became a leader. It was then that I realized that students truly have different work methods and one is not better than another. It is in some students' nature to just immediately try out the problem, while others may have to sit back and collect their thoughts before they know where to begin. Both methodologies can be successful in leading a student to the right answer. It is sometimes hard to facilitate a group with many different learners especially when their styles don't seem to mesh at all. I've found that a good tactic to help the group stay cohesive is to have the problem read out loud and then to force all of the group members to sit and think about the problem for about 30 seconds before they go off into pairs, small groups, or round robin. This way you can avoid some of the immediate frustration that can result from two very different partners and then they are more likely to start working on a more middle ground and avoid one person being left behind.

Another important thing to keep in mind is that not only do students have different work styles, but they also have very learning types. There really is a distinct difference between being an auditory and a

visual learner. You have to be careful to not exclude a group of learners and only focus on the style that you prefer. Take care to emphasis every question's concepts in both ways. Do not be afraid to use the board for even the simplest idea. Sometimes the visual learners just need to see the words written down somewhere. It is also beneficial to always draw any sorts of orbitals, bonds, and geometries especially for students who can't visualize them in their heads. Just as you have to take in the needs of visual learners, you also need to make sure you are satisfying auditory learners. Make sure that you don't just let your students answer the question. Challenge them to explain every step of their work and also the conceptual basis of the answer. Come prepared with interrogative questions that will force them to actually ponder the point of the question, which will emphasize that it's not always just about the right numerical answer. I find it really helpful to make sure that every student in the group is forced to explain at least one concept at some point. It really challenges them to get actively involved and to really think about the chemistry behind the problem set. No matter the type of learner, remember that your goal as a leader should always be to push your students past the obvious and the right answers, and to force them to hopefully imbibe some actual chemistry knowledge.

