

## Study Suggestions for Introductory Biology Courses

**Read the entire passage below, then fill in the table at the end of the passage on the next page.**

A biology textbook cannot be read the way you would read a novel. Begin by pre-reading the chapter; glance at the section headings, charts and tables in order to organize the material in your mind and stimulate your curiosity. This will make it easier to read the chapter and extract more information from it.

**Realize that *reading is not studying*.** Reading is a form of passive learning which is the least efficient and least effective way for most people to learn. (Listening is another form of passive learning.) Active learning involves reprocessing and using the information in some way and is a much more efficient and effective way to learn. To turn passive reading of the text into active learning, stop frequently (at least every paragraph) and consider what you have just read. What is the concept being discussed? Put it in your *own words* (out loud or by writing it down); by doing so you are reprocessing and using the information presented in the text. Place a few key notes in the book's margin; make sure these notes include all new terms and illustrative examples. If there is not enough room in the margins to write, use "post-its" for making your notes. (Extensive high-lighting of your text does not constitute active learning and generally is a waste of time. The author has usually already put the key words in bold print.)

Taking lecture notes is a form of active learning if done properly. Simply writing down what is written on the board is passive learning (it's a start, but is not as effective as it could be). To get the most out of taking lecture notes, do it in a systematic manner. Before class read the textbook material to be covered in lecture. You will then use class time more efficiently because you will learn more from the lecture, and you will be able to take better notes having been introduced to many of the concepts in the text. During lecture do not attempt to write down every word that is said; that approach is futile and unnecessary. Instead, focus on the major ideas. Once you understand a point that is being made, write it down in your own words (i.e. practice active learning), making sure to include any new terms, illustrative examples, diagrams, or lists which may be given. Leave three inches on the left hand side of your page so that you can add notes after class to amplify the major points of each lecture as well as fill in gaps and add relevant information from the textbook or lab manual. For best results this should be done before the next lecture. Simply rewriting lecture notes word for word is not active learning.

Most of you will be able to follow the lectures; that is, the presentation will make sense to you as it is given. Don't be fooled, however, into believing that being able to follow a lecture constitutes understanding the material well enough to answer questions on the exam. It will be necessary for you to actually study the lecture content (hopefully while it is still fresh in your mind) for you to be able to use that information during the exam. Some of the questions on exams require that you combine (integrate) information from two sources to arrive at the answer; in other questions you will have to apply information you have learned to a new situation. In other words, just memorizing the material is not enough to do well on exams; you will need to understand the material so you can use and/or apply it. Here are two examples. In one lecture you learned that membranes are composed of phospholipids; in another lecture you learned that chloroplasts contain membranous thylakoids. You might be asked to integrate this information and recognize that chloroplasts contain more phospholipids than do ribosomes, the nucleolus or the cell wall. In another example, you learned that the Golgi complex functions to package materials for export from the cell. You might be asked to apply this information to a new situation by recognizing that a nectar secreting cell in a flower would have a very active Golgi complex (rather than a very active mitochondrion, chloroplast, nucleus or vacuole).

Lecturers frequently approach a subject by presenting the "big picture" first -- explaining the *what* and the *why* of the subject, then subsequently presenting the details, the *how*, of the subject. In your studying you should use this same approach. Start out by making sure you understand the big picture and then study the details which should help you understand and remember the big picture. The objective here is to understand the material, not simply memorize it. If you understand something, you can relate it to other knowledge you have, you can apply it to new situations (including exam questions) and you will find that it is easier to remember the material because it "makes sense". Something you have memorized is often harder to remember because it doesn't "make sense".

Summarize information by making your own diagrams and tables which will allow you to rehearse and test yourself on the material. Rehearsal and self-testing are crucial steps in the active learning process. For example, sketch out the life cycle of a moss from memory, labeling the stages (gametophyte, sporophyte), structures (sporangium, eggs, sperm) and processes (fertilization, meiosis). Write down the summary reaction for photosynthesis from memory and describe what happens to carbon, energy, electrons and oxygen during photosynthesis.

Relate new information to other, related information -- For example, it is especially useful to be able to place organisms in their proper phylogenetic (evolutionary) relationships and to relate structure and function. In other words, it is easier to remember the characteristics of an organism if you remember the characteristics of its ancestors and close relatives. It is easier to remember the structure of a molecule, cell or an organ if you can also remember something about the function of that molecule, cell or organ. As you study, ask yourself "How does this fit in with what I already know?" "Does it make sense?" Compare and contrast exercises are especially helpful in identifying relationships you may not have noticed before -- "In what way is it similar to or different from a similar process or structure?"

Study with a friend in the class. Take turns explaining the material to each other. Explain a concept, process, or life cycle as a story that unfolds logically from point A to point B to point C etc. with one event or item leading naturally to the next, just as they would in a story. Verbalizing the material is one of the best forms of active learning because it forces you to organize it in your own mind and helps you remember it. Teaching a subject is the best way to learn it -- ask any teacher.

Take advantage of the pictures and figures in the text (a picture is worth a thousand words). Some of these illustrations will be covered in lecture and you will be expected to understand the concept being illustrated. Exams may include figures to analyze.

There is too much new material in a biology class to be able to learn two weeks' worth of material the night before an exam. New terms are introduced faster in biology courses than in foreign language courses. You must keep up. Interact with the course material on a daily basis; learn the new words, concepts, phylogenetic relationships, structures and their functions. Review your text material and lecture notes daily so that you can avoid cramming at test time. Daily studying and rehearsal helps get information into long-term memory.

**THE BOTTOM LINE** -- Your instructors are here to help you learn this material, but you are the one who has to make the effort and do the learning. Daily, active learning (thinking about the information, putting it in context and, especially, putting it in your own words) is the most efficient and most effective way to learn. Your time is valuable; make the best possible use of the time you spend studying for this course.

Things above that I already do:	Things I can (will?) do to help learn more effectively