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This is a GREAT TEACHING STATEMENT (not mine!). What I like about it is:

1. **It is personal.**
2. **It is specific.**
3. **It is non-platitudinous.**
4. **Gives numerous examples.**
5. **Avoids sweeping generalizations and promises.**
6. **It is very well thought out and connected. It has a theme.**

Early in my education, I became a keen observer of my teachers, comparing their different philosophies and approaches, thinking about their teaching methods, and assessing which methods enhanced my own learning. By continuing this analysis throughout high school, college, and graduate school, I slowly and deliberately amassed a collection of effective teaching techniques.

The distillation of those years of observation and analysis, combined with the lessons I am still learning from my own teaching experience, yields the overriding principle that I strive for in the classroom: ***clarity – in presenting material, in detailing expectations, and in expressing educational goals.***

<u>Clarity of Lectures</u>

My goal in all of the courses I teach is that **each student develops a picture of the world at the atomic level and couples that picture to the mathematical language by which we study, explain, and predict chemical behavior.** To accomplish this, the imagery and words I use to explain chemical phenomena must be clearly presented.

This does not mean, however, that I equate clarity with simplicity; to the contrary, simplistic explanations often raise more questions and create more misunderstandings than do organized lectures that carefully present the subtleties, nuances, and complexities of most concepts. Thus, clarity manifests itself in my teaching by directing my selection of the most effective methods of teaching the various chemical concepts covered in my courses to the diverse range of students in my classes.

Often, **I find** the most effective method of teaching is writing equations, reactions, and chemical processes on the board and explaining them to the **class (chalk can still be a powerful**

teaching tool!). I find that analogies made to common experiences are also quite helpful, such as comparing the behavior of gas molecules to that of the lottery machine's ping-pong balls.

Other material, however, lends itself to more complex modes of presentation. Certainly, **chemical demonstrations** are a powerful way to illustrate important principles, since they allow students to observe the physical reality and consequences of the mathematical and chemical equations used to describe, explain, and make predictions about the physical world.

Still other material is more effectively presented using computer graphics and animations. When discussing how to visualize and interpret two-dimensional drawings of three-dimensional molecules, these resources are quite helpful, as are actual three-dimensional models that students can physically manipulate themselves.

Finally, **chemistry is fundamentally a problem-based discipline that requires students learn how to use chemical concepts to solve problem**s. Thus, a simple but valuable teaching instrument is allowing class time for students to work on problems related to the material just presented. This allows them an opportunity to apply what they have just learned and provides me immediate feedback as to how successful the presentation was. With this information, I can make real-time decisions as to whether or not the class is ready to move on to new information.

In the laboratory, students must understand the chemical properties underlying the experiments. Too often, students perform laboratory manipulations and collect data which they can "number crunch" with little or no understanding of the chemical principles illustrated by the experiment. **It was not until I had to repair a spectrometer in graduate school that I found I truly did not understand how chemical instrumentation worked in terms of collecting data and the relation of that data to chemical theories and equations**. I also realized at that point that if I ever taught a course in chemical instrumentation, it would be necessary to have students work with the internal operation of the instruments rather than just viewing them as "black boxes." Thus, based on this experience, **I started collecting chemical instruments and components that the students can take apart and manipulate to better understand the instrumentation**. The analogy I make is that someone can tell you how a car engine works, and you can understand the principles, but until you have to take one apart and rebuilt it, your knowledge of how the engine works is probably incomplete.

Consistent with this philosophy, **I design laboratory experiments where the focus is the phenomenon being studied and not merely the collection of a large amount of data**. I also expect laboratory reports detailing the students' understanding of what the lab was about. After completing the experiments, writing the report, and revising it based on my suggestions, students should demonstrate a clear understanding of the connection between their physical manipulations of a chemical system and the fundamental chemical concepts those manipulations reveal.

Thus, while my primary mode of teaching falls under the broad category of "lecturing," it is significantly augmented with a range of techniques specifically selected for each different topic taught – a selection based on the careful observation and analysis of a number of teachers and modified by own teaching experience. Regardless of which methods I use, however, I feel that my class sessions must be highly organized. I must anticipate and address potential misunderstandings, and I must constantly check with my students to ensure that they understand the material.

Clarity of Expectations

My own experience, both as a student and as a teacher, **suggests that students who are unclear about expectations often get frustrated and tend to resist learning**. I strive to clarify, both in my syllabus and in what I say, that I have high expectations for my students. I want them to master the material so that when they take exams, they are confident they will do well. This was the standard set by my general chemistry professor in college and I have directly adopted it from him. This standard requires students to know not just the specific details of the chemistry we have covered, but also how those details connect to the broader chemical concepts we have studied. In other words, **I expect them to see the forest *and* the trees.**

In order for them to obtain this kind of mastery, I make certain the students know **that it will be necessary to ask questions and that I expect them to do so**. I also expect and encourage them to take advantage of my office hours or to make appointments with me. I faithfully respond to e-mails on the day I receive them and also place a comment box at the back of the room each day so students can submit questions anonymously. I respond to any comments, questions, or suggestions in the next class session. In doing these things, I make it clear that I expect them to put the same effort into being a student that I put into being an effective teacher.

Since exams are a main mode of evaluation**, I clarify their content by distributing study guides outlining the specific equations and concepts as well as the broader chemical principles that the test will cover. I also recommend specific problems from the textbooks and provide a copy of the previous year's exam so students can gauge the level of difficulty of the exam**. In the laboratory, students receive a three-page description of my expectations of the contents of laboratory reports. Furthermore, examples of previous students' work that I consider exemplary are available in my office. I expect laboratory reports to be an opportunity for the students to improve their writing skills, and I reinforce this by offering opportunities for resubmission after students talk to me about their original drafts.

My fundamental philosophy is that the level of student performance is generally dictated by the level of expectations. **We have all talked with graduates who say that they did not like a particular course because it was difficult at the time, but that, in retrospect, they realize the value of that course. If that is the response to my courses, I will be pleased**. I know teaching is not a popularity contest, and that often students do not immediately reap the benefits or see the merit of our efforts. Therefore, I am content to receive students' comments about the level of difficulty of the course as long as I also continue to receive favorable feedback from former students regarding the worth of my course and as long as I know my expectations are clear, my examinations are fair, and that I have given as much of myself as I can to assist them in their efforts to learn.

Clarity of Educational Goals

It is also important that my students clearly know my goals for their education. They need to know what I hope they get out of each interaction I have with them, and what I hope they get out of their overall education.

In each interaction, inside or outside the classroom, I hope to expose the students to something they have not learned or thought about before. I challenge them to view both chemical systems and broader educational and world issues in new ways, thus expanding their knowledge base and providing them with new insights. I also want my students to see the course I am teaching in the broader context of their education. For example, since many of my general chemistry students are pursuing careers as physicians or pharmacists, I use medical and pharmaceutical examples to illustrate how chemistry is fundamental to those careers.

I ardently advocate a liberal arts education and try to make it clear to my students that I expect them to pursue a broad education that demands they bring a variety of perspectives to a particular issue. For example, when I teach about the chemical causes of the sinking of the Kursk submarine, I ask the students to also reflect on the political and social ramifications of the chemistry responsible for the disaster. At the same time, I try to provide a clear model of the merits of such an education by having discussions with my students about topics outside the direct scope of chemistry.

To illustrate**, I am writing this just days after visiting the Salvador Dali museum in St. Petersburg, Florida.** I brought back two postcards of Dali paintings to show my classes. One painting, "Galacidalacidesoxiribunucleicacid – Homage to Watson and Crick," clearly has a DNA double helix as well as cubic representations of molecules embedded in it. The other paining, "The Disintegration of the Persistence of Memory," is his famous "Soft Watches" painting, only "atomized" or "quantized" in this updated version. **It is clear that Dali was influenced by the major advances in chemistry and physics that occurred during his life and I think it valuable that my students see the influence that science has on other areas**. I also offer an honors course (described below), which specifically discusses the works of Linus Pauling, James Watson, Francis Crick, and the major developers of quantum theory. Thus, this connection between art and science will be particularly appropriate for that course. By making connections such as these, I try to illustrate and model the joy and pleasure derived from a liberal arts education.

Through all of the above expectations, I try to make certain the students understand what expectations I have for them – from the understanding of the minutiae of individual chemical concepts through the planning and execution of their broad-based, life-long education.

Teaching Outside of Chemistry – Characters in Science

In addition to my chemistry courses, which are content-driven and lecture-based, I have had the great fortune to develop and teach an honors course dealing with the personalities of famous scientists. This course is discussion-based and open to all majors, so while we certainly discuss the science associated with each person, science is not the primary focus of the course.

Instead, we study the scientists' personalities and compare them to society's stereotypes and media presentations of scientists. While I continue my emphasis on clarity of expectations, liberal arts education, and the relationship between this course and others, I am more flexible regarding the direction of this course. Since it is discussion-based, it inherently relies on the issues and interests identified by the students, and I make it clear to them that it is, in part, their responsibility to direct the course. However, while the direction of the course is geared to meet student interests, I demand clarity from them. They write, peer-review, and rewrite several essays, with required meetings with me throughout the process.

In their writing assignments, **I constantly challenge them to refine their thoughts on a variety of topics (e.g. what is genius? Does the Nobel Prize hinder or promote science?), and encourage them to generate their own clear, but not necessarily simple, thoughts about the complex personalities and scientific issues dealt with in this course. In this way, I try to not only model clear thinking, but expect it from the students.**

Conclusion

In summary, my careful observations of the teaching styles, methods, and philosophies that I experienced throughout my education provide a valuable collection of effective teaching techniques from which I draw. The distillation of those varied approaches leads me to adhere to a principle of clarity which demands that my lectures, expectations of students, and educational goals for them be as clear as possible in the interest of maximizing their educations.