

The following content is provided under a Creative Commons license. Your support will help MIT Open CourseWare continue to offer high-quality educational resources for free. To make a donation or view additional materials from hundreds of MIT courses, visit MIT OpenCourseWare at [ocw.mit.edu](http://ocw.mit.edu).

We, we are solid state devices. This is soft matter. My eyes are photo detectors. Band gap of about two electron volts. They're just not made of a compound semiconductor inorganic. And this motion is just conformational changes in a polymer. See it's all chemistry. The rest is stamp collecting.

So the principles that apply to inanimate objects apply to animate objects. And the solid-state chemistry umbrella is very broad. If I say solid-state chemistry, people are apt to think of electronic devices, transistors, what have you. But that extends to the life sciences. I mean we, as human beings, are chemical machines.

So this is the classical view. Electronic structuring informs bonding but then in 3.091 bonding informs atomic arrangement, which tells you everything. The shape of all things, it's all electronic structure. There's nothing more.

The difference is that the focus in the chemistry department, their focus is the molecule. Whereas in 3.091 I like to think of the focus being aggregates of molecules, namely solids. Because engineering systems are made of solids.

If you're steeped in chemistry from high school, you've had the AP curriculum, again 3.091 might be something that is a fresh look at chemistry from a slightly different perspective.

What I wanted to play for you as you're leaving today is an old Beatles song, *Lucy in the Sky with Diamonds*.

Being able to bring in subject matter, music, art, literature, into a chemistry class and make the connections to the world around us, I think is most important in the 21st century, when problem solving even in the technical domain is going to require skills that build bridges to the humanities, arts and social sciences. And so I like to think of 3.091 not as a chemistry class, but rather a chemistry-centered class.

The majority of students taking 3.091 at MIT may never take another chemistry class. So I ask myself what topics are critical for someone who might major in electrical engineering? Or for someone who might major in physics? Or what's the chemistry that's critical to an MIT student who might major in political science or economics? And that informs my choice of topics. And it turns out that that doesn't diminish from the education of the student who may choose to major in a chemically intensive discipline such as material science, chemical engineering, or even chemistry itself.

I don't view the presentation of the subject matter as a linear track, where this is the beginning and this is the end.

I view it more along the lines of a spiral. And so the first time you encounter a certain concept it's at a rather superficial introductory level. And then at some point later in the semester you spiral back and see it again. And then maybe there's a little more context and a little more intensity. Maybe there's a little more mathematics associated with it. And then you'll see it applied later again. And through that revisiting-- repetition by design-- I think that key concepts get driven home.

Some people are shocked that I stand in front of a chalk board and I write on it and I believe that that's still a valid means of teaching. For the first-time learner I think it's important to activate all of the learning channels. The act of drawing and inspiring them to draw is important. And maybe the person at home ought to put themselves in a chair in the auditorium and be taking notes as though they are attending the lecture.

Watching those videos, especially for someone that has had a fair bit of high school chemistry, you're going to hear a lot of the same things but maybe coming at you at a slightly elevated level. But not so elevated that you won't follow it. And I think that's good for a high school student to be talked to at a higher level. I think the videos also have utility for people that are interested in specific topics. I mean for example, if somebody needs to know something about x-rays, or the use of x-rays, dropping in to that three-lecture sequence on x-rays could be quite useful. I think it's possible to sample with a goal of mastering a particular concept.

So clearly for the learner out in the World Wide Web, going to recitation and interacting with a recitation instructor is not practical. So in lieu of the recitation section OCW has created these help session videos. We actually hired some recitation instructors from the fall of 2009 and asked them to work through some sample problems and what you see in the help session video is essentially what would have happened in a recitation section.

I issue the homework questions with model solutions at the beginning of the unit. So the homework becomes a study aid. And I recommend to students that they try the homework problems without referring to the answer key initially. And to turn to the answer key when they reach an impediment.

What's the message of 3.091 for the man on the street? An understanding of those relationships. Electronic structure to bonding. Bonding to atomic arrangement. Atomic arrangement to properties. Is the key to understanding the world around us. And in particular it's the key to fueling invention. And I believe in practice very much and in the application of science in service for humanity.

Why do we worry about designing a car that's a zero-emission vehicle, as if to do no harm to the environment? Why don't we go even further and say, what about a car that purifies the air as it drives down the road? So that the air in the wake of the car is cleaner than the air in front of the car? And I'm finding that increasingly that's a message that resonates with the students. They want to take the tools of technical analytically centered education

and put them to work to solve societal problems.