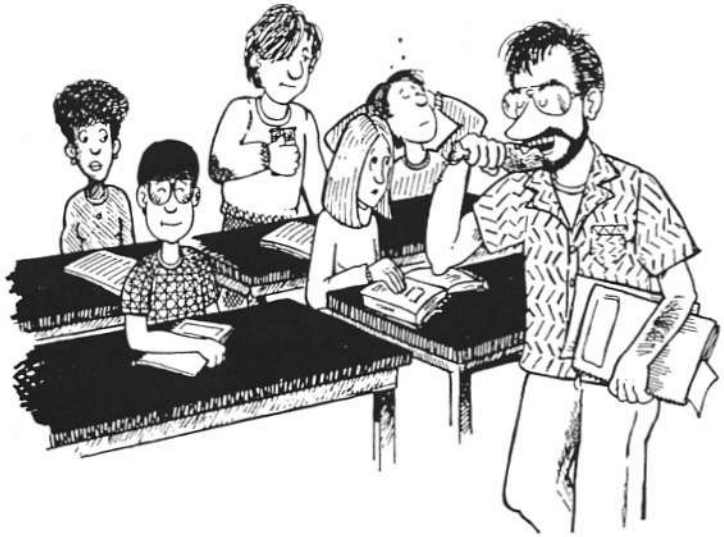
Skills Workshop

From PROFESSOR FARNSWORTH'S Explanations in Biology, (1990) FRANK H. HEPPNER, McGraw-Hill Co

A room smaller than the auditorium. About 50 students are sprawled over the desks, sluggish from trying to digest the dining hall supper. At precisely 7:30, Professor Farnsworth appears. He is wearing a shirt that looks vaguely African, and he's gnawing on the end of a chicken drumstick that clearly has seen better days.

FARNSWORTH: Well, you must be all the A students. (*Hopeful laughter*) It's true—it seems as if the only people who ever come to these things are the ones who don't need them. I wish I could promise you that what I will tell you tonight will really give all of you A's, but I can't do that. All I *can* promise is that if you more or less follow these suggestions, you will do as well as you can.

The fact is that not everybody starts this race from the same starting point. Some of you went to rotten inner-city schools, and some of you have come from good prep



schools. Some of your parents are Ph.D.s, and others haven't opened a book since they left school. The ones I feel sorriest for are the ones who did very well with little effort in high schools that didn't make many demands on them. They face the greatest danger, because by the time they realize the rules have changed, it sometimes is too late.

However, just because somebody comes in with an advantage, that doesn't necessarily mean he or she hangs on to it. We have had tough ghetto kids come in here, who knew what they wanted, and they simply blew the preppies out of the water. So what it comes down to is this: whether you've had the advantages or not, everybody has a shot at it.

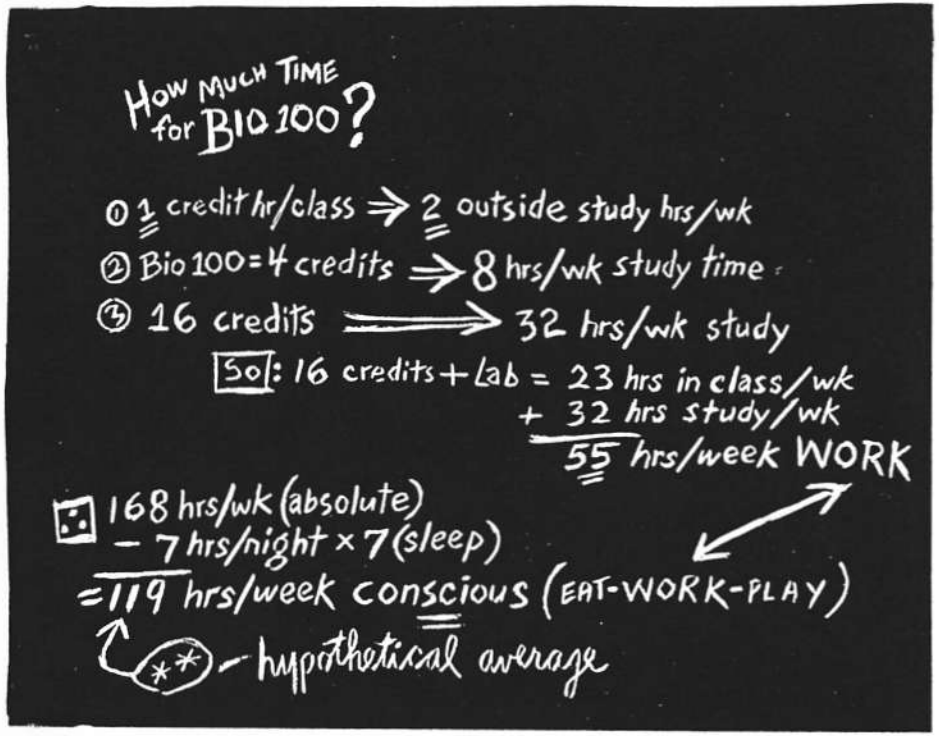
Okay, study skills. Every course is a little bit different.* You don't prepare for an English course in quite the same way you do for a chem course, and two different instructors for the *same* course might have dissimilar expectations, so your first task is to find out, as best you can, what those expectations are. The place to start is the course syllabus, if there is one. At a minimum, this will tell you what the lecture topics are, the dates of the exams and assignments, and the readings. Some course outlines will contain a lot more useful information. Read and heed this outline. It is absolutely amazing to me how often students just throw away their good grades because they don't read instructions. I've always tried to make my instructions on exams as clear as I could make them, but still, a lot of students didn't seem to follow them and would do things that would unnecessarily cost them points. Were they being nonconformists? Were they rebelling against formal instructions? I didn't know, so I decided to try an experiment once. I made up an exam question—a real killer. This question was so hard it would have made Einstein cry. It took 15 minutes just to read the question. I put this question on an exam; it was question 7. The instructions to the exam were printed on the answer sheet, and they went something like "Use only capital block letters. There is only one correct answer to each question. The answer to question 7 is 2,713. If you think this is a trick, raise your hand and I will confirm that that is the answer." So after the exams were distributed, and the students had them in their hands, I said, "Now, before you start, be sure, absolutely sure, to read the instructions for the exam, because they are very important." Now, what fraction of the class do you think got question 7 wrong, with the answer printed right there in the instructions on the answer sheet? You won't believe it, and neither did I—40 percent of the class got it wrong. The lesson is don't throw away anything that is given to you free. Read the syllabus and any instructions. Save them in your course notebook for future reference.

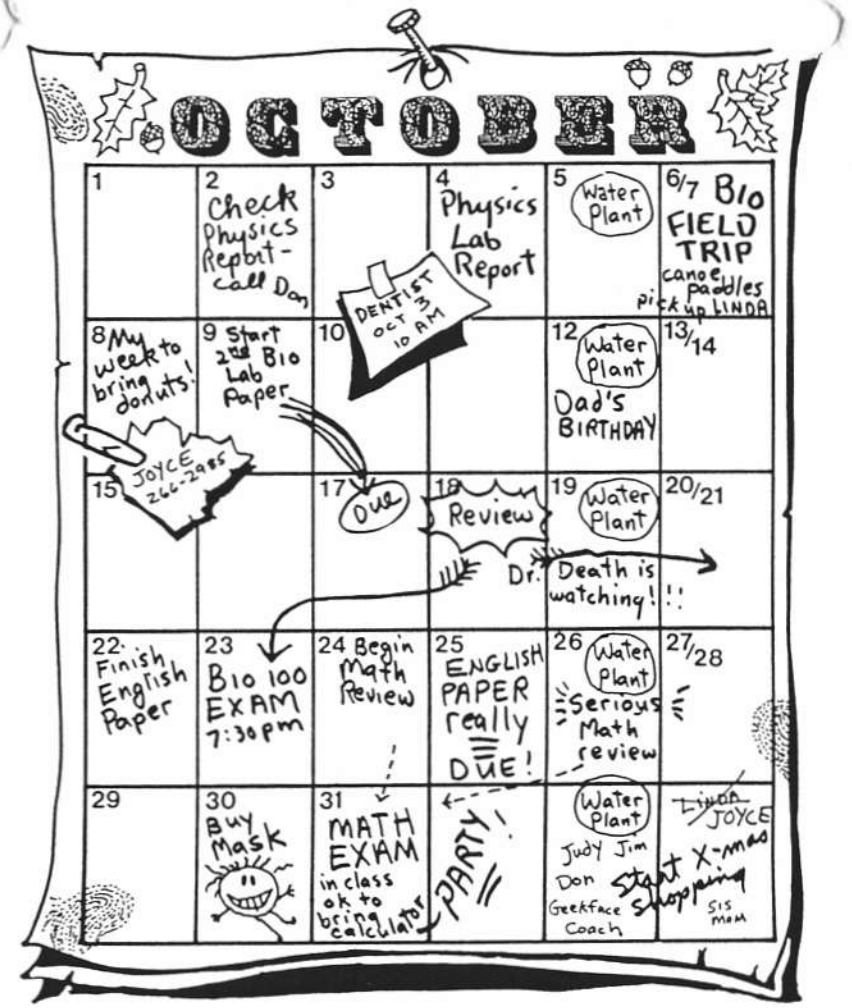
Now, you have more courses than just Bio 100, and you have only so much time during a week. How do you decide how much time you can afford to spend on Bio 100? Well, a rough rule of thumb for figuring out how much study time is expected in a semester-long science course is: two hours outside of class every week for every

**Editor's note:* Professor Farnsworth's suggestions and recommendations are based on *his* course. Although much of this material will be of general use, be sure to check with your own instructor for specific details and requirements.

credit hour of the class. Bio 100 is a four-credit class, so eight hours a week, on average, is a reasonable figure. That eight hours doesn't include taking coffee breaks, checking out the guys at the next library table, or staring into space to compose your thoughts. So, you figure, if you're carrying 16 credits, we own your brain for 32 hours a week outside of class time. If you have a fair number of labs, 16 credits is probably about 23 hours in a classroom, so we have you for 55 hours total a week. Since there are 168 hours in a week, figure 7 hours a night for sleep, that leaves you with 64 hours a week to eat, work, play, or fool around. Not too bad.

So far, however, we have been talking about an *average* work week. There is really no such thing as an average week, though. Academic life is very erratic. Papers due, exams, things seem to bunch up so that some weeks are very quiet and others are horrendous. This is where your first important tool comes in. Get yourself a calendar, one of those big kinds that has a space for notes for each date. On this calendar, write all the dates when you will have quizzes and papers and exams. When you do this, you will immediately see that in some weeks there will be a pileup of work. So much so, that you probably would not be able to get everything done if you waited until the end to do it. What does this tell you? That you must do some things way *ahead* of when they're due. This is a big difference between most high schools and here. In high school, you really could get away with putting everything off until a couple of days before the due date. Also, high school teachers





tend to remind you constantly about upcoming assignments and tests. Those days are gone forever, and the calendar will serve as a replacement for all those human reminders.

In figuring out a calendar, you will want to include padding time for emergencies. Suppose this is September 27, and you know that you have a paper that will take you a week to do and is due on November 20. When do you start the paper? November 13? No, because maybe it will take you a little longer than estimated. November 11? What happens if you get the flu for three days on the sixteenth? A rough rule of thumb in figuring when to start a project that has a fixed deadline is to add 25 percent to your time estimate if you have never done this kind of work before, 10 percent if you have, then add another 10 percent to allow for unforeseen occurrences. So, if you figure it will take you 2 weeks to do a semester paper, and

you've never done one before, 25 percent of 14 days is about 4 days, making 18 days. Add your 10 percent for emergencies, or another 2 days, and you now have 20 days to do a project that you think you can do in 14. The more projects you do, the better will be your estimating ability, but at first be very, very conservative. It also helps to set a personal deadline for a project a couple of days ahead of the real deadline. Much better to finish a couple of days early, because many instructors will not accept late work *at all*, regardless of your excuse. Why take that chance?

Now we have a semester calendar, but we need to make another kind of calendar, a sample weekly calendar. Let me ask you this—how many of you are night people, doing your best and most concentrated work after nine o'clock? Okay, quite a few. How many are morning people—get up real early and get reading done before breakfast? Again, a fair number. On another tack—how many of you can get good studying done if you have an hour between classes? Some. How many of you need an uninterrupted couple of hours? A lot more. Okay, the point is this. Everybody has a different biological study clock, and this clock must be accommodated when planning your study day.

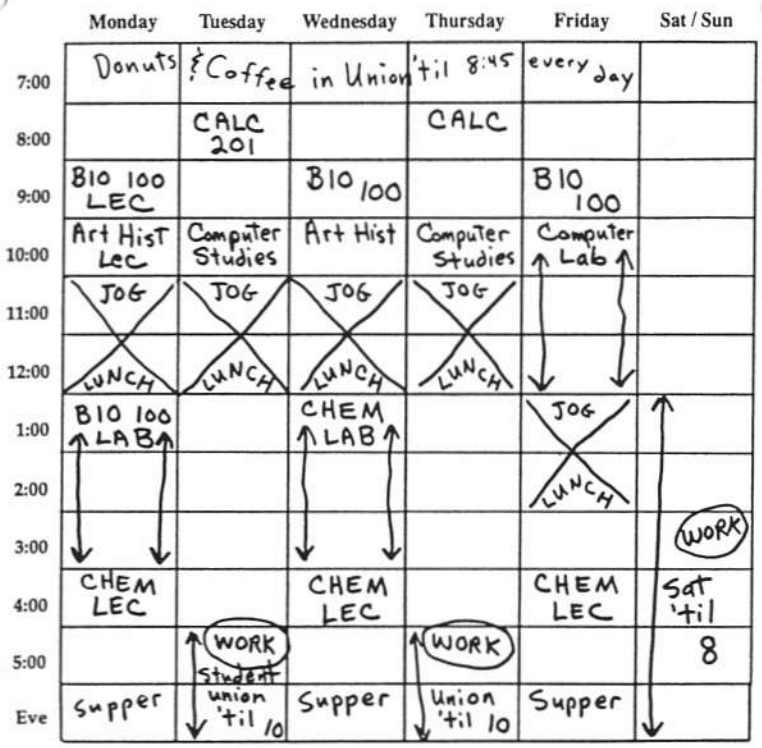
For example, somebody who needs a big block of time to establish concentration shouldn't try to figure on any studying between classes. That will be the time for personal errands, talking with friends, etc. Somebody who can use that time profitably might be wise to bring a text or notes to class to study in the hour before the next class.

The first thing you do, then, in making up your weekly calendar, which will go from the time you get up to the time you go to bed, will be to plug in your fixed time obligations. Classes, sports, labs, part-time jobs, family responsibilities. Then add meals and personal necessities like showers. What you will be left with is a series of "holes" on your schedule, into which you will insert your blocks of study time. In general, most people find it better to space their studying on a particular subject through the week. In other words, you wouldn't put in all eight hours of Bio 100 time at one stretch. An hour and a half per subject is a pretty good rule, because that will let you take one day of the weekend off and at least one night for R and R.

Your final calendar might look like this. (*He puts a sample calendar on the overhead projector.*) You'll see that it has some vacant places. That's fine; nobody can be productive all the time—you need some time-wasting time to let your brain rest. You'll start to get into trouble when the time-wasting time starts to exceed the productive time.

Having made this calendar, you will not take it too seriously. You haven't included unavoidable disasters and special events. This calendar is a guide only, to give you a general idea about how your week should run. Without having gone through the exercise, however, you won't have a good feeling for how you should arrange the week.

Now we're ready to talk about studying itself. In a science course, you have two main tasks. First, you have to master and memorize a fairly substantial vocabulary, and secondly, you have to come to an understanding of principles and concepts, some of which will be rather complicated. The way you deal with both tasks is



they should just try to memorize the whole book and all the lectures as best they can. That may have been a productive approach in high school, but it won't work here. It won't work, first, because there is simply too much material to memorize. It won't work, second, because we're not going to ask you just to parrot back the book. You'll have to parrot back the vocabulary, but we'll ask you to solve problems using the concepts and principles, and if all you've done is memorized some phrases in the book, you'll be dead meat on an exam.

So, how do you prepare for this kind of challenge? Just read the text over and over, or maybe highlight with a yellow pen? No, I suggest you use something called *active studying*. It's a lot of work, and it isn't necessarily the best approach for everybody, but it's a good starting place.

The first part of active studying is development of a good attitude. The student who knows exactly what he or she wants out of life has it easier than the one who is undecided, because the committed student *knows* that the material is relevant to the future, and this certainty makes the studying less work. If you can convince yourself that the material in the course will be useful to you, as preparation for the practical things you will learn in your advanced courses, your study will be a lot more enjoyable. If you don't understand why you are being tormented with all this garbage, well, of course it will be hard for you to develop any enthusiasm. Well, what if you *are* uncommitted to a particular direction? There is at least a *potential*

that the material will be useful for you, and until you do make up your mind, why close off any possibilities?

All right, now we have a good attitude—what's next? Let's start with a text assignment. Chapter 23, let's say. First, I'm going to suggest that you *not* read the chapter summary, even after you've finished the chapter. You're going to save that chapter summary for something valuable later. The first thing you will do is read the chapter over quickly, almost like a novel. I mean very quickly, a skim, really. As you do this, you have a task in mind. That task is to explain to an imaginary 12-year-old kid what the chapter is about, in ordinary, simple English, after you've finished your first reading. Do you see the purpose of this? You want to get a general idea, an overview, before you start your detailed study, and it is very easy to get bogged down in facts. So skim that baby the first time through and then afterwards actually explain, talking out loud, what the chapter was about to the imaginary kid, or another student in the class. The best way to learn something is to explain it to somebody else.

The *second* time through the chapter, you have two tasks—to get a handle on the vocabulary and to identify those ideas that you don't grasp right away. The vocabulary problem can be addressed with flash cards or cue cards. Get yourself a stack, a *biiiig* stack, of 4 × 6 file cards. As you go through the chapter, every time you see a word you don't know, or a word in boldface or italics, write it out on one side of the card, saying the word aloud as you write—this is very important. On the other side of the card, write the definition. This does two things for you. It gives you a handy review aid. While you're lying around, you can thumb through the cards. If you have a boring date, you can pull the cards out of your pocket and send a message. Even more important than *having* these cards is *making* them. There has been all sorts of research

on memorization that shows that the more senses you use in memorizing something, the better that something sticks. Writing it out uses your sense of touch. Saying the word aloud involves speaking and hearing. That's why a homemade set of cards would be much better than a set you bought that was already printed up.

There's another thing about memorization. It's context-sensitive. What the hell does that mean? It means that you can recall something better if the conditions where you are asked to do the recalling are similar to the ones where you did the memorizing. So, if you like to listen to loud rock when you study, unless they play loud rock during the exam, you won't do as well as you would have if you studied under quieter conditions.

Okay, so now you're reading along, making up your vocabulary cards. That's not all you're doing, though. You are reading the text to see if there are any statements you don't understand—are there things that just don't make sense to you? Any statement that you don't understand, put a big check mark by it. If a quick reread of the statement doesn't straighten it out, just go on. Don't try to read it over and over, hoping that something might click. Probably won't happen. *After* you've finished the chapter for the second time, you will have, in effect, a list of statements that need further explanation. The fact that you didn't get the material the first time through isn't necessarily a bad reflection on either you *or* the book. I've found over the years that people are very different in the way they look at things. For some people, the book might have the perfect explanation for a particular subject. For other people, equally bright, the explanation won't make sense, but if it were rephrased just a little bit, it would be perfect. It's almost like taste in food. Not everybody likes squid soup as much as I do, but that doesn't mean they're bad people. So, not every explanation is good for everybody, and if the book's explanation doesn't do it for you, why then you just have to find another one.

There are a number of ways to do this. Many times, the lecture will cover the same material in the text, from a different viewpoint. You could ask somebody else who's taking the course—although this is a little dangerous. You can't be really sure another person's explanation is a correct one. You could ask a teaching assistant. You can certainly ask me—I'm delighted to talk to students one on one. Just use a little initiative, and you can always find a second explanation.

There's a right way and a wrong way to ask for help, though. If you come to me and say, "I don't understand any of this genetics stuff," there's not much I can do for you. If, on the other hand, you say, "I don't understand in the Hardy-Weinberg equation why it's $2pq$. Where does the '2' come from?" then I can help you right away. It's a two-way street. To get maximum benefit from help, you have to do your homework *first*. Nobody's going to spoon-feed you, but you can get all the legitimate help you need.

Okay, now you have your questions answered, and you're on top of the vocabulary. It's time to go over the chapter a third time, and this time you will be able to go through it fairly quickly. Not a skim, really, but by this time you have the vocabulary solid, and you don't have any unanswered questions. This will be your chance to consolidate your knowledge.

After this third reading, you are ready for your first knowledge test. Close your book, and write out a two- or three-page chapter summary from memory, then check it against the book's summary. Do you see now why you didn't look at the book summary the first time? You might have had a tendency to try and memorize it, which is exactly what I *don't* want you to do. If you have truly mastered the chapter, you won't have any particular trouble writing out your own summary in your own words. You are now ready for the next and final step of your chapter study.

If you did okay in your summary writing, find a friend. Ideally, the friend should be taking the course with you, but that isn't even really necessary. Give your friend the textbook, point out the proper chapter, and have him or her fire questions at you. Not just a few questions—take at least a half hour for each chapter. Obviously, a friend who is taking the course will be able to ask more sophisticated questions

of you than somebody who doesn't know anything about biology, but having a textbook in your lap is a great equalizer.

It is very important that this questioning be done well before an exam. If you do it just before the exam, there will inevitably be questions you can't answer. With an exam looking at you the following morning, all that will happen is that you will become panicked. The night before the exam, go to a movie. In high school, it was possible to pull an all-nighter and do okay, and that is even possible in some college courses, but it won't work here. You need to be mentally alert for the exam, and you won't be if you've stayed up 'til five in the morning.

After this question-and-answer session, you will know two things. You will know what you know and what you don't know. The things you know you won't have to bother with anymore, except in review. The things you don't know you can go back and restudy.

That, then, is the basic approach to studying a chapter. Any questions now?

STUDENT: How about using a study guide?

FARNSWORTH: That depends. If your instructor *assigns* a study guide, it would be foolish not to use it, because you can be fairly sure that the instructor is going to base some of the exam questions on the guide. If it is *not* assigned, then it gets a little tricky. You don't want to use a study guide *instead* of doing the text reading, so if you're a real slow reader, the guide might be counterproductive—you'll need all the time you can get on the book. Also, the study guides rarely have really challenging questions, so the potential A student might be better off with supplemental readings like *Scientific American* reprints. But for the great middle group, a guide does have potential benefit. Okay, next question?

STUDENT: What about highlighting?

FARNSWORTH: Well, I suppose for some people, highlighting or underlining might be helpful, but I have found that what that encourages you to do is memorize phrases without trying to understand them. Let me give you an example. Most of you took high school biology. Let me ask you a simple question. What does the kidney do? Anybody?

STUDENT: It filters the blood.

FARNSWORTH: Good, now, what does it remove from the blood?

SAME STUDENT: Impurities.

FARNSWORTH: Fine, but where do these impurities come from? Impure water? Impure air? Would a frog that lived in pure spring water, and breathed smog-free air, and ate only organically grown flies need a kidney?

SAME STUDENT: No, well maybe they're not impurities like that, they're, like, body wastes, you know?

FARNSWORTH: Well, in your food, what do you waste? Why bother to eat something you're going to waste? And anyway, I thought the waste material went out of the body in the form of feces. So what are these supposed wastes and impurities?

Silence.

FARNSWORTH: Do you see my point now? At some stage in your high school textbook, there was a phrase, maybe it was underlined or boldfaced, that said, "The kidney purifies the blood" or something like that. So you memorized it. Then the teacher asked you a question on an exam—"What is the function of the kidney?"—and you gave back your memorized answer, without really understanding what you were saying, and you got an A on that exam. You don't really know how the kidney works, but you can call back a memorized phrase. Well, in Biology 100, we will not ask "What is the function of the kidney?" We will ask you "Would you expect the kidney of a freshwater animal to be bigger or smaller than the kidney of a saltwater animal of the same size? Explain your answer." A plain memorizer would be murdered by that kind of question, and since I don't want to see anybody murdered, I guess that's why I don't like highlighting. It is okay to memorize vocabulary—as a matter of fact, there's no other way to master it—but I don't want you to try and memorize a description of a concept. I'd rather have you think about it a little, and that's why I encourage active studying. Any other questions here?

STUDENT: Doesn't active studying take a whole lotta time?

FARNSWORTH: Yes. Absolutely. That's where the eight hours a week comes in. It would take you only a couple of hours to read all the material in the conventional way. You have not really studied, if all you've done is read the chapters over. You see, you really do have to make some priority decisions. There are a lot of other

subjects you could take that would involve a lot less time, but there is so much material in biology, you really just have to bite the bullet. Next question.

STUDENT: How about studying from old exams?

FARNSWORTH: That one's tough. I assume, naturally, that you're talking about old exams for a course in which the instructor makes them available. Certainly, there's an advantage. You can get an idea of the "style" of an exam, its format, and the level of difficulty of the questions. There are some pitfalls, though. There is a temptation to think that because there are questions on a very specific subarea of a topic, that all you have to do is study that subarea. Very dangerous assumption. Exam questions come out of a rifle, not a shotgun. What the instructor is interested in is your general knowledge of a *topic*, not any one subarea. So if there is a question this semester about a particular subarea, in all probability there *won't* be a question about it next semester. Another pitfall is that you might see a question on the current exam that is very similar to an old one. The problem is that you have a mind-set about the old question and its answer, and you might not notice the crucial difference in the new one. Bottom line is that old exams are a mixed blessing. Now if there are no other questions, let's consider the lecture notes.

There's a lot more variation in approaching lectures than there is in studying texts. A book is a book, no matter what, but every instructor is different, and I want to caution you that the things I say about taking lecture notes in my course may not necessarily apply in another course. I'll try to give you some generalized hints, though, that you can use to figure out what is best in other situations.

There are two problems in a lecture; listening and writing. How much writing you have to do depends on how much the material the lecturer is giving you is duplicated in the text. If most of it is from the text, then your notes can be very simple, just reminders of general topics. If none of it is from the text—for example, if the lecturer is giving you material so new that it isn't *in* any text, or is giving you

controversial i[illegible]al that the book doesn't want to touch—then your notes are going to have to be much more complete because you have no alternative source of information. Since you are bound to run into this situation sooner or later, it will pay you to learn how to take detailed notes. Ideally, your instructor should tell you what the relationship is between lecture and book, but if he or she doesn't, you'll have to do the best you can from the syllabus.

In Bio 100, I give you lectures on text material only when long experience has told me that it is easy for you to get bogged down on a particular subject because the text presents so much factual material that it is hard to see the central idea. So the lecture is a source of explanations, not a source of facts. You need both.

So, your first job is to figure out whether to take down everything, or be more selective. Sometimes, as in Bio 100, the instructor will tell you. Other times, you'll have to figure it out yourself. It will take you a couple of lectures, and some reading of the text, to do this.

If you are going to have to take down everything, some kind of shorthand is helpful. It doesn't have to be a big deal like the system secretaries use. Just leave out the vowels, and you can speed things up. For example, you can figure this out, can't you? (*He puts a transparency on the projector that says, "U cn red ths prty wel, cnt u?"*) Don't try this kind of abbreviation with the technical words, however—too easy to misspell them later.

So, during the lecture, you're going to use this fake shorthand to keep up. Now, here's an important point, very important. At the first possible moment after the lecture, when you have a free 15 minutes or so, go back and clean your notes up. Finish the drawings. Write out the abbreviations in full. Your goal should be that you could give these notes to a friend and the friend could understand them. Now, I know what you're thinking. You're thinking, "Why should I go to that bother when *I* wrote them—I'm the one who's going to read them, and I ought to be able to figure out what I wrote." Ah, but remember, you're going to be reviewing these notes for the final, four months after you've written them. Are you really going to remember what this (*writes "chndrspndylts"*) means, out of context, 120 days after you wrote it? Probably not. I'm not saying you have to rewrite your notes completely, although many instructors recommend it; just edit them so they are perfectly understandable. This is a 15-minute investment that will pay big dividends later. Besides, maybe you can sell your notes to your friends who don't come to lecture. Okay, any questions about lecture? Yes?

STUDENT: Yeah, how do you stay awake?

FARNSWORTH: (*Laughs*) I hope, sir, you are not speaking about *my* lectures. Sure, sometimes that is a problem. You have an eight o'clock class; you've been up 'til three. It's hard. A good lecturer is the biggest help, but that's outside your control. Lecturers have to go to lectures too, to keep up their professional skills, and some of those lectures are as good as a couple of sleeping pills. It sounds silly, but I wiggle my fingers a lot and every couple of minutes take a couple of good, deep breaths to get a little oxygen in. It doesn't help a whole lot, but it does help some. The biggest help is a lot of rest the night before, but that isn't always possible. That's why I don't mind too much if I see an occasional student dropping off. Snoring,

that's a different story, and if the whole class starts to go under, then I know I've got a problem someplace. All right, if there are no more questions about lectures, let's go on to consider examinations.

There are all sorts of exams, but in a big science course like this, a very common kind of exam is the multiple-choice exam, and that's mostly what I'll be talking about. Before you approach taking *any* exam, however, you want to have a feeling for whether you're just going to have to use your memory, or you're going to have to solve problems. If it is going to be *all* memory, it might pay to pull an all-nighter. Fatigue doesn't seem to have that much of an effect on memory. If you are going to be asked to think, or solve problems, it is absolutely imperative that you get enough rest. Fatigue dramatically increases the probability of error in problem solving. In Bio 100, you'll have to solve problems, so that means the night before the exam, go to a movie. Seriously. By that time, it is too late to try to figure out a concept you haven't gotten, and you'll just put yourself into a panic.

Attitude is very important going into an exam. If you tell yourself you're going to flunk it, you probably will. It's a self-fulfilling prophecy. Saying that it's so makes it so. Try not to think of the *outcome* of the exam. Think instead about the questions themselves. Even if you haven't studied as much as you should have, hey, maybe you'll get lucky. Positive attitude is everything. That's true here as well as in sports.

So now you walk into the exam with your positive attitude, and what's the first thing you're going to do when you get the exam? That's right, read the instructions. Count the pages—make sure that you didn't get an exam with the last page missing. Once you've checked these mechanical details, you're ready to start the exam—and I'm going to give you a couple of tricks.

First of all, you have to know if the instructor penalizes you for guessing. Some do, some don't. If there is a penalty, they usually subtract the number of wrong answers from right, or something like that. In Bio 100, there's no penalty, so make sure you at least try every question. Look at question 1. If it is at all difficult, or

will require time to set up, skip it and go on to the next. Go through the whole exam this way, answering only the easy, quick questions. Why do this? Because if you should run out of time, you don't want to leave a whole bunch of easy questions unanswered at the end of the exam. In addition, you will start out on a positive note. After the easy ones are done, go back and try the tough ones, and here are some tips for tough questions.

If you can rule out a couple of answers by the process of elimination, you will be left with three or, even better, two possible answers. If you don't know the correct answer right away, if you have uncertainty, your first guess has a better chance of being correct than your second guess. The reason for this seems to be that the correct answer is probably lodged someplace in your subconscious, and just kind of pops up, like a free association, the first time you read the question. Now I didn't say that your first guess is always correct—it is more like you have a 60 percent chance of being correct, instead of the 50 percent chance you would have if it were a true random guess between two choices. Still, why throw away an advantage, even if it's a small advantage?

Another trick you can use on a multiple-choice exam, which unfortunately won't work for you in Bio 100 because I don't write the exams this way, has to do with certain peculiarities about the way questions are written. If you have five choices, *A*, *B*, *C*, *D*, and *E*, and you can't decide between any of the answers, if it's a pure guess, guess *C*. It turns out that *C* is the correct answer about 28 percent of the time, instead of the 20 percent you would expect. The reason for this is that instructors are often hesitant about making the correct answer *A*, because they figure it will be too conspicuous. Same thing for *E*. A variant on the theme is that the

ect answer tends to be the longest one, if the answers are of differ ngth. n't try to follow these rules in Bio 100, because I don't write the que s like that.

Another important thing to remember—many multiple-choice exams are graded by computer, which often means you have to transfer an answer from a worksheet to an answer sheet. Before you turn the exam in, be sure to check that you didn't make any errors in transcription. Okay, any more questions about exams? Yes?

STUDENT: Any advice on essay exams?

FARNSWORTH: Well, we don't have essays in Bio 100 unless you ask for them, but I'm sure you will have essays in other courses. Preparation for an essay isn't really any different from preparation for a multiple-choice exam, but the actual exam technique is different. There is one piece of information you have to find out about yourself first. You have to know how much you can write in a given period of time. Can you write 100 words a minute? Fifty words? You will have a certain number of essay questions on an exam, and you can figure out how many minutes you can afford to spend on each question. Let's say you have five essay questions for an hour exam. Fifty minutes, really, since the class isn't an hour long. That means that for each question, you have 10 minutes to organize what you're going to say and get it down on paper. If you know in advance that you can physically write four good-sized paragraphs in 10 minutes, you can structure your answer so that it has an introductory paragraph, two paragraphs of information, and a concluding paragraph. It is important to remember that the answer that can't be read can't be graded, so don't be too ambitious about how much you can write. It is also important to remember that an answer should have a beginning, a middle, and an end. It shouldn't just sort of die away without concluding something.

Another thing to remember is that in science courses, BS, garbage that's there just to pad the answer, mostly earns you negative points. The instructor has a lot of papers to read through. The teacher who has to wade through piles of garbage in your answer is an unhappy teacher. Keep your answer limited to stuff you understand.

Okay, I don't know about you, but it's getting late for me, so if there are no more questions, let's call it a night. (*A few students come up to ask private questions—the rest straggle out sleepily.*)