

Ten Tips to Solve Biology Problems

1. **Do the problems seriously & carefully.** Here is one student's advice on what it means to do the problems seriously:

One of the things I struggled with was the urge not to think about the problems. I think it's easy to believe that everyone is party to some secret trove of information, or is much smarter than you, and that you are the only one who looks at a problem, and doesn't have the slightest idea where to start. After looking at a problem without any joy for a while, my urge is to write a sentence worth of b.s., and flip to the back to see if I'm on the vague track. This gets me nowhere, cause I see the answer, get it, and then sort of convince myself that I've understood the problem. NOTHING replaces struggling through the problem (which in my book is thinking about the problem.) So I've made myself the rule that I won't look at the back of the book unless I have an answer which I would be willing to submit on a test. Now this backfires in the case of 'learning' problems... You struggle, and struggle, and are missing some key bit of information. But surprisingly often, I start with a sentence worth of b.s., resist the urge to flip to the back of the book, keep writing, find myself contradicting myself, and going all over the place, and stumble upon a path. In other words, I often initially assume that I don't have enough info. to even start the problem, and very often I'm wrong ... I just haven't exerted myself. (I think some of this is the fault of cookie cutter textbook questions which had been my science experience before your class...questions in which you need to regurgitate one thing, or need to be familiar with one mechanism, and if you know it you know it, and if not, you flip through the text till you find it.) Your problems cannot be done on auto-pilot, and no answer lurks in any cranny but those of your mind (and the back of the book).

2. **How to use the Starred Problems:** Do the unstarred problems first (to help you learn the material) and leave the starred ones for later (to test yourself). Go over the unstarred problems until you feel confident with the material; go over them more than once if necessary, but don't do the starred ones until you understand the others. Once you feel on top of the material, do the starred ones as if it were a test -- write out the answers and write out explanations of how you got your answers.

3. **Spread the Job Out.** There are problems listed in the lecture notes after each major topic. Try to do at least some of these problems as you go along. Trying to do a whole problem set at one sitting can be intimidating and overwhelming. You may find it easier to do the selected problems after you review each section of the lecture. Of course this will work the best if you review the lectures regularly, after each class, or at least once a week. You'll want to do all or most of the problems in every problem set, including the ones not mentioned in the lecture notes, but it may be easier if you spread the job out.

4. **Make a Diagram, Picture, etc.** Try to convert the problem into a table, chart, or diagram. The problems are very wordy. Try to extract the critical information and organize it by drawing a picture, making a chart, etc. If a

process is described, draw the steps or make a cartoon. (Use pictures and/or words as you see fit.)

5. **How to use the Answers.** If you got the wrong answer, don't read the whole correct explanation and go on to the next problem. Only read as much of the correct explanation as you need to see where you went wrong. Then stop reading! Go back, and redo the problem from that point. That way you learn more.

6. **Use the Blaer Option.** Students tend to think there are two options when faced with a question. Option 1 -- you'll know the answer immediately. Option 2 -- you don't know the answer. But there is a 3rd possibility. Option 3 (the "Blaer" option) -- you won't be able to answer the question right off the bat just by looking at it, but you CAN figure it out. I call this 3rd option the "Blaer option" because it was explained to me by Prof. Alan Blaer of physics. (See also tip #1.) Most of the problems you encounter in college science courses require you to use the Blaer option. You have to learn to abandon hope of using option 1 most of the time, rule out option 2, and move on to option 3. Options 1 & 2 are unlikely to work, because we try to give you problems that are hard, but doable. They are unlikely to be impossible (option 2) or too trivial (option 1). We do make mistakes, so options 1 & 2 work sometimes, but you can count on taking the Blaer option almost every time. You may think that everyone else in the class is using option 1, but that's an illusion, and you shouldn't be ashamed of needing to think about each problem in order to solve it. You are not alone.

7. **How to Review the Problems.** It probably doesn't pay to do the problems over and over. You want to review what you have learned, but doing the problems over multiple times may not be the most effective method. Most people don't learn that much from doing it the second or third time because they already know the answer. (They also tend to memorize the problems if they do them too often, and this can cause difficulties. See tip #8.) So how to review the problems effectively? There are (at least) two ways to deal with this:

Method 1. (Suggested by a TA.) Do the problems once, when they are assigned and/or you cover the topic. Then do them again, close to the exam. By that time you will probably have forgotten the answer, so review is worth it. Don't do the problems twice in close succession, and don't do them over again if you can still remember the answers. So what to do if you remember the answers? See method 2.

Method 2. Do the problems once. After each problem, write down what you learned from doing the problem -- not the answer, but the principle or idea that you learned from doing it. Review the list of principles, not the problems themselves.

Which ever method you chose, do the problems carefully, looking up the answers only after you have thought long and hard about the problem. See tip 1.

8. **Don't memorize the problems (or answers).** The point of a problem is to figure out the underlying issues, not just to get the right answer. If you memorize the answer, that tends to lead to two difficulties:

A. **You answer the wrong question (on an exam).** Once you memorize an answer, it is very tempting to provide that answer to a problem on the exam. However the exam problems are usually not exactly the same as the homework problems, and your automatic knee jerk answer is often incorrect. You have to be able to adjust your answers to match the 'new' questions. Repeating the old answer verbatim doesn't usually work.

B. **You don't learn the principles.** If you memorize the answers, you tend to overlook the underlying principles. It is usually the principles, not the 'old' answers, that are needed on exams. If you have memorized the problem, but not understood the principle, you usually can not solve a 'new' exam problem.

9. **Read the tips in the Problem Book.** See the problem solving tips in the problem book, page 2.

10. **Don't Use Pronouns.** When you explain things to yourself, or to others, try not to use pronouns. Use nouns instead. This may sound silly, but it really helps you to be sure that you understand what you are saying. If you use pronouns or vague terms you can fool yourself into thinking you understand when you really don't. An example: Suppose you say "The gene is transcribed and *it* goes to the cytoplasm and is translated, *which* uses tRNA and mRNA." What do you mean by *it* and/or *which*? Is *it* the gene or the mRNA? Does *which* refer to translation or transcription? Sometimes you know, and you are just using shorthand. But sometimes you don't know, and you don't even realize it until you are forced to pick the right terms to replace "it" and "which." So try to be as specific as possible instead of as vague and as general as possible. Being specific has multiple advantages. It helps you to learn, it helps listeners understand what you are saying, and it helps graders on exams know that you really understand what you are talking about.