Learning Approaches for Chemistry: A Guide for Students

What is unique about learning chemistry? And what does it have in common with other courses? This document pulls the curtain back on Chemistry and talks about the unique learning challenges that Chemistry presents and aspects of the courses that are common with courses in other fields. We then discuss knowledge resources and human resources available to undergraduate students taking Chemistry at UNC Chapel Hill.

Chemistry: A Rare (Learning) Element

Just like in sports or music, you wouldn't read about running and then go out and run a marathon. Nor would you read about playing music for weeks on end and then try to play a concierto at a live musical performance. Chemistry is actually very similar - the courses rely on applied conceptual exercises, taking the knowledge learned through class and text materials and using it in problems.

Learning Chemistry also includes developing and manipulating visual aids to assist in understanding Chemistry concepts and mechanisms of interaction. Memorization will only take you so far here; you have to become familiar with both conceptual understanding and application in order to be prepared for scenarios and questions that you've never seen before.

It's Elemental

Reading textbooks and attending lectures will help you learn the elements on the period table, as well as their physical properties and the rules that govern their interactions. However, applying these rules conceptually is what sets Chemistry apart from other classes and therefore requires a certain type of thinking and studying. Chemistry actually has more in common with other rule-based courses such as Mathematics and Physics, and even Linguistics.

It's All About the Process – Think Through What We Do

Focusing on the steps we're taking, and our underlying justifications and reasons for doing so accomplishes a few important things. First, it helps us visualize and articulate our rationale for the steps in solving a problem. In addition, should you have an issue with a problem that you need help with, you can retrace your steps and rationale.

Questions that help you think about your process:

- What are the things that you're doing thus far?
- How are they working?
- What can we learn from the things that are working well?
- How can we modify / enhance these approaches to build upon what you've experienced so far?
- Is there a practical application for the problems you're learning in class?

Working out a problem can be broken down into steps using the questions below:

- Can you take a problem and work it out? What are the steps? Why are you doing these?
- *For each step, can you say "I did this because…"?*

Example of Working out the Process

Problem 8.23	**The Steps to Solving 8.23**	**"I did this because"**
Determine the volume occupied by 2.34 grams of carbon dioxide gas at STP	1. Rearrange PV = nRT to this: V = nRT / P	
	2. Substitute: V = [(2.34 g / 44.0 g mol^{-1}) (0.08206 L atm mol^{-1} K^{-1})(273.0 K)]/1.00 atm	
	3. Significant Figures: V=1.19 L (to three sig figs)	

Flexible Thinking in STEM – "What If Scenarios" and Re-Teaching

Another important learning component of Chemistry is to think of scenarios that change components of a problem. For example, in a problem that is looking at the products of a reaction, we might introduce a question like, "I have a good handle on this reaction. Now, what if it changes? What if this thing that I just spent time explaining and understanding changes – what is the new picture?

Similar to scenario changes, another learning approach to flexible thinking is re-teaching course material in a way that lay persons can understand. Teaching information and concepts to others that do not inherently know something can be a very helpful opportunity to explain things in a way that you'll understand and also presents the opportunity for that person to ask further questions. Explaining something and getting questions back helps you think about concepts in a whole different way.

Writing Test Questions in STEM –Activate the Learning Process

Actively writing out questions that an instructor might ask while working through material not only helps think more broadly about the relationship between studying and evaluation, it also helps generate a personal study guide that can be useful in test preparation. Moreover, this approach empowers you to think critically about the subject, spend time teaching, and can enhance your self-confidence in the presentation of the material and concepts.

Example Questions to Ask Yourself:

- If you were going to write a question for this topic, and you were going to administer it with the goal of testing whether I really understand a concept, what would you ask me?
- If it's multiple choice question that you are asking, what would your distractor answer be?
- What kind of qualifiers would you include? Would you use words like ALWAYS or NEVER?

Exploring Root Words in STEM – Finding Answers in Terms

Students have so much knowledge that, at times, it can be difficult to extract that knowledge and apply it in the moment – whether that be a coaching session or an exam. If there is a concept or term that you don't know, there are multiple approaches to uncover the definition. One example is unpacking the components of the term, such as in the example of *Oxidative Phosphorylation*. In an instance where you are uncertain what a term like this might mean, it's an ideal time to work through it by breaking the concept or term into smaller pieces.

Using Practice Tests in STEM

Practice tests and previous exams that a student has already taken play an important role in Chemistry courses. Multiple choice questions present an opportunity to review questions that you got wrong and identify your thinking on the problem and learn from the mistake. But multiple choice questions also present an opportunity to work with questions that you previously got correct by using the other non-selected answers to justify why each of those questions is incorrect. For example, you might write "This answer would be correct if…" or "This answer is wrong because…"

Practice tests also give insight into how the instructor thinks about the course material and the general psychology and syntax used to describe questions. This includes being able to identify how instructors write distractor answers that are intended to mislead students. In addition to re-working previous questions and insight into test vernacular, practice exams are also resources to assist students in figuring out what they should be focusing their studying on in preparation.

Additional Information Resources at the University of North Carolina: *What Learning Resources and Approaches?*

Learning Stage	Learning	Location
Information Sources	The Book	Print; Digital
	Lecture	On Campus
	Mastering Chemistry: Videos	Digital
Information Processing	Notes	Book (Reading Notes)
	Interactive Worksheets	Lecture (Flipped Classroom)
Applying Information	Practice Problems	Book
	Sapling Questions	Digital
	Mastering Chemistry Questions	Digital

Human Resources at the University of North Carolina: *help with concepts, clarifications and questions?*

Who?	Where / How?
Course Instructor / Professor	Office Hours in Department
Course Teaching Assistant / Mentor	Weekly Review Sessions
Chemistry Learning Specialist	Learning Center Appointment Scheduling
Learning Center Peer Tutors	Dey Hall Drop-In Appointments
Classmates, Friends and Family	