EASTERN WASHINGTON UNIVERSITY
Cheney • Spokane

Academic Support Center
111 Monroe Hall
Cheney, WA 99004-2416

Studying for the Sciences

THREE ELEMENTS FOR SUCCESS

Knowing how to approach the material is the first step in succeeding in a college level science course.

The amount of material covered, and the speed at which it is covered, may seem overwhelming; but if you follow these guidelines, your stress level will decline as your success increases.

There are *three elements* to succeeding in a science course: Lecture, Time Management, and Test Preparation.

I. Lecture

A. Attend every lecture.

1. Everything you need to know will be covered in the lectures.
2. Go to lectures alert and awake.
3. Write down *everything* you can. Anything is fair game on the exam.
4. If you miss a lecture, get notes from at least 2 people.

B. Prepare for lectures.

1. Read over the lecture outline before class. This will help you focus.
2. Skim the reading that corresponds to the lecture outline.

C. Find a "Note Buddy".

1. Photocopy and swap your notes with someone after class every day.
2. Meet once a week and teach each other the notes.

Voice: (509) 359-2487 fax: (509) 359-2808

II. Time Management

A. Start early

1. Use the first 2 weeks of the term. Don't start snowballing.
2. Start studying for your next exam 2 days after your first one.

B. Set deadlines

1. Make a term calendar.
2. Set new deadlines. Have all your *studying* done 2 days prior to the exam. This gives you 2 days to review.

C. Find your "Bio Hour".

1. Spend an hour a day reviewing your notes; make it part of your daily routine.
    a. Three 20 minute sessions throughout the day
    b. 40 minutes reviewing notes, 20 minutes preparing for lectures.

III. Test Preparation

A. Condense the material.

1. Make flash cards over your notes.
2. Write out answers to your cards.

B. Reading should be supplementary.

1. Use the reading to supplement all concepts covered in class.
2. Know all the figures that relate to the lecture.

C. Apply the material.

1. As you study, think of applications of the material.
2. Use old exams as guides to applying the material.

Techniques for Studying Chemistry

Before taking any chemistry course, make sure that you have the required math skills. Since chemistry involves many calculations, you must have the math prerequisites specified in your university catalogue. Moreover, read the course description very carefully, and if you have any further questions, contact the chemistry department.

COMMON PROBLEMS FACED BY ALL STUDENTS:

1. *Often students sitting in a chemistry lecture fail to stop the professor when they do not understand a problem or a concept.* Ironically, many other students have the same question. Don't push it aside and hope that you will understand it later on; you are paying for the course, and you need to ask questions.

2. *Perhaps the most annoying situation a student gets into is working a problem out and failing to get the correct answer.* This is not rare. Almost everyone works a problem wrong the first time. In addition, these mistakes teach us what we did wrong. Chemistry requires discipline in order to understand it and solve problems.

3. *"Which professor should I take?"* The professor can make a big difference in your grade. Therefore, you should ask other students who have taken chemistry courses at this university who they recommend.

4. *"How can I improve my problem solving skills?"* There are many things that one could do; however, the best thing to do is work as many problems as you can. Every chemistry book should also have a study guide with many problems worked out and explained. These study guides are very useful, and they assist you in understanding the material.

5. *"My professor talks too fast, and I can't keep up with him while taking notes."* The best thing to do in this situation is to bring a tape recorder into the lecture room and tape the lecture. (Make sure you have the professor's permission to tape the class lectures.) Meanwhile, you can listen to the lecture and concentrate on any problems he or she may work on the board.

6. *"Sometimes I can't work a problem, and I need help."* Before hiring a tutor, check your professor's office hours; moreover, have the questions fully prepared so that he or she can help you. In addition, make sure that your professor knows you by your name so that he or she will know that you are taking the course seriously. If the professor knows that you are a serious student, he will help you as much as possible.

STUDY TIPS FOR CHEMISTRY

1. *Try to keep up with your daily reading assignments.* Many students wait until the day before the exam to study and realize that they have a lot of material to "cram." Your professor will warn you of future test dates. Take the time to study well in advance before the exam so that you have time to reflect on the material.

2. *Always concentrate on the material that your professor discusses during class.* Moreover, after your first exam, you should have an idea as to what you can expect on future tests.

3. *Before every lecture, take some time to review the last lecture.* This should help you make the transition to the new material you will cover in class.

4. *Get to your lecture on time, and stay there until it is over.* You never know when your professor will assign homework or announce a test date.

5. *Read the course syllabus* regarding material that will be covered on your next exam.

6. *If you encounter any bold faced words in your chapter,* look up their meanings. This may help you in solving problems.

7. *Most sections in your book should include sample problems* with complete step-by-step instructions on solving them. Work these problems if you do not feel ready to work the ones at the end of the section.

8. *Memorize all the formulas and common ions* well in advance before your exam. There may be more than you anticipated.

9. *If you do not understand a problem, see your professor.* Don't hope that it won't be on your exam; most of the time those problems you didn't expect are on your exam.

Studying Biology

Ten things to do for success in Biology

1. *Work together:* Recent research has shown that people who study and work together learn more quickly and effectively than people who study and work alone. Find a few friends who are working on the same material (the optimal study group is three people), and then help each other to understand the concepts. If you can teach something to someone else, you will really understand it yourself!

2. *Get help early:* If you find yourself struggling with biology (or any other academic subject), get help right away. Professors and teaching assistants hold regular office hours: *use them!* You can also attend groups sessions and workshops offered by the Learning Strategies Center.

3. *Read the textbook:* Always read the textbook with a specific goal in mind, such as answering specific questions or understanding particular concepts. *Don't* read it like a novel. If you do, you will retain almost none of it — this is why we can reread novels!

4. *Write in the margins:* Most biology textbooks have extra-wide margins between the text and the outer edges of the pages. These margins are there for a reason: *you* should be writing in them! What do you write in the margins? Questions about the material, summaries of the main points, supplementary material you have learned or read elsewhere...whatever helps you learn! (P.S. Simply highlighting massive amounts of text are almost *never* an effective learning strategy.)

5. *Learn the key terms:* Several biology textbooks use **boldface type** to emphasize the key terms in the text. These are usually also defined in a glossary at the end of the textbook. Learn the meaning of these terms, and be able to apply them correctly.

6. *Study the illustrations:* Biology textbooks are very lavishly illustrated; in fact, more money is usually spent on the art program than on the authors. Therefore, the illustrations are usually outstanding, and can clarify concepts as well as, if not better than, the text.

7. *Attend lecture:* If you're not attending lecture, you're missing the most important part of the course. **Note:** Copying someone else's lecture notes or simply reading them is *not* enough!

8. *Know your lecture notes cold:* Exams are based primarily on material presented in lecture. Use these rules of thumb: If it's mentioned in lecture *and* in the textbook, there's a 100% chance it'll be on the exam. If it's *only* mentioned in lecture, there's still a 75% chance it'll be on the exam. If it's *only* mentioned in the text, there's only a 25% chance it'll be on the exam.

9. *Understand the concepts:* In biology, as with any science, memorization is important. But, at Cornell, memorization alone is *not* enough — you must be able to apply the concepts that you have learned to new situations. One way to learn how to relate concepts to each other is by concept mapping**:** make a diagram of the various concepts relating to an overall idea, and then connect them with lines that indicate the relationships between the concepts.

10. *Be an active learner:* To do well in science courses at Cornell, you must be able to understand the concepts presented, and to be able to apply them under new circumstances. So, when you read your text or go a lecture, constantly ask yourself what the material *means*.

Reading Biology Textbooks

1. *IMPORTANT:* Have you taken the reading assessment test? Can you read at a level that is adequate for this text? In general, all college biology texts are at least 12.6 grade level and some are considerably higher. If you read at the adequate level, then the following suggestions may be helpful. What follows is a summary of strategies that are being used by students who are successful in biology.

2. *Slow down!!* The flow of a biology book is not like the flow of a novel. A novel can be read effortlessly, smoothly and rapidly, but biology books cannot. If you are reading a novel and are somewhat distracted, you can still get the idea of what it is about. When you are not concentrating on biology you will get very little out of it, and it will seem more difficult than it really is.

3. *Every word counts.* Biology books are usually not repetitive, so there is little chance of picking something up from reading on. Writers of biology texts believe that extra words and repeats get in the way of clarity.

4. *It is best to tackle each chapter at least three times.* The first time you should skim the chapter, noting topic sentences, words in bold print, all tables, diagrams and summary charts. This is best read before the lecture. The second reading should be in more detail, studying each area and not proceeding until each section is understood. Reread each section as many times as necessary until you understand its meaning. Mastery can take minutes or hours or days. The last major reading is for writing down terms and definitions and important concepts (see #6 below).

5. *Talk to yourself as you read.* Explain what you have read aloud and make up your own examples to better understand what you have read. Rereading the material aloud, especially in your own words helps clarify the information. Hearing yourself makes a lot of difference.

6. *Words and symbols of biology have specific meanings.* Each time you come to a new term or concept, cover up the text and see if you can express the idea aloud in your own words. Write down all the words you do not know. Emphasize words in bold type. Whenever possible write out the definitions in your own words. Strive for understanding the definitions so that you can easily state them in your own words; you are more likely to remember them that way. By saying it out loud and writing it, you are more like to recall it later, when needed.

7. *Study all diagrams and charts.* They condense a lot of valuable information. Cover up and see if you can visualize them.

8. *Write as you read.*

- During your first reading write nothing in the text.
- Do not highlight it slows down reading and it is often used as an excuse for not concentrating.

- In a later reading, call attention to important words or phrases by underlining them (do not overdo this). Complete sentences or paragraphs should be bracketed and not underlined.
- Write summarizing statements to yourself in the margin.
- Make notes to your self right in the text.
- Note questions that you need to have clarified.
- DO NOT WORRY ABOUT THE RESALE VALUE OF THE TEXT.

9. *Summarize:* Record all key points on a separate sheet.

10. *Study Questions:*

- If there are study questions at the end of the chapters, be sure you can answer them. They are good practice for the exam.
- Make flash cards with terminology and concepts.
- Keep testing yourself on a separate sheet of paper.
- Without looking back, write out and say aloud the important points.

11. *Create tasks for yourself as you read the text.* After reading an example and working it out for your self, try to think of other examples that would fit the idea being discussed.

12. *Use more than one book on the topic you are studying whenever possible.* Pick books that appeal to you. If you are very verbal, a book with long explanations is likely to be most helpful. If you are more visual, you might choose a book that has more illustrations.

13. *Read the chapter before, and again after, class.* You will get the most out of class if you have read the material before the instructor presents it. Even if you understood the material in class, read it over again in the text. The more you review it the more likely you are to recall it.

17. *Get quizzed by others.* If possible, have a friend or family member, or a classmate quiz you on your notes and text information. Done regularly, this commits more information to long-term memory.

Physics – Effective Class Participation

It's important that you be well prepared for class in order to use its potential fully for integrating the course material. To prepare for the class, you should do the following:

PRIOR TO EACH CLASS:

1. *Check the course outline or reading assignment to see what will be covered.* Prepare by briefly previewing the sections of the textbook that apply to the subjects to be covered. This preview will improve your ability to follow the class, for you will have seen the new terminology and will recognize signposts that will help integrate the classes into an overall picture.

2. *Read the introduction and the summary of the relevant chapter* and look at the section headings and subheadings. Try to formulate questions in your mind about the subjects to be covered. This question-formulating helps you manipulate and therefore better understand the material.

3. *Examine the drawings and pictures.* Try to determine what principles they illustrate.

4. *Make notes of* new words, new units of measure, statements of general laws, and other new concepts.

5. *Do not underline or highlight the text*, since you do not yet know what will be emphasized by your teacher.

6. *Right before the beginning of class, check your notes from the last class.* Reading your notes will prepare you to listen to the new physics class as part of an integrated course and will help you to see the broad development of themes.

DURING CLASS:

Come to the class on time.

1. *Take good notes.* It's helpful to draw up a set of abbreviations and use them consistently in taking notes. Keep a list of them for later reference. Leave ample margins for later comments and for questions or write on only one side so that you can use the opposite side for comments and questions (see After Class, below).

2. *When you copy drawings, completeness is worth more than careful artwork.* You should not only copy what is on the board but also record important points that the teacher makes orally about the diagram.

3. *If you get behind in your note-taking, leave a space in your notes and go on.* You can fill in your notes later with the help of a classmate or your textbook.

4. *Ask questions. Don't be embarrassed to ask your teacher questions.* Many teachers depend on feedback from students to help them set a proper pace for the class. And of course it can happen that the teacher does not explain a step she takes, or even makes a mistake when writing something on the board.

AFTER CLASS:

1. *After class, as soon as possible, review and edit your notes.* You need not rewrite them. Rather, you should look for important ideas and relationships among major topics. Summarize these in the margin or on the opposite side if you've taken notes only on one side, and at this time you may want to add an outline to your notes. Also, this would be a good time to integrate notes from your textbook into your lecture notes; then you will have one set of integrated notes to study by.

2. *As you review your notes, certain questions may come to mind.* Leave space for recording questions, and then either ask the teacher or even better, try to answer these questions for yourself with your friends and with the help of the text.

READING YOUR PHYSICS TEXTBOOK:

Reading the text and solving homework problems is a cycle: Questions lead to answers that lead back to more questions. An entire chapter will often be devoted to the consequences of a single basic principle. You should look for these basic principles. These Laws of Nature give order to the physicists' view of the universe. Moreover, nearly all of the problems that you will be faced with in a physics course can be analyzed by means of one or more of these laws.

When looking for relationships among topics, you may note that in many instances a specific problem is first analyzed in great detail. Then the setting of the problem is generalized into more abstract results. When such generalizations are made, you should refer back to the case that was previously cited and make sure that you understand how the general theory applies to the specific problem. Then see if you can think of other problems to which that general principle applies. Some suggestions for your physics reading:

1. *Make use of the preview that you did prior to the class.* Again, quickly look at the major points of the chapter. Think back to the points stressed in class and any questions you might have written down.

2. *Read the homework problems first.* If specific homework problems have not yet been assigned, select several and look these over. Critically assess what principles seem to be most significant in the assigned chapter. Based upon your brief review of the class and your examination of the problems, try to generate questions in your mind that you want the chapter to answer.

3. *Read actively with questions in mind.* A passive approach to reading physics wastes your time. Read with a pencil and paper beside the book to jot down questions and notes. If you find that you are not reading actively, once again take a look at the problems and the lecture notes. Read to learn, not to cover material.

4. *Stop periodically and pointedly recall the material that you have read.* It is a good idea to repeat material aloud and especially to add notes from the textbook into the margins of your class notes.

5. *During your reading you will notice sections, equations, or ideas that apply directly to assigned problems.* After you have read such a section, stop and analyze its application to a homework problem. The interplay of reading and problem solving is part of the cycle of question --> answer --> question. It helps you gain insights that are not possible by reading alone, even careful reading alone. Passive reading is simply following the chain of thought in the text. Active reading also involves exploring the possibilities of what is being read. By actively combining the questions that are inherent in problem solving with your reading, you enhance both your concentration while reading and your ability to recall and to apply the material.

PROBLEM SOLVING IN PHYSICS

You may now be like many students a novice problem solver. The goal of this section is to help you become an expert problem solver. Effective, expert problem solving involves answering five questions:

- What's the problem about?
- What am I asked to find?
- What information am I to use? What principles apply?
- What do I know about similar situations?
- How can I go about applying the information to solve the problem?
- Does my solution make sense?

You, the expert, will decide, "this is an energy problem," or, "this is a Newton 2 problem." A novice is more likely to decide, "this is a pulley problem," or, "this is a baseball problem." The novice concentrates on the surface features of the problem while you concentrate on the underlying principle. You, an expert problem solver, will answer these questions, play around (briefly) with the problem, and make drawings and sketches (either in your mind, or even better, on paper) before writing down formulas and plugging in numbers. A novice problem solver, on the other hand, will try to write down equations and plug in numbers as soon as possible. A novice will make many more mistakes than you will when you become an expert.

In a physics course it's important to remember a couple of things about physicists and physics professors:

- *A physicist seeks those problems that can be modeled or represented by a picture or diagram*. Almost any problem you encounter in a physics course can be described with a drawing. Such a drawing often contains or suggests the solution to the problem.
- *A physicist seeks to find unifying principles that can be expressed mathematically and that can be applied to broad classes of physical situations.* Your physics textbook contains many specific formulas, but you must understand the broader Laws of Nature in order to grasp the overview of physics. This broad understanding is vital if

you are to solve problems that may include several different principles and that may use several different formulas. Virtually all specific formulas in physics are combinations of basic laws.

GENERAL OUTLINE OF HOW TO APPROACH A PHYSICS PROBLEM:

1. *Read the problem.* Look up the meanings of any terms that you do not know. Answer for yourself the question, "What's this about?" Make sure you understand what is being asked, what the question is. It is very helpful if you re-express the problem in your own words or if you tell a friend what the problem is about.

2. *Make a drawing of the problem.* Even a poor drawing can be helpful, but for a truly good drawing include the following:

    a. Give a title that identifies the quantity you are seeking in the problem or that describes the problem.

    b. Label the drawing, including the parameters or variables on which the solution depends and that are given in the problem. Write down the given values of these parameters on the drawing.

    c. Label any unknown parameters that must be calculated along the way or obtained from the text in order to find the desired solution.

    d. Always give the units of measure for all quantities in the problem. If the drawing is a graph, be sure to give both the units and the scale of the axes.

    e. Include on the drawing information that is assumed and not given in the problem (such as g, the value of the acceleration due to gravity), and whether air resistance and friction are neglected.

3. *Establish which general principle relates the given parameters to the quantity that you are seeking.* Usually your picture will suggest the correct techniques and formulas. At times it may be necessary to obtain further information from your textbook or notes before the proper formulas can be chosen. It often happens that further information is needed when the problem has a solution that must be calculated indirectly from the given information. If further information is needed or if intermediate quantities must be computed, it is here that they are often identified.

4. *Draw a second picture that identifies the coordinate system and origin that will be used in relating the data to the equations.* In some situations this second picture may be a graph, free body diagram, or vector diagram rather than a picture of a physical situation.

5. *Even an expert will often use the concrete method of working a problem.* In this method you do the calculation using the given values from the start, so that the algebra gives numerical values at each intermediate step on the way to the final solution. The disadvantage of this method is that because of the large number of numerical calculations involved, mistakes are likely, and so you should take special care with significant figures. However this method has the advantage that you can see, at every step of the way, how the problem is progressing. It also is more direct and often makes it easier to locate a mistake if you do make one.

6. *As an expert, you will more and more use the formal method of working a problem.* In this method, you calculate the solution by doing as much as possible without using specific numbers. In other words, do as much of the algebra as you can before substituting the specific given values of the data. In long and complicated problems terms may cancel or expressions simplify. Our advice: gain experience in problem solving by substituting the numbers when you start physics, but gradually adopt the formal approach as you become more confident; many people adopt a compromise approach where they substitute some values but retain others as symbols (for example, "g" for the acceleration due to gravity).

7. *Criticize your solution: Ask yourself, "Does it make sense?"* Compare your solution to any available examples or to previous problems you have done. Often you can check yourself by doing an approximate calculation. Many times a calculation error will result in an answer that is obviously wrong. Be sure to check the units of your solution to see that they are appropriate. This examination will develop your physical intuition about the correctness of solutions, and this intuition will be very valuable for later problems and on exams.

   *An important thing to remember in working physics problems is that by showing all of your work you can much more easily locate and correct mistakes. You will also find it easier to read the problems when you prepare for exams if you show all your work.

8. *In the AP examination, you may have to do problems under a strict time limitation.* Therefore, when you are finished with a homework problem, practice doing it again faster, in order to build up your speed and your confidence.

9. *When you have completed a problem, you should be able, at some later time, to read the solution and to understand it without referring to the text.* You should therefore write up the problem so as to include a description of what is wanted, the principle you have applied, and the steps you have taken. If, when you read your own answer to the problem, you come to a step that you do not understand, then you have either omitted a step that is necessary to the logical development of the solution, or you need to put down more extensive notes in your write-up to remind you of the reasons for each step.

10. *It takes more time to write careful and complete solutions to homework problems.* Writing down what you are doing and thinking slows you down, but more important it makes you behave more like an expert. You will be well paid back by the assurance that you are not overlooking essential information. These careful write-ups will provide excellent review material for exam preparation.

Effective Test Preparation

If you have followed an active approach to study similar to the one suggested here, your preparation for exams will not be overly difficult. If you haven't been very active in studying, your preparation will be somewhat harder, but the same principles still apply. Always remember: Physics courses, and therefore physics exams, involve problem solving. Hence, your approach to studying for exams should stress problem solving.