Study Tip Archive

#1—Practice Retrieval

“Knowledge” of basic facts is the basis of all further learning. Students often think that knowledge means having something in your head. Actually, it’s being able to get something out of your head on demand!!! If you think of your brain as a big file room, the easiest things to find will be where you have worn a path to by going to get it over and over.

**Retrieval is not:**
- Reading your text or notes (however many times you do it!)
- Looking up the answer in your text or notes
- Reading someone else’s solution of the problem
- Once and done; once learned you do not have to review

**Retrieval is:**
- Flashcards—if you actually try to answer the question without looking
- Attempting practice problems without reference to notes or resources
- Closing your eyes when you answer a question
- Use spaced repetition*
- Taking quizzes....
  even mock quizzes your generate for each other in a study group
- Explaining to someone else how to get an answer in your own words

Retrieval is what you will be expected to do on tests. Why wouldn’t you practice it beforehand?

*Spaced repetition* means taking breaks between practice, increasing the break every time, so that you spend days or even a week before you try it again. Also do your work in different spaces, it’s amazing how much of our memory is tied to locational clues. *Spaced repetition is critical to actually learning something.*

You have a list of things to memorize. That is a perfect thing to practice your retrieval skills on!
#2—Use your textbook wisely

A textbook is not a novel. Reading it like one is not an effective study technique. Think of it more like a treasure hunt for information.

**Reading the textbook before class:**

Don’t expect to understand much. Note key words (you know, the ones in bold and/or italics!) and watch for them in class. Look at the pictures, so when your instructor attempts a drawing you know what it is supposed to look like. Some students don’t like reading it before class...that’s ok.

**Using your textbook during class:**

In this class...don’t. We will not use the textbook in class. Save your back.

**Soon after class:**

Use your text to proofread your notes. Did you get things written correctly? Did you miss something important? Is there a conflict between the notes and the text? Use their pictures and graphs to better understand your own. (The text is right unless the instructor specifically said otherwise, but if you are paranoid, you can double-check with the instructor.) Note what sections of the text you covered, you will need that for the next step.

**Before the next class:**

Work on practice problems. The best thing about any textbook is all the practice problems it provides. You noted the sections you covered so: 1) In the text of that section there are example problems. Try to work them without looking at the provided solution. There is generally a second one where the solution is in the back of the book. 2) Look at the end of chapter problems. They are divided into sections that correspond with sections in the book. Do the problems associated with section you are studying. Check your answers with the back of the book for the bold problems. If you need more explanation, there are solution manuals on reserve at the library. ONLY use these to check problems you have already attempted. Reading the solutions will not help (See study tip #1). 3) Do not forget the “visual problems.” These are “conceptual” like your final and many test questions. 4) If you have the access code, you can also do the electronic homework and get immediate feedback.
#3—Problem-solving is not about the answer

The phrase “show all work” indicates that you are explaining how to get the answer, the answer itself is a minor part of the procedure. If a question requires significant problem-solving, it will likely be worth a lot of points (8 – 12 on a test) but only one of those points will be for the actual answer. The good news: this means you can get partial credit!

To earn all these points, you need to show your work clearly. Remember, it’s not practice if you don’t do it the same way as you would do it on the test. So get in the habit of writing all this stuff out (you are also explaining it to yourself and/or your study buddies) and use the same calculator you will be using on the exam!

If you are solving the problem algebraically: Start with the equation you will be solving/using. Use standard variables whenever possible. For the variables for which there is a numeric value, relate that number (with units and appropriate significant figures!) to the variable. You can do this with an equality or by putting the number in exactly the same spot it is on the equation. On a separate line, show the algebraic manipulation, use multiple lines if needed. You should finish with the variable equal to your final answer, double-check for significant figures and units and circle it so that the instructor knows that is what you mean to report.

For example: Density = mass/volume = m/V
13.6 g/mL = 7.42 g/V
(13.6 g/mL)V = 7.42 g
V = 7.42g/13.6 g/mL
V = 0.545 mL

If you are solving the problem with dimensional analysis (this is the preferred method): Start, on the left, at a logical point, which is NOT one of the conversion factors. Make sure that all conversions have units and the units cancel top to bottom. Do not cross through the units (this impedes the ability of the professor to read your work). Circle your final answer making sure the units and significant figures are correct. You may want to write conversions off to the side until you know if you need to use them. Values in the problem that have two units divided by a slash are likely meant to be a conversion factor rather than your starting point. Rewrite them as conversion factors. For example: 13.6 g/mL can be 13.6 g = 1 mL; 2.456 m/s can be 2.456 m = 1 s; $4.99/lb can be $4.99 = 1 lb.

For example:

$$0.742 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mL}}{13.6 \text{ g}} \times \frac{1 \text{ cm}^3}{1 \text{ mL}} = 54.5 \text{ cm}^3$$
#4—Test Preparation

Most of your learning should already be done. The day before the test is too late to memorize or understand ideas that will be tested. Remember, tests are not about knowing information, they are about retrieving and USING information. Chemistry tests in particular want you to take information and use it in a new situation and maybe combine it with other ideas you should know. Still there are things that you can do:

**A) Organize the information**

*It is jumbled around in your head right now. What is it you need to know? How are those ideas related to each other? Some ideas for organizing:*

- **Make lists**
  - Of topics that will appear
  - Of equations and definitions
  - Of the big ideas and even some of the smaller ones

- **Make a concept map**
  - It looks like a spider web. You put a main or central concept in the middle and link to related concepts and/or definitions. Next to the links, use single words or short phrases to describe the relationships. See this link for an example.

  http://defiant.corban.edu/jjohnson/pages/bioi/02/chemconcmapframe.html

- **Make a “cheat sheet”**
  - What if you were allowed to look at one page of stuff, what would you put on it? How would you organize it to find the information you need? Do it! Just because you can’t use it on the test does not mean that it is not useful. These are great tools for a last minute review.

  NONE OF THESE IDEAS WORK UNLESS YOU MAKE YOUR OWN BY HAND. COMPUTER CUT AND PASTE IS NOT THE SAME. Using someone else’s is totally useless.

**B) Practice**

*You know that everything is easier with practice. Practice as close to the actual circumstances as you can.*

- **Find practice tests**
  - I do not provide them, but Goggle is your friend here

- **Make your own practice tests**
  - Remember to mix up concepts. Questions do not have the nice labels that the homework at the end of the chapter does.
  - Try “problems from hat”: Copy homework problems (mine and book and internet), cut away all identifying information and pull them at random to work.

- **Set time limits**
  - You only have 50 minutes to complete the exam, practice with these limits. Normally no more than 1 minute for a multiple choice question, 1-2 minutes for fill in the blank (depending on the type of question) and 5-10 minutes for a problem.

- **Do it like the test**
  - Not only the time limits, but use the same calculator, pencil, periodic table, etc. Even do a practice in the same room if possible.

**C) Come prepared**

*You will need a fully functional brain to be successful.*
• Get a good night's sleep.
  It is dangerous to drive when sleep deprived. It is also dangerous to take a test.
• Eat breakfast
  Your brain needs fuel. Some caffeine is good. Too much is distracting...jitters and a potty break eat into your test-taking time.
• Bring the right materials.
  You will need a pencil with a good eraser (NOT A PEN!) and the appropriate calculator. Maybe bring a back-up or two. You will not be allowed any other items.
#5-- Do the work

Most of the learning you do occurs outside of class. Class is meant to tell you what to learn and give suggestions on how to go about it...then you go away and spend at least twice the amount of time you spend in class actually working on learning. The only way the instructor has to judge if students are doing this is whether or not they turn in homework. In my (Myers) class, I typically grade 15 - 20 homework assignments per term. So I looked at the relationship between how many assignments students actually worked on and their grade. I figured that if a student had a zero, they either did not turn it in or did not put in any real effort. So I counted how many zeros each student had over three semesters and grouped them into grade categories. The results are below:

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<th>max</th>
<th>max2</th>
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**Number** = number of students over three semesters with this grade  
**Min** = fewest number of assignments missed by a student with this grade  
**Max** = maximum number of assignments missed by a student with this grade  
**Max 2** = second highest number of assignments missed by a student with this grade  
**All** = number of students who missed no assignments  
**%All** = percent of students in this category who did all the assignments  
**Mode** = number of assignments missed by most students in this category  
**Median** = half the students missed fewer than this number of assignments, half more  
**Mean** = average number of assignments missed by students in this category  
**Deviation** = statistical variation in number of assignments missed

Now when I look at the results, this is what I see. Since I normally drop at least 4 of these grades, for most students it is not the zero that is affecting their grade, it is the pattern of behavior. In general, the more work you do, the better your chances at getting a higher grade. A-students rarely, if ever, miss an assignment. Can you be diligent and still fail? Apparently, but I wonder if those F-students actually did the homework themselves or if they just copied someone else’s answers without making the effort to actually understand the work or doing other practice. I did not do any statistics, but I did note that many of them had low homework scores. That should have been a signal that they needed help in understanding so that they could take action to get it. In college, learning is the responsibility of the student, not the teacher.

Another reason to do the homework is the impact on your grade. I used the grading system as detailed in the syllabus to do these grade calculations:

**Grade calculations**...these are some imaginary student grades. Note that they are paired where the only difference between the pair is the homework grade. Yes, it is typical that the first test in this
class is your highest grade. It’s the easiest and because chemistry is naturally cumulative, there is less stuff to know. I did some reorganization of the class this year, so the higher grade might not be as representative of this semester.

<table>
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<th>hwk average</th>
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Test average calculated by \([\text{test 1} + \text{test 2} + \text{test 3} + \text{test 4} - 0.5(\text{low test})]/3.5\)
Course average calculated by \([0.55(\text{test average}) + 0.2(\text{hwk average}) + 0.25(\text{final exam})]\)
#6—Interweave topics of study/spaced repetition

Chemistry is naturally cumulative. You need to know one topic to understand the next. That means you cannot learn material then mentally dump it until the final exam. If it doesn’t come back in a future chapter, it will return in CHEM 1212 or your next science class. For example, it the current study of naming, you need to know from previous material: element names and symbols, parts of the periodic table whether referred to by section name or group name, how ions are made and predict the charges...just as a start. Naming is one of the more difficult topics because of all the skills it requires.

This means that you want to keep reviewing previous topics. Sneak them in as you do the new work. Part of this goes back to the file cabinet analogy. If you want to use information from your brain’s filing cabinets, it’s useful not only to have a well-worn path there, but many paths to that filing cabinet. You should be able to find it from any direction.

The good news: This interweaving of new and old topics has been shown to be a more effective study tool. Students who do mass studying (studying the same thing for a long time) and students who interweave (break up new studies with review of old) or do the same amount of studying but in several shorter sessions perform the same on an immediate test. HOWEVER, if they are tested a month later, the students who have done interweaved studying do substantially (at least a letter grade) better.

So as you study, go back and test yourself on previous material. If you are making a practice test for your study buddies, add a question from the first test. If you are doing “problems from a hat” make sure that there are problems from all chapters, not just the one you are currently learning.

Do your studying in many short sessions rather than one long one. Remember, your tests are only 50 minutes long, if you can’t get a lot of things done in that amount of time, you will not have time to be successful on the test either. HOWEVER, you still should average a minimum of 2 hours of real study for every hour you spend in class. Those hours should occur between each class so that you have learned the previous material and are ready to learn new things. You will have to schedule some extra time before a test, but not as much if you stay caught up and current on ALL the topics that will be on the test. Test prep will be for review and organizing, not learning. This is as is should be.
#7—Set Goals

There is a lot of research pointing to the “study with purpose” or “mindful studying”. Essentially, it means the studier must set goals for each study session. It’s the act of setting the goals that puts the brain (and the material) into an organized state of reference and context. Plus, there is more personal satisfaction when the studier knows when success has happened... the goal has been reached. Example goals (not a complete list):

- Complete 5-10 problems in 25 minutes, without looking at the answers.
- Review flashcards, getting over 80% correct
- Create a study sheet
- Make a practice quiz or test for a friend...pass each other’s tests
- Make a list of all the important topics since the last exam
  - Rank them in difficulty
- Do 10 problems of the most difficult type, 9 of the next most difficult, etc.
- Make flashcards for all the important vocabulary terms
- Use an online resource to find example problems...do the problems
- Explain a periodic trend or big idea
- List ideas from the first exam needed for the second exam,
  - add some of those to your practice problems

#8 – Explain yourself

Every teacher knows that the best way to learn something is to have to teach it. You can take advantage of this by teaching yourself or your study group. YES, you must say things out loud and/or write it for this to work!

As you prepare your “lesson” consider the things you want in a good teacher. You want to know: 1) What is it you are trying to do? (in other words: What is your purpose and goal?) 2) How are you going to accomplish your goal? (What tools? What steps?) 3) Present your problem-solving method in an orderly fashion, explaining how each step leads to the next. Orderly means start at the upper left and go left to right and/or top to bottom; not skipping even “obvious” steps. 4) Evaluate your answer. What does it mean? Does it make sense? 5) What is the significance of your lesson? What does solving this tell you about the world? Consider both the atomic perspective (what are those atoms/molecules/electrons doing?) and macroscopic perspective (what can we see with our own eyes). 6) How does it connect to other topics in this class and to other classes (Biology? Math? Psychology?).

It is not to torture you that most homework problems ask you to “explain.” It is intended to make you think about your answer.
#9—Don’t Brain Dump...constantly review

Chemistry (like many subjects) is cumulative knowledge and often taught in a “spiral.” Thus, after covering a topic, you circle back to it and look at it again in a deeper way. Just because you have been tested over a topic does not mean that you can forget it. N is the time of year when this becomes very obvious.

For example, this test includes intermolecular forces. To successfully evaluate which substance would have a higher melting point, you need to know from test 2: 1) Is the substance ionic or covalent? Which is also going to require knowledge of the periodic table from test 1. 2) What are the ions that make up an ionic substance? Which may also require predicting monoatomic ion charges from test 1. 3) What is the Lewis structure of a covalent substance? Can you count s and p valence electrons from test 1? 4) As Lewis structure predicts electronic geometry you need that to determine if the substance is polar or nonpolar. After answering these OLD questions, you have enough information to move on to the new ones. If you can’t answer these questions, you will not get the new one correct.

Not only will the new material continue to draw on old knowledge, but also recognize that: 1) Your final exam is cumulative for the entire term. 2) CHEM 1212 is a continuation of this course, so it is expected that you will use and build on your CHEM 1211 content. 3) Lab will use class information and class may use lab information. It should not matter where it is first presented. 4) Advanced Chemistry courses constantly refer back to CHEM 1211 and 1212 knowledge. 5) OTHER science courses consistently use ideas from chemistry courses! Why else do you think it is a required part of the major and often a prerequisite course?

What should you do?

• Review old tests and homework.
  Make sure that you know the correct answer to every question.
  Identify whatever misconception caused you to miss it the first time.
• Randomly add old questions to new practice problems.
• Note which “old” skills are required for new problems.
  If you do not have these old skills, go back and acquire them.
• Look for chemistry skills/knowledge appearing in other classes.
  This will give you more practice in a different context.
• Notice which ideas and skills keep recurring.
  That is a hint that these are important.
#10—Keep your purpose in mind

This is the time of year when everything just seems too much and you want to quit, or at least take a break. Not yet. To reinspire yourself, remember why you are doing this. What is your ultimate goal? Picture yourself as a success. (maybe even literally, stage a photoshoot then put the picture of the successful you somewhere you will see it when you study.) There will always be obstacles to your goal. Your only choices are to overcome or turn around.

But why chemistry? Why are the powers-that-be making you take this course? Some reasons:

1) **Chemistry is the central science.** Its principles show up in all the other science courses. Notice (particularly in biology) how many times ideas that we have learned in chemistry are used to explain a biological process. Most of the interesting research is on the cutting edge of chemistry and something else.

2) **Chemistry develops useful habits of mind.**
   
a. **Paying attention to detail.** I know you find getting all the details right frustrating. (Really NA, is not good enough? Answer: NA IS TOTALLY WRONG!) However, details are important. Where you put the decimal on a drug prescription is the difference between medicine and poison. Should I amputate the right or left leg? (Doesn’t matter, they look the same, right?) A or B is only one slip of the mouse when entering grades.
   
b. **Show your work.** Communication skills are highly valued by all employers. Knowing how to communicate your thoughts in a context-appropriate way is invaluable. Someday you will have to convince your patient/customer/boss that your conclusion is correct; can you lead them through your thought process convincingly? Besides, any teacher will tell you that teaching is the best way to learn.
   
c. **Problem solving and critical thinking.** These are higher-order (more difficult) thinking skills that are also valued by employers. It’s not enough to memorize the answer to a familiar problem, you need to be able to apply your learned skills to new problems. You need to be able to look at other people’s ideas and decide if they are useful or harmful. You need to question information and not assume every Nigerian is a prince with a secret bank account 😊.