HOW TO DRINK FROM A FIRE-HOSE WITHOUT DROWNING – Successful study strategies in medical and pharmacy school

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Why should I change my study strategies?

The practice of medicine and pharmacy requires a physician or pharmacist to have quick access to a *lot* of information in a fashion that allows them to access it accurately and from a wide variety of different angles.

The material presented in medical or pharmacy school is not conceptually more difficult than many rigorous undergraduate courses, but the *volume flow rate* of information per hour and per day is much greater – it has frequently been described as "drinking from a fire-hose."

Only change your strategies if you're *not* satisfied with your exam scores.

- *Everyone* admitted to any medical or pharmacy school has developed study strategies successful for an undergraduate informational flow rate – unfortunately, those developed by most undergraduate students are not *efficient* enough for the fire hose flow rate.

Efficient studying – the best use of your limited time – requires ***active*** learning, not passive.

- Active learning requires *making decisions* about the material – "Is this important?" "How is this different from the other examples given for the same process?" "Where does this fit into the 'big picture'?" "What is the exact definition of this term?"

"Drinking from the fire hose" requires **active** studying – if you aren't making decisions about the material as you study, it *isn't* active.

- Passive reading of pages of text or "going over" notes (even with a highlighter) and hoping to absorb the information is inefficient – if you have enough time, it will eventually work, but it usually isn't adequate for the fire hose.

Changing a habit that has worked for many years isn't easy, so don't be surprised if you need to hear the same things many times – and don't be afraid to ask to hear it again!

What are the fundamental processes in a successful *active* studying?

1) **I**dentifying the important information – answering the eternal question of "what's important here?"
2) **O**rganizing the information – create chunks of information and use patterns to *facilitate memorization* and to emphasize the *connections* needed for *application* questions, e.g., for *differential* diagnosis.
3) **M**emorizing the information – don't put this off because "I'll just forget it again"! Memorize your chunks and patterns as soon as possible, then *review* the main points each time the topic comes up again; it's annoying, but actually easier – and it will actually get into long-term memory more effectively.
4) **A**pplying the information to more complex problems – practice methodical approaches *before* the exam.

What are the goals of an *active* study plan?

First – to create as quickly as possible the study sheets that *together* contain the needed information, with the information organized into chunks and into patterns that promote memorization.

Second – to memorize and synthesize that information so that it can be applied to new situations and problems.

What are the steps of this plan?

1) **Before lecture,** devote ≈ *10 minutes per lecture hour* to identifying and memorizing **the "big picture"**.
   a) The ***main goal*** of pre-lecture work is to have a basic roadmap of the lecture in your head.

i) Identify the <u>*number*</u> of ***key headings*** (*decide* which these are from the outline/summary) first, then ***memorize*** them (don't skip this part!).

ii) Reinforce the headings by reading the *summary* (and perhaps the introduction in a text).

iii) If you have time, scan the material for ***definitions, equations*** and ***diagrams*** that you'll need later.

b) What to preview:

i) If the lecturer uses powerpoint, use the outline and any summary slides (don't get caught up in the rest)

ii) If the lecturer provides a text summary of the content, use the major headings and subheadings.

iii) If the lecturer only provides an outline, use that; otherwise skim the assigned readings for the headings (they often tell the key points of the story) and summary.

2) During lecture, take notes that emphasize *connections* and *what the instructor thinks is important*.

a) If practical, *annotate* power point slides or lecturer notes, rather than taking completely new notes, and use the backs of the pages if you need more space.

i) ***<u>Don't</u>*** rewrite data already present in notes or slides.

ii) Use a single slash to cross out any material the lecturer says isn't key (you can still read it).

iii) Let "color commentary" or "new cool stuff" that is outside the scope of the class go.

b) Focus on adding the "take-home message" from the lecturer and any information about what is important.

i) Note the "take-home message" for each graph or chart, and clearly identify or label the axes.

ii) Note any lecturer comments that identify or integrate key points – especially in the introduction or in summaries.

iii) Always note information that helps you *decide between options*, e.g., circumstances that indicate when one reflex or response will outweigh another, or in what circumstances one molecular technique is used rather than another, etc.

c) *Use abbreviations* and *symbols* whenever possible to increase the information you can take down.

3) After lecture, on the same day (if feasible) edit your notes and *begin organization* (see next p. for Tips).

a) Your lecture notes will become the messy (but complete) back-up document – so <u>*don't* rewrite them</u>.

b) <u>Edit them in *one pass*</u> by having the text (if needed) and learning objectives (if useful) present while you:

i) Add the major headings and subheadings for the lecture into the notes (if they aren't already present).

ii) *Circle specific terms and definitions* within the notes in a different color – these will be used both for reference and for keying memorization of the material.

iii) Decide what is important and what can be left out of your study sheets.

- <u>*Don't*</u> get caught up working through extraneous figures ("color commentary") or non-relevant information on figures (detail not needed for the "key point").
- If a key point or definition doesn't make sense, use the text (or online references) to complete any missing definitions or fill in missing ***key*** information. Be selective and focused!

iv) Cross-reference! Each time the lecturer mentions something you remember being discussed in an earlier lecture, *stop*, find the pages in your earlier notes and list them in them in *both* places in the left margin; cross-referencing is much faster at this stage, rather than hunting just before the exam.

b) For topics than lend themselves to a reasonably simple organization, <u>sketch out that organization</u>.

4) Within few days find time to complete your lists, charts, flow diagrams and pictures – these are summaries that form the "final draft" of your information that you will study for the exam.

a) **Memorize** the organizations actively as you complete each – DON'T WAIT– and use frequent short reviews to consolidate it in your memory (see next pages for Tips).

b) **Apply** the information by working practice problems or quiz questions *effectively*; work out a method to approach complex problems that could appear on the exam – DON'T WAIT to just before the exam.

Tips on organizing, memorizing and applying the material

1) **Organize topics** to create memorizable chunks of information and to create patterns to reflect connections.
   a) Create *functional* categories to organize the information into memorizable "chunks".
      i) Most people remember connections and function better than individual facts.
      ii) Use the "**rule of 5**" for lists and charts/tables: no more than ***five*** items in a given list – if you need more, then *decide how they are related* and create *subheadings*.
      iii) Don't recreate the wheel. If you find a ***good*** chart in some text or other source, photocopy it and add it to your summaries. Be sure to add any additional information to make it complete or more comprehensive — try a different color ink to make it stand out.
   b) Tables can compare/contrast steps in related processes, etc.
      i) People remember "stories" better than written text or unrelated facts.
         •Have a reason for the order of horizontal and vertical headings in a table, e.g., sequence in time, position in body, etc.
         •Choose headings that will emphasize features for the processes being compared that *distinguish* between the processes.
      ii) Use headings or examples within the material to decide on a useful way to organize a particular topic; but you can also have "default" sequences to fall back on:
         •E.g., for neurotransmitters, hormones, etc.: structure, synthesis, biological effect, regulation.
         •E.g., for molecular processes: basics (product, location, etc.), initiation, elongation, termination, processing
   c) Many people remember visual patterns better than tables or charts.
      i) Flow diagrams can be very useful for visualizing connections between topics and subtopics.
      ii) Simple schematic pictures can be annotated and location on the page is useful– don't overfill them.
      iii) Graphs can be very useful – but *memorize the labels on both axes* and not just the line shapes!
   d) Finding connections between different topics aids both memorization and application
      i) Use equivalent headings or orders of headings for separate tables on *related topics* – it both aids memorization and emphasizes connections within the material that help with application.
      ii) Create "big picture" charts, flow diagrams or pictures that *organize **key** related topics* from multiple lectures – the topic charts from each lecture can then provide the detail.
      iii) Don't hesitate to include key information on different summaries, especially if they are organizing the material from different points of view or at different levels of detail.

2) **Memorize the material** actively (**"3 Ss"**) and use frequent short reviews to consolidate it.
   a) Organized material is *useless* unless it is organized and accessible in your ***memory***!
      i) The material needs to be *in long-term memory* and *accessible* – which means in an organized pattern.
      ii) Cramming doesn't work long-term! – courses build on each other and you need the information from earlier classes to understand and apply material from later courses.
      iii) Getting information into long-term memory requires *multiple* repetitions and ***active*** memorization – "going over" or "reading over" material is NOT efficient.
      iv) Memorization is never fun, but the *most efficient* methods are also the *LEAST* painful.
   b) ***Active memorization*** uses **3 Ss**: **"stories"**, **steps** and **self-testing**.
      i) Good organization reflects a "*story*" and emphasizes connections – studies have shown that the more *connections* made between information, the better and longer you will remember it.
      ii) ***Actively*** memorize with these *steps*:

1st : memorize how <u>*many*</u> items (*e.g.,* headings) there are – it's much easier to know if you've got them all memorized if you know how many you need.

2nd: memorize the <u>*headings*</u> themselves – using biological logic, visualization, or mnemonics.

3rd : memorize the <u>*information*</u> associated with the first heading, starting with just a <u>*key word*</u> *or* <u>*short phrase*</u>, and *finally* adding the full item.

4th : as you memorize each chunk (row, column, region of a picture, etc.), close your eyes and quiz yourself just on *that* piece until you've got it.

5th : continue this process until you think you have the full organization.

c) Self-test <u>*on paper*</u> (or whiteboard) when you think you have memorized a full chart or diagram:

- Cover the original, and write out the material on a blank piece of paper (don't be pretty, but don't cheat!), then ***throw what you have just written away***!!!
- Look at the original – if your confident you got it all – great! If there is any question, *don't compare* with what you should have thrown away – just memorize it again.
- This method emphasizes what you *don't know*; comparing the new with the old only confirms what you already knew, which can mislead us into thinking we know more than we do.

d) Self-test with a quick active mental review of the key material *at every opportunity*.

- Every time an earlier topic or concept is mentioned, stop and review to yourself the relevant summary list – how many, then the headings, then the key words, then the concepts or facts.
- Review basic flow diagrams or sequences at other times as well, e.g,, washing your hair.
- This sets the information in your memory, and <u>*builds practice in the sequences you'll use to answer questions*</u>.

e) Quizzing <u>*each other*</u> is good motivation, but beware of subliminal cues used to help answer the questions without mastering the material. Explaining it out loud to yourself is a good start, but you can verbally "hand-wave" around areas you aren't clear on. **Always** check yourself with writing.

3) Practice *application* early – don't put it off until just before the exam!

a) Use practice questions as *diagnostic tools* as well as testing your knowledge, so DON'T save them until just before the exam.

i) Use the stems *and* the answer choices (correct and incorrect) to help identify the level of detail you need to know and how much integration and/or application is expected.

ii) If you got the question correct, identify *why* each incorrect choice was wrong.

iii) If you got the question wrong, go back to the organizations that contained all the relevant information and rememorize them (NOT just the bits on the question).

- Work out a method for approaching that type of question – "where do I start?"
- If the material includes clinical cases or scenarios, predict application questions by asking: "Given data (clinical or molecular)", determine the most likely cause of the symptoms or test results, or the best assay/technique to use, or the mutation that could cause the results, or the calculation needed to determine the risk of having the disease, etc.

b) Use practice or quiz questions more than once, even if you remember the correct answer.

i) Work through the method to approach the question and use it to mentally review the relevant information.

ii) Change values or other features to create a new version and work it through as well.

Where do I find time for all this?

1) Successful high-volume studying relies on ***good investment strategies:***
   - •Finding the "big picture" before lecture is easily put off, but it pays off by increasing learning during lecture and facilitating design of organizations after lecture.
   - •Focusing on the key points and NOT getting caught up going through unneeded detail on slides or through "color commentary" slides provides extra time.
   - •Creating summaries takes time, but you'll learn the material with connections and insight that will let you answer those application questions; and they also pay off with *more* time during the inevitable finals crunch because you won't be leafing through endless pages of slides wondering where that information was (and what they all mean).
   - •Memorizing as you go and frequent review of earlier concepts as you study pay off *immediately* because you'll need less time to study for subsequent lectures, you'll be able to recognize connections and correlations that lead to more effective organizational aids, and you'll remember the material both more effectively and longer.
2) There is more time available in a day than you think – don't let "studying "*all* that" help you procrastinate.
   - •Divide your studying into a series of short tasks so you don't feel so overwhelmed, and so you don't feel the need to wait until you have 2 or 3 hours to study. Convincing yourself to start on a chart is much easier than finding a large block of time. And once you're started, it's easier to keep going.
   - •Use small bits of time while your clothes are drying or 1/2 of your lunch hour, or while the rice is cooking for dinner for active studying tasks.
   - •Use all the "extra" time you can in the *first week* to be caught up in lectures, because the blocks are short and there is lots to cover.
   - •Be VERY careful about "robbing Peter to pay Paul" – it's tempting to skip lecture to finish an upcoming project, but try to keep it to a minimum. Skipping class to study is usually a bad investment because you'll probably need even more time to master the material from the skipped class.

What are the most common problems MSI/P2 students have with exams?

1) Clarity and precision in definitions and concepts vs. approximate definitions derived from context.
   - •Often, students generate their own general concepts or definitions from context (after all, that's how we learn to speak) – but this *doesn't* provide enough clarity to analyze and correctly answer the questions.
   - •Medical terminology and equations are very precise – being "close enough" often isn't sufficient.
2) Familiarity with material vs. mastery or synthesis of the material.
   - •"Familiarity" refers to recognizing the logic provided by someone else – as when leaving a good lecture, you can say, "yeah, that made sense."
   - •Mastery or synthesis of the material requires integration and memorization of sufficient detail that the information can be successfully *applied to a new situation.*

Frequently Asked Questions/Frequently Heard Comments (FAQ):

TOPIC: "How do I know what will be on the exam and practice for it?"

"How do I know what will be on the exam?" or "How do I know how much detail to learn?"

1. How do I know how much detail to learn from lectures?
   a. If the learning objectives are "task-oriented" and specific, use them! Don't overthink the simpler objectives, and complete all of them using the lecture material, with the assigned text as a back-up. Task-oriented learning objectives focus on the level of material presented in lecture, so using outside Web sources often encourages students to go well beyond the lecture's intent, which wastes time.
   b. Check your *lecture notes* – they should emphasize the lecturer's context, which includes any comments by the lecturer on what is important.
   c. If the learning objectives are unfocused, seek help from the *lecture outline*, *introductory* and *summary* slides, and *key point slides* for "big picture" concepts should be important, then identify examples or conditions that support them. If the lecturer has provided any additional tables or charts, use them!!
   d. Other indications that information is important:
      •If the concept is *mentioned in more than one lecture*, it's probably important – check your cross-referencing. The same topic may be addressed from different points of view in different lectures, but the exam question on the topic may integrate all those points of view.
      •If *a clinical example* or *disease* is described or explained (not just referred to in passing), you may well need to know the molecular or biochemical or genetic abnormality and the biochemical or physiological consequences of the abnormality.
      •If the instructor gives a *sample calculation*, and an accompanying table has more examples, fill it in.
      •If the course includes *conferences with assigned questions,* be sure to analyze and answer all the questions that *other* students presented. There is a lot of difference between tracking logic outlined by the lecturer or text and applying principles in a way you have not seen before.
2. Use any ***practice or sample problems*** to identify the level of "necessary detail" (see the question below); use quiz questions in the same way, then expand that to apply to all the topics *not* asked about.
3. Assume that all lectures – *including* introductory lectures – will be asked about on the exam. In most cases, the questions on an exam are balanced to roughly proportionately to lecture hours per topic. Of course, it doesn't always work out that way, but it is a place to start.

"But I need to save the quizzes or practice questions to test myself *after* I know all the material."

Don't save practice questions to test yourself just before the exam – it is then too late to modify your studying!! You may do well and be complacent, or do poorly and be a nervous wreck – neither helps!

Practice exams or questions are a vital piece of the answer to the questions, "How much of detail do I need?" and "What kind of questions will they ask?"

Start using practice questions ***as*** *you create the summary for a particular topic* — after setting the headings in your summary, check over the practice questions on that topic to make sure you haven't missed anything.

You can use practice questions again – see the answer to the question below.

"How do I use quiz questions to help my studying?"

1. *Analyze* each quiz question, don't just count up how many you got right. Whether or not you got the question right, analyze it thoroughly.
   a. Make sure you understand why EACH possible answer is right or wrong *and* how each wrong answer could be made correct and what topic it was referring to (why did they include it?).
   b. If you didn't get it right, go back and memorize the *entire* chart or summary that contained it.
   c. Ask yourself if there are any other examples that could easily be used with the same format.

2. Make sure the information for each quiz question is somewhere in your summaries or charts (not just the original class notes) – if not, add it and any equivalent information to any related categories.
3. *Try writing a few possible questions yourself*, then answering them (or trade with a friend). This is a very powerful technique because you have to analyze the material, know the big picture and know details.

"I need more practice questions to study from; where can I get them?"

Used properly, relatively few quiz and sample questions are plenty for preparation — see question above.

"I did well on the weekly quiz, but then I didn't do well on this exam."

The exam will contain different questions and you'll be under more stress, so quizzes seem to have a greater *negative* predictive value (if it goes poorly, correct your studying!) than *positive* predictive value.

Without the stress of the exam, you don't make as many mistakes and usually think more clearly on the quiz. That's why *thorough* analysis of the quiz questions (see above), assuming the ones you *didn't* get right are more indicative of exam questions, and predicting a few harder ones, will be much more effective preparation for the exam.

TOPIC: "It takes too long to do this active studying thing"

"I need to go over my notes at least twice before the final, so I don't have time for all those other steps"

Active studying must *replace* passive studying, not add to it. Analyze what you are doing and *delete* all the passive steps, including **"**going over" your rough draft notes for the final – actively memorize and apply your summaries instead!

"It takes too long to make those summaries."

Basically, if your studying isn't giving you the results you want, then you need to change your pattern — and there is a very good chance you need to integrate the material and memorize it better. Summaries are the best way to do this. They do take time to create, but *replace passive studying with this time*, and maybe use some "extra" time in the day. *Don't recreate the wheel* by copying over perfectly good (but not too pretty) charts or by recopying perfectly good charts from the text or syllabus or other sources. Modify a photocopy in different colors of ink to highlight important additions or points.

"I don't have time to identify and memorize the big picture before lecture."

Efficient studying is based on good investment decisions about your time and *"losing the big picture"* is one of the most common difficulties faced by medical and pharmacy students. If you don't identify the big picture before lecture, your notes will be less organized and you won't track much of the lecture – so you will need even more time to fix your notes. Skipping a 10' process, which then requires 30 minutes or more to make up for, is a bad investment. Of course, if you've had a good course as an undergraduate, you can shorten this "big picture" step.

TOPIC: " I still need to 'go over' my notes and/or recopy them."

"I need to go over my notes a couple of times to get familiar with it before I can make charts"

The best time to identify the big picture is *before* lecture when you memorize the major headings and subheadings in the course outline, syllabus and/or reading. So if you are having trouble with the big picture, be more rigorous in your pre-lecture skimming and in imposing the "big picture" on your rough draft by inserting the organizational headings into your notes. Don't go over the notes a couple of times looking for the big picture — know it ahead of time and put it in as you create your rough draft.

"I need to recopy my notes."

Your notes are the *rough* draft that has all the possible information. Your summaries are the *final* draft with the picked information organized for integration and easy memorization. Don't worry about your rough draft being pretty, just well labeled and cross-indexed. Spend that time creating summaries instead.

TOPIC: "I don't want to go to lecture."

"I never went to lecture as an undergraduate and did just fine. Why start now?"

Skipping lecture is usually a poor time investment choice, since you are missing your first chance to hear all of the details (if you actually pay attention) and to reinforce the big picture. Additionally, this is the best place to find out what is likely to be on the exam (see FAQ below), which depends a lot on intonation and emphasis not available on powerpoint slides. The informational flow rate in medical school is a lot higher than in undergraduate classes, and the analysis by the lecturer is a valuable tool you should use, not ignore.

"I have an exam coming up, so I don't have time to go to lecture."

The above answer applies here, too. In addition, successful studying requires *overall efficiency*, but each step depends on having performed the earlier steps. If you do skip lecture for whatever reason, don't forget you need to replace *both* the analysis and review the lecture provides **and** the further studying you need to organize and memorize the material.

"I don't like the lecturer and don't learn anything from him/her."

Different lecture styles work better for different people, but the bottom line is that lecture is still the best place to find out what the professor thinks is important. If you aren't learning anything in lecture, pre-read more rigorously and memorize the headings and subheadings well enough that you won't get lost if the lecturer rearranges the order somewhat. If you lose track, pick up again when you reach the slides covering the next topic.

"My note-taking is so bad that it is a waste of time to go to lecture."

You still lose the experience of hearing the emphasis and extra explanation – and the only way to improve your note-taking with is practice. As a physician or pharmacist, you will be continuing your education (and note-taking) the rest of your life, so now is a good time to get better. Re-read the section on note-taking for specific suggestions on how to improve it.

TOPIC: " I didn't do well on the exam – I need help with my test-taking strategies."

"I understood the material, but I had trouble answering the questions — my problem is test-taking."

Test-taking strategies can always be improved and can help the student display what he or she really does know, but *usually* most of the problem with less than stellar exam scores is *passive studying strategies*. Two common types of problems are listed below

1) Clarity of definitions or concepts vs. those derived from context.
   - •Students often generate their own general concepts or definitions from context (that *is* how we learn to speak) – but this *doesn't* provide enough clarity to analyze and correctly answer the questions.
   - •Medical terminology and equations are very precise – being "close enough" often isn't sufficient.
   - •Knowing the exact definitions and equations very well also increases exam speed, allowing more time for analytical questions.
2) Familiarity with material vs. mastery of the material.
   - •"Familiarity" refers to recognizing the logic provided by someone else – as when leaving a good lecture, you can say, "yeah, that made sense."
   - •Mastery of the material requires integration and *memorization of sufficient detail* so that the information can be successfully *applied to new situation.*
   - •Knowing *how much detail* to learn is difficult, and varies with each class – see the first FAQ.

"I have trouble with those trick questions."

Many "trick" questions aren't tricks at all — they just require careful reading (so will prescriptions, etc.) and care in answering. *In general:*

•Focus on the data in question by *underlining, boxing or circling* relevant information in the stem.

- •Jot down any useful equations or quick lists in the margin as a reminder – you may use them later, too.
- •Have a general idea of the possible answers before you read the answers, then find the *most* correct answer among them.
- •Try to have a "back-up" alternative logic to verify your answer, other than that in the answer itself; emphasizing organization and connections during studying helps this technique this a lot.

Common *specific* problems that increase the chance of missing a question include:

1) Choosing the *first* correct statement, even though it is not the *best answer* to the question.
   - •Be sure the statement answers the stem and is true under the conditions listed.
2) Choosing a *familiar* association between two factors, even though that association does not work in the described scenario, or the factors are related inversely instead of directly.
   - •Rely on clarity, not familiarity, and *write out* the appropriate equation or relationship.
3) Reading the *first half* of an answer and choosing it, without reading the second half and realizing that it makes the answer false – make sure the 2nd half does not conflict with the 1st half.
4) Trying to second-guess yourself or the exam-writer.
   - •If one answer is obvious to you, they aren't trying to trick you – it is almost always correct!
5) Assuming that if you've never heard of an answer or a condition in a question, that it's a trick.
   - •The question is probably testing fundamental principles in a new application. Think basics! What situation that you've heard of might be analogous to this condition?
   - •A surprising number of students will skip over an answer they think is correct to choose one they have never heard of, assuming they must have missing something. Have faith! If you've never heard of it, the choice is probably wrong. Go with what you first thought was correct.

<u>*Unfocused*</u> questions ("Which of the following is true concerning _____?) require a <u>*different technique*</u>:

- •Read each answer as a continuous statement with the stem or as an answer to the stem and decide if it is true or false; mark off incorrect answers and decide which of the remaining is most accurate.

"<u>*Except*</u>" or "<u>*which of the following is false*</u>" questions also require a different technique:

- •Be sure to mark T or F next to the beginning of each answer in any *"except"* question –it is very easy to get distracted by your analysis of the question and just pick the next correct answer. Of course the question is asking you to choose the *incorrect* answer. If you see two Ts as you look at the next answer, you're more likely to remember you need to choose an *incorrect* "F" answer.

"I always get it down to 2 answers and the always choose the wrong one."

This is a very real problem for many students – it's not just a misperception. At least two different processes seem to contribute to consistently doing this.

i) Students unconsciously equate *effort* with *accuracy*. So if it takes 3 minutes to justify one answer and only 30 seconds to justify another, the 3 minute answer is often chosen – after all, that effort must mean something (or you're just tired of trying to figure it out, so you pick the one you just spent a lot of effort working on). Of course this usually means that it took *more* assumptions and tortuous reasoning to justify the 3-minute answer, which makes it *less likely* to be true.

ii) Students also frequently give more validity to impressions of "what your body wants to do" or "what the cell wants to do" than to actual known relationships or equations that describe reality. Often, a student will say something like, "Well, I knew that stroke volume times heart rate equals cardiac output, and answer 'b' fit that equation, but I though that stroke volume should be really important in determining $M^{\circ}V_{02}$ because the heart wants to move all that blood, so I chose answer 'c'." Notice the difference between "knew" and "should".

So try to avoid these traps by sticking with the answer that first that *made sense* – UNLESS you recognize a serious flaw in your logic or suddenly remember a fact or equation that you could actually write out!

If you're having this problem even with focused questions (the kind that you can guess at the answer by just reading the stem), sometimes it's worth considering each answer with a ***5-part scoring system*** to help analyze the question.

1) Read the question stem once carefully and then begin reading each answer carefully – as you read each answer *the first time*, write its score (described below) *just to the left of the answer*.

   It's important to assign a score on your *first impression*, since this is usually based on fundamentals and often correct – the more you analyze a question, the more likely you are to tangle up your analysis and end up choosing an incorrect answer.

   - **TT** = definitely true – you are confident of the fact or can write out the equation or can visualize the information from your notes or summaries that support it.
   - **T** = probably true – you aren't confident, but something tells you it's probably true.
   - **?** = no clue – don't be afraid to use this if you don't know!
   - **F** = probably false – you aren't confident, but something tells you it's probably false.
   - **FF** = definitely false – you are confident of the fact or can write out the equation or can visualize the information from your notes or summaries that support the fact this is false.

2) Scan the answer scores for their pattern.

   a) If only one is TT or T and the others are ?, F or FF – no problem, pick the correct answer.

   b) If there are both TT and T or both T and ? (or both F and FF on an "*EXCEPT*" question), *re-read the stem and the each answer as a single unit*. Try to utilize biological or physiological mechanisms or equations in your analysis. Don't change a T into a TT, or a "?" into a T, or an F into an FF *unless* you can write the supporting evidence on your exam page. That rule will allow you to change answers when you need to and minimize answer changing for the *wrong* reasons.

When I change answers, I always seem to change them from right answers to wrong answers.

If you *don't* have a good reason to change an answer, the first answer will most likely be correct. Your first answer choice is usually based (often subconsciously) on fundamentals – that's good. If you start thinking too much about the question, you're likely to mislead yourself by getting sidetracked into unlikely logic paths with more assumptions and tortuous reasoning. These are the same ones that take up a lot of time and make the answer *less likely* to be true. So:

- If you can *write out the reason* to change your answer, *do so*. This should take care of those times that you really recognized an error in your logic or in an equation, or a later question gave you some information you had forgotten.
- If you *can't* write out the reason, *don't* change the answer. This should minimize the problems explained in the first paragraph.

You may lose a question occasionally using this advice, but overall, you'll end up with better scores. (Several studies have concluded that changing answers on multiple choice answer exams is beneficial, but if you read the studies, these studies don't discriminate between changing answers for valid reasons versus not. This advice takes care of both issues.)