

Chem Camp from the Other Side

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This past June, I had the opportunity to serve as the Peer Mentor at the US National Chemistry Olympiad (USNCO) Study Camp, held at the US Air Force Academy in Colorado Springs. The program, colloquially referred to as “Chem Camp,” brings together the top 20 high-school chemistry students across the entire country (based on the national selection exam) to prepare them for the International Chemistry Olympiad.

For two weeks, the students dedicate themselves to chemistry: they attend advanced theoretical lectures on organic, inorganic, physical, analytical, and biochemistry; they work with the mentors and with each other to solve challenging problems in all of these fields; and they work in the laboratory every afternoon to master advanced techniques. At the end, the top four students, along with two alternates, are selected to represent the United States at the International Chemistry Olympiad, which comprises a five-hour theoretical exam and a five-hour laboratory practical exam.

As a high school student, I attended Chem Camp in June 2005, where I was selected to attend the 37th International Chemistry Olympiad in Taipei, Taiwan. The entire experience, from the study camp to the international exam, was such a formative one that I jumped at the opportunity to return this year to the study camp as the Peer Mentor. This article is my behind-the-scenes look at Chem Camp from the “other” side—that of the mentors and instructors.



From student (June 2005, top left) to mentor (June 2013, bottom)

Preparation for the study camp begins long before June. In January, the host country of the upcoming inter-national exam releases a book of Preparatory Problems: about 30 theoretical problems and 10 laboratory experiments. The problems are really flippin' *hard*, creatively combining many advanced topics into a single question, and they define the scope of the international competition by indicating which topics will be emphasized. Since the competition this past year was hosted by Russia, a country with a long olympiad tradition, the problems were even harder than usual—many at the level of a graduate student!

My first task as Peer Mentor— long before the camp started—was to work through the theoretical problems. Some took many hours; others required that I learn topics far afield from my expertise (for me, the real zingers are inorganic chemistry!). The chemistry nerd in me loved this process—I got to confront topics I hadn't thought about in a long time. I knew it was important to understand every problem inside-out, as I would soon face 20 bright students asking hard detail-oriented questions. In addition, I searched for other problems— mostly from old olympiad exams—covering similar concepts. These could be used as practice problems or exam questions.

Armed with a large binder full of my notes and solutions to the Preparatory Problems, I arrived at the US Air Force Academy with the three mentors three days before the students. Those three days went by in a blur: coordinating with lecturers, buying supplies, and—most importantly—setting up laboratory stations and making sure all the experiments were ready to go. The mentors took the lead in this enormous task: prior to the camp, they tested all the laboratory experiments in the Preparatory Problems and designed additional experiments to give the students practice with the techniques being emphasized by the Russians. Their dedication to designing, tweaking, and managing so many complicated experiments is the main reason our team performs so strongly on the practical component of the international exam. The three days of preparation flew by and, before we knew it, the students started to arrive.

Meeting the students for the first time is an inspiring experience. One student, barely after putting down his luggage, started to ask me deep and sophisticated questions about advanced equilibrium techniques—a topic I was scheduled to lecture later in the camp. (I silently noted that I needed to make my lecture harder and more advanced.) But most important is the camaraderie that emerges when you bring 20 students *obsessed* with chemistry—for the first time—in the same place. One of the most memorable moments is the opening dinner, where the students receive six college-level textbooks ranging across all the subfields of chemistry. You can see the look of Christmas-come-early in some of their eyes—see the picture if you don't believe me!



Christmas in June! The students receive their textbooks.

After the first night, the Chem Camp routine begins in earnest the following morning: breakfast, four hours of lecture, lunch, four hours of laboratory, dinner, study and relaxation time in the evening, lights out. On top of this standard routine, which lasts ten days, are piled three exams, one final exam, and two lab practical exams.

As Peer Mentor, I attended all of the morning lectures with the students. My main goal was to help the students bridge the gap between the theoretical lecture material and the level of hands-on problem solving expected in the Preparatory Problems. During each lecture break, I would announce which Preparatory Problems the students were prepared to attempt and the students would come to me with questions. Near the end of the camp, I also gave three lectures focusing on analytical chemistry: advanced equilibrium techniques, advanced titrations, and a more general how-to-solve-a-problem-when-you-have-no-idea-what's-going-on lecture.



Stephen Ting, Saaket Agrawal, and Jessica Xu working together at the whiteboard during a break in lecture.

Chem Campers from other students I have taught, including most Harvard undergraduates, is how *demanding* they are—in the best way possible. They never left any academic stone unturned. If a lecturer skipped steps in a derivation, students would cluster around the blackboard during the break to fill in the missing steps. Similarly, many students loved taking assigned problems and making them *harder*: What if you dropped a key assumption? Could the result be generalized? I often found that, rather than *teaching* these students, I ended up interacting with them as colleagues—participating excitedly in the give-and-take of their discussions, but letting them guide the

way. I think this is the only group of students I have ever had that was more talkative *inside* the classroom than outside of it.

After lunch, the students typically spent the full afternoon working in the laboratory. While I occasionally observed the students and assisted them with instrumentation, as a theorist, I ultimately left most of the laboratory responsibilities to the mentors—who did a fantastic job preparing the students for the practical exam at the International Chemistry Olympiad. Instead, I used the after- noons to prepare for the evenings: researching the answers to particularly tough student questions and culling through old International Chemistry Olympiad exams to satisfy the students' endless thirst for more practice problems.

After dinner, in the evenings, the students could *finally* relax. Games of mafia proved especially popular and, by the end of the camp, we had complicated the standard rules so much that I was at my wit's end to implement them correctly. Even during this evening relaxation, the uniquely creative talents of the students shone through: two of them went off to develop a mathematical model to find the optimal number of mafia members needed to make the game as fair as possible. Many of the students, even while relaxing, were still chewing away on a tricky problem—and sometimes this would erupt without warning into a full discussion. I think these unplanned moments—with the line completely blurred between chemistry and hanging out—were the highlight of the camp. Where else but Chem Camp, after all, could this line be so blurred? For me, at least, this permanently blurry line between chemistry and camaraderie is the defining aspect of Chem Camp.



Chemistry and camaraderie all blurred into one.

Lights out marked the end of a jam-packed day for the students. But for the mentors and me, lights out was a new beginning. With lectures to prepare, laboratory write-ups to finalize, practice problems to find, and exams to write and grade, all of us had more than enough work to keep us burning the midnight oil long past midnight. With exams ranging from thirty to fifty pages, and involving some of the hardest and most creative chemistry problems, perhaps the only thing harder than *taking* the exams is *writing* them. Even with generous help from the Air Force Academy faculty in their areas of expertise, I think it would be fair to say that the mentors all felt a sense of pride (and exhaustion!) after each exam—only to start all over again the next day. The first thing I did when I returned home after Chem Camp was to go to sleep—uninterrupted—for a long time.

The last few days of the camp rushed by in a sleepless haze: an outing to the beautiful Garden of the Gods park, an elaborate closing banquet at which the top six students are announced, emotional good-byes (though many of the students will be reunited in a few short months at university), a few more days spent training and testing the top six students, and ultimately the selection of the final four students on the traveling team.

But the work of the students and mentors did not end with the camp. After returning home and sleeping off all of the end-of-camp excitement, the four students worked together for a month before the international competition to make sure they were all well prepared. As Peer Mentor, I helped the students by preparing a repository of practice problems. Just like during the camp, I was amazed by how endless was their desire for more problems. We also created a Facebook group where the students could share resources and advice. What impressed me most was how dedicated our four students were at stamping out their weaknesses—not just individually but collectively. With some students experts on synthetic chemistry, and others experts on mathematical chemistry, I was blown away by the vigor with which each side helped the other achieve mastery. I merely helped to answer questions and make sure their efforts were well-directed.

Given this wonderful synergy which developed among our students, I am pleased—but not surprised—to report that our team put in an outstanding performance in Moscow at the international competition, with David Liang and Runpeng Liu receiving gold medals, and Stephen Ting and Saaket Agrawal receiving silver medals.

As for me, I am already counting down the days until Chem Camp 2014!