

# Learning (Your First Job)

by

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## **Introduction** (*Don't skip this part*)

These pages contain some fairly blunt suggestions about what to do in college. Some of them may seem strange to you, some might seem old fashioned, and most will come across as labor intensive. But they have worked very well for many students over the past 20 years, since the first edition came out. This edition is more up to date, but the basic message has not changed much.

A fundamental idea that you will encounter over and over again, is that learning is not something that just happens to you, it is something that *you do to yourself*. You cannot be “given” learning, nor can you be forced to do it. The most brilliant and inspired teacher cannot “cause” you to learn. Only you can do that. What follows are some fairly explicit “learning activities” or behaviors, but they are all *your* activities, and now and then those of your fellow students. But there is also a basic assumption underlying these ideas, and that’s that you do want to learn something while getting a diploma. Without that desire, nothing will work.

## **Some words we need to understand**

It happens, too often, that someone reads a passage or paragraph, as you are, and gets an idea very different from what the writer intended. This is almost always because the reader has somewhat different meanings for the words than did the writer. So that we don't have that problem here I'll make clear the meanings I intend by the words I use.

We'll start with:

### ***Learning:***

While few people think of it this way, learning is a biological process. It is indeed biological because thinking occurs when certain webs (networks) of neurons (cells) in your brain begin sending signals to other webs of neurons. You, of course, are not conscious of this process, but only of the thought that results. But there is no doubt that thinking is the result of webs of cells in your brain sending signals to other webs.

How can knowing what causes thought help in the learning process? Start by considering that human learning has two components:

- 1) Understanding
- 2) Remembering

Either of these by itself is not sufficient. Knowing a bit about how the brain works when you're thinking will help you to see why *both* understanding and remembering are necessary for learning.

Anytime you encounter a new idea (and that, after all, is why you are in college) you need to “make sense” of it, or, to understand it. And if you are actually *trying* to

make sense of it, your brain is firing a lot of webs of neurons until one or more of them “sees” the logic or causality in a situation. Understanding sometimes comes in a flash and we feel, “Oh, I get it!” Other times it takes repeated exposure or the use of analogies until we finally “get it.” But if we *never* get it, then we still don’t understand—we haven’t tried enough circuits in the brain.

So, right from the beginning, making sense of what you read or hear involves focused attention and concentration, in other words, “brain work.” I’m confident that almost all college students “could” understand what is required of them by focusing attention on what is being read or heard, and stick with it until the thoughts in their heads pretty much matched those of the speaker or writer.

Unhappily, this is not the way all students in college behave. The most frequent complaint I hear from college instructors is that too many of their students are simply “passive observers.” So the big rule about understanding is that it *cannot* be achieved passively. It demands an active and focused mind.

Some very bright students find little difficulty in understanding what they hear or read. But some of these smart people get very poor grades and sometimes drop out. The reason is, they neglect the second part of learning, which is *remembering*.

For most people, I suspect, remembering is more difficult than understanding. I would suggest that this is because few people know much about memory, or that it is likewise a biological process involving the firing of webs of neurons in the brain. Most people think of memories as ideas, pictures, or events that are lodged somewhere in their heads, and these places simply need to be “found.” The fact, however, is that memories are not things always present somewhere in our heads. Memories must be *reconstructed* each time they are remembered. This reconstruction, in biological terms, means firing up almost the same webs of neurons that were used to perceive the original event. This would seem to be easy, *but it is not* in most cases. Here’s the reason.

### **Use it or lose it**

These webs I’ve been speaking of are networks of connected neurons. The details do not need to be understood, but the fact is, the *connections* between brain cells are not necessarily permanent. *Much of our brain is not hard wired*. One can think of neurons as having a big, important rule, “if the connection I made gets used a lot, it must be doing something important or useful, so I will strengthen the connection so it doesn’t fall apart.” And that’s exactly what it does (even though, in fact, it itself doesn’t *know* what it’s doing.) Now the bad news. If a neuron makes a connection that does *not* get used (no matter how useful it *might have been*) it breaks the connection and it’s probably gone forever. In short, neural circuits that get used become stable, those that do not get used fall apart.

So it is that we can understand something quite clearly, and some time later not be able to remember what it was we understood. The biological explanation is that the “web of understanding” was not used enough to become stable, so it fell apart.

If you’ve followed all of this you probably see the bad news coming. If learning means *both* understanding and remembering, we have to *practice* what we understand. Without rehearsal, that fantastic circuitry that enabled our understanding will gradually disintegrate and we can no longer reconstruct what we once understood.

Some readers are no doubt wanting to get on to the “tricks” for getting high grades. But for a lot of college courses, getting a high grade involves *only* one trick—learn the material. Learning, as described here, is the trick that always works. Learning is the goal—keep that always in mind through the rest of these pages. Grades will take care of themselves.

### **The Classroom**

The classroom might be very traditional—a collection of students in chairs and an instructor at the front—or people seated at computer terminals, or alone at home with the computer. So long as these are in some way “interactive” with an instructor, the following suggestions will be valid and useful.

The reason something must be said about so commonplace a thing as the classroom is that too many students see it incorrectly and so they waste a highly valuable occasion for learning. The most common misconception is that the class period is that occasion when the instructor tells you what you need to know to pass the tests. Seen this way, it can only be a dreary thing, and from this perception flow a number of bad habits and behaviors that make learning more laborious and less interesting that it can be and should be.

#### **“Taking” notes**

I would like to see the expression “taking notes” removed from the vocabulary and replaced with one often used in Great Britain, that is “making notes.” “Taking” implies a passive reception of something someone else has made. It too often consists of copying what’s on a chalkboard or being projected on a screen. Copying from a projected image is usually quite difficult and trying to copy what someone is saying is nearly impossible. Attempts to take notes in this way produces something that is usually quite incomplete, often garbled and has the awful effect of turning off the *listening* part of the brain. We are not capable of focusing attention on two different activities at the same time. So we miss what an instructor is saying while we concentrate on writing what he has already said, or copying from the board or screen. Some instructors compensate by making notes *for* the students and passing them out. This practice can help the better students—those who already know how to learn—but for many others it only makes matters worse. For a passive person, having a set of teacher-prepared notes means that they now have *nothing* to do during the class period. So they just sit, or daydream, or doze off, and often quit coming to class altogether. Why not, if it’s all in the notes? Two more definitions will help to see that this is a recipe for failure.

## Information and Knowledge

Even college professors and authors of books often confuse these words or use them interchangeably. In fact they mean very different things. Let's start with information. The world is awash in information. All the books in the library have information, as do journals, magazines, and the uncountable number of websites and postings on the internet. All of this information is transferable from one medium to another, sometimes with lightening speed. *None of it, however, is knowledge!* The reason being that knowledge can only exist in someone's head. Furthermore, the expression "transfer of knowledge" is ridiculous because it describes the impossible.

This might be a novel or surprising idea so let's examine it further. Suppose your chemistry teacher has a correct and fairly thorough knowledge of oxidation/reduction reactions. Can this knowledge be transferred to you? How wonderful if it could be. Something like a "transfusion" or "mind meld" and you know instantly what he/she knows! None of that is possible. All your teacher can give you is *information*, and perhaps the inspiration for you to do your part. This information is always in the form of symbols. These symbols might be words,—spoken or written—numbers, signs, diagrams, pictures, and so on. You cannot learn anything unless you have previous knowledge of the meaning of the symbols. As a clear example, you cannot learn from someone speaking Farsi if you know only English, no matter how accurate and useful the information embedded in that language. This idea—new knowledge depends greatly on prior knowledge—will come up again later.

But if, happily, you can indeed "make sense" of new information on chemical reactions (or anything else) you can then construct your own knowledge by using the new information and incorporating it into your prior knowledge base. But, as noted above, this will involve using some not-used-before neural connections, so if you want to *remember* what you now *understand*, you must practice, that is review a number of times, or use the new knowledge repeatedly to solve problems or answer questions. Remember the rule about new knowledge—use it or lose it.

### So, what do I have to do?

All of this talk about brains, information, and knowledge is not just abstract theory. It *is* the way we learn. The way to learn, then, is to align your own activities with those behaviors we already know will work.

#### ***Time***

Time is nothing at all like the way we talk about it. How often do you hear someone say that they "didn't have time?" It's a perfectly meaningless expression. When you wake up on a Sunday morning, you have exactly 168 hours of time until the following Sunday morning. And everybody on the planet gets 168 hours. *No one ever has any more or any less time than anyone else!* Time cannot be "found," nor "stretched," nor "compressed," nor "lost." It cannot be "saved" or "bought," or in any other way "managed" for any realistic meaning of the word "manage." So why do we use all these meaningless expressions? It's because they let us avoid the embarrassing

process of examining our priorities, a ranked list of those things we hold to be important. Sleeping is a high priority for everyone—it’s a biological necessity, like food—so we all spend a fair amount of our allotted time blissfully unconscious. Now, what about the rest of our 168 hours? For someone who has to work part time to meet expenses, work is a high priority activity and they show up on schedule and on time because losing the job would mean losing the income and the consequences would be serious. So, after sleeping, eating, working, and, one hopes, going to classes, the rest of our 168 hours are spent doing whatever we find personally important. For some, doing assignments, reading books, writing reports and the like are important, so they always get done. For some others, TV, “hanging out,” the internet, and partying are of primary importance, and sometimes they fill up so many of the 168 hours available that there is nothing left at the end of the week. Remember, no one gets more than 168 hours, so anyone who thinks they can “do it all” is *always* going to “run out of time.”

It’s your priorities and not the clock that will determine the outcome of your college experience. If it’s really important, it will always get done, and always at the expense of the less important.

## **Studying**

You and your teachers will use the word “study” frequently, and always assuming that it means the same thing to everyone. But it doesn’t. For way too many college students, particularly in the first year, study never happens until just before a test. Teachers are amazed at the idea, but many students simply see no reason to study if there is no test on the horizon. So here in a nutshell is a most serious misunderstanding between college teachers and beginning students. For teachers, the purpose of study is to understand and remember the course content; for students the purpose of study is to pass the tests.

Now in an ideal world these would amount to the same thing. But in the real world, unfortunately, you can pass some tests without learning much at all. This is not the place for me to beat up on my colleagues, but some do produce truly simple-minded exams that do not require much by way of preparation. So here’s an absolutely *heroic* idea if you find yourself bored with a class; try learning more than the teacher demands. Wake up your childhood curiosity and ask why other people find this discipline so interesting that they spend their lives at it. I can about guarantee that there are bright, articulate, and interesting writers in every college discipline. Find a good book and read. That way you’ll learn something even if the teacher doesn’t demand it.

But such “gut” courses might be rare in your college. The one’s that cause trouble and hurt the grade point average are those where the teacher expects serious learning, but leaves most of it up to you. How do you cope with that?

## Tough Courses

What makes a course tough? Well, sometimes it only means large amounts of material, many pages to read, lots of writing assignments, and the like. But the really tough course is one where the subject itself is complex, or presents difficult problems for the learner to deal with, and often goes faster than students would find comfortable. Suppose we add to that a super-smart teacher, but one who simply assumes you know how to learn, and sprays information like a fire hose. For a typical first year student this is the famous “worst case scenario.” The whole purpose of my writing is to help you cope with worst case scenarios.

## During the Lecture

In these tough courses the first idea you must abandon is that you can sit, “take” notes, and worry about it later. Here’s another key idea to bring with you to every lecture period. *Worry about it **now**.*

You can look upon your teacher as an adversary, something that stands between you and a diploma, but that’s a defeatist and erroneous idea. It’s better to think of the instructor as your private tutor. Most teachers welcome a considered question on the content. They nearly all resent questions like, “is this going to be on the test?” You don’t do yourself any favors by giving your teachers the impression that you’re a lazy goof off trying to slide by with minimal effort. Teachers can often pack a wealth of important information in what just sounds like an interesting story. They do not seem to be “giving notes.” It’s a serious mistake to get comfortable and daydream. When notes are not “given,” then you have to make them, and that’s anything but relaxing. It takes careful listening, concentration, and a focused mind to pick out the important nuggets from what appears to be a non-stop verbal ramble. A casual remark like, “there are several reasons we believe these things happen,” is a clear clue that something worth knowing is coming. As noted, some teachers may pass out notes that they have made, and these might contain an outline of what’s important. A fair number of college faculty have learned that this only encourages passivity and cutting classes. (It’s quite easy to get the notes from someone else, and if it’s only the notes that are important, why spend time sitting in a classroom?) Some teachers have discovered that students can only be prodded to serious mental activity if they *don’t* provide prepared notes. This might seem mean spirited to you, but they’re just trying to activate your brain.

Under conditions described above, you, to make notes from which you can learn, have to be attuned to what’s being said. Not every sentence that drops from an instructor’s mouth is going to contain some pearl of wisdom. Much of it is “filler”—rephrasing, giving examples, preparatory remarks for the next point and so on. You have to learn quickly where the gems are. Sentences you hear stay in the short term, immediate recall part of your brain for only a couple seconds. During that brief time you have to make the decision as to whether you’ve heard something important or just filler. If it was important you have to get the gist into your notes, even if that means not being

quite so attentive so far as listening goes. Once it's down, refocus and wait for the next useful idea.

In short, teachers who do not “make it easy” by doing all the work, are, in fact, doing you a favor. What is often called “deep learning,” the kind that demands both understanding and remembering of relationships, causes, effects and implications for new or different situations simply *cannot be made easy*. Such learning depends on students actually *restructuring* their brains and that demands effort. Such learning can, however, be most satisfying and enjoyable, even as it demands effort. I always think of serious learning of any academic subject as being something like practice for a sport or with a musical instrument. No one is born with a genetic endowment for playing either the trombone or ice hockey. These are both *developed* skills and both take long periods of concentration and effort. Both are simply difficult, but how satisfying they are as small elements are learned and burned into our brain circuits! How enjoyable to become proficient! It's exactly the same with academic matters. Give it a try.

### **About Interests**

An obvious response to the thoughts just expressed might be, “but I like hockey, I have no interest in history,” or chemistry—whatever. That may well be true, but what *is not true* is the assumption that these interests are natural—something you came into the world with. Here's another strange but important truth; *all of your interests had to be learned!* This is a small example of a paradox. You need to *know something* about a musical instrument, or a sport, or indeed, an academic subject, *before* you can judge whether or not it's interesting. But if you hold the belief that you cannot learn anything *until* or *unless* it's interesting, then you can never get started on anything new.

I was always impressed with my senior biology majors who came to my office and got around to talking about their courses in psychology, or philosophy, or art history. These students gave every discipline a chance to prove itself. Instead of depending on a teacher to “make it interesting,” they studied it on their own to discover why other folk found it interesting enough to write books about it, and teach it in college. You would do yourself a great favor by developing this “curiosity habit” as early on as you can.

### **Between Classes**

When a teacher happens not to assign some specific work to be done for the next period, a disturbing number of beginning students simply assume that means that nothing at all needs to be done. And it so happens that a lot of college instructors *do not* assign each time some reading, or writing, or problem solving to be done. And if you had an orientation session, someone probably told you that “they” expected you to spend three hours on each of your subjects, *for each hour in class!* That usually comes to an amazing 45 hours a week. Most students find that unreasonable and unnecessary, and I tend to agree. But the proper response to an excessive demand is not to do *nothing*. A huge number of new college students, when told to *study* but given nothing specific to do, simply do nothing. So here are some realistic suggestions for study outside class time.

## Fill in the Notes

As noted above, it's essential during a lecture to produce some record, no matter how sketchy, of what was presented during that period. A most useful and highly recommended way so spend half an hour or so of study time is to make sense of these notes, and most importantly, turn lists and key words into real sentences that rephrase what went on. When memory fails, that's the time to use resources. Sometimes your best resource is the textbook. Even if no pages were assigned directly, there is a very high probability that the text contains, somewhere, a good, or better, description of what the teacher had presented. You may have to search for it, but tables of contents, chapter headings and the index will lead you to what you need.

Now, read with the intent of re-discovering what was presented in class. Read with understanding as the goal (this will *feel* different than reading because it was assigned.) People who know the education process thoroughly say that *most* learning in college goes on outside the classroom. So it is that you will know *more* about the day's material after this "filling in" process than when you first heard it.

But there is a further critical element here. You must *write* in your notes, in real sentences, what you have learned by the reading. Writing has an enormous power to *fix* things in the mind. *Always* write what you have learned. (Once in a while a short paragraph that summarizes or paraphrases an important aspect becomes exactly what you need on an exam. You will almost certainly remember it because you've already written it before.) There are two other good resources for filling in the notes should the textbook be insufficient. These are your classmates and the teacher (or tutor if one is available.)

Huge studies have been done to find out just what "works" for college students. What, in other words, did the truly successful students actually *do* that the unsuccessful ones did not? The first of the two most outstanding findings was that successful students had gotten "connected" to those of their teachers who were open to talking with students (and there are a lot of these.) The intent was not merely social. The point was to become more familiar with course content by simply discussing it with an expert. Remember, the successful students said that this was the *most important* thing they did to be successful. So you don't have to wonder about it; the experiment's already been done.

The second most important activity for success was to form small study groups, or pairs, with the express purpose of talking about the course content, their notes, and assigned work. Working together on assignments and problems is not cheating. Copying without learning is cheating. Discussing the details of an assignment or problem is just cooperative learning—one of the most useful habits you can develop in college. (I'm perfectly aware, by the way, that getting some guys together to discuss psychology sounds like a pretty "nerdy" thing to do. Well, so what? Really smart college students have no problem stealing a page from the "Nerd's Handbook" if it means learning more and doing better.)

## Assignments

Here again, attitude will influence how you react to assigned work. To view it as paying dues, or taxes, or as mere busywork that teachers insist on out of habit, is to squander an excellent learning opportunity. Inexperienced students see assignments as something to be *done*; experienced students see them as something to be *used*. Look on every assignment as a clue from the teacher—what he or she considers important enough to spend time learning. Assignments, in most cases, are solid, meaty chunks of what’s important. Don’t just *do* assignments with minimal effort and thought, *use* them to learn something new.

### *Thoughts on verbalization*

Here’s another experiment that’s already been done and you won’t have to repeat. Things do not go into memory as a result of thinking about them vaguely—in the abstract. It has been well documented that *thought*, to be useful, must be *verbal*. Now all that means is that, to be remembered, and so useful, your thought on a topic needs to be either spoken, aloud, to another person, or written on paper. (Recall the earlier idea that information can only *move* by means of symbols, words spoken, signed, or written.) In either case, good English sentences are needed—not just word clusters. You need *verbs*. Who did what to whom? How does this thing cause that thing to happen? These facts support the suggested need to talk to teachers and classmates and *use* writing assignments to say what’s true or useful. And here’s a bonus! If you have filled in your notes and discussed a topic with a classmate, even if it only took 30 minutes, you will be *prepared* for the next class. That means you will have something to say should there be a “pop quiz,” or if the teacher starts asking questions. Or, just as well, you can start the class by asking a well-prepared question on the last period’s material. Trust me—the teacher will notice, and remember, favorably.

## Access and high technology

There have been some noisy claims that today’s students will turn out to be the best educated so far, *because* they have access (by way of the internet) to unimaginably more information than any previous generation. I have reservations about this claim for several reasons. For one thing, the internet has been with us for quite some time, and those of us who teach college are still looking for the promised improvement. Results should have showed up by now.

The principal reason, however, goes back to the fundamental difference between *information* and *knowledge*. Knowledge is what has the potential for improving the individual and society. But websites are completely devoid of knowledge; all they have is information (and not all of that is reliable!) No matter how many websites you have access to, none of them can do anything for *you* unless you can make sense of (and evaluate) what you find there.

And here is another little paradox I discovered by observing the differences between accomplished college seniors and most first year students. Instead of getting

knowledge from the internet, *you need to have a lot of knowledge beforehand* to make sense of the ocean of information you find there.

It's tempting to believe that access to more information is going to make college easy. But it's just a temptation. You fall for it at your peril. The internet is a tool, and a very useful one, but as with all tools, you have to be knowledgeable to use it profitably.

## Exams

I have intentionally put last what most new college students consider to be the single most important aspect of college—tests and exams. My reason for this approach is simple. If you attend class regularly, listen with attention, make the best notes you can, fill them in later (preferably with a study partner or two), verbalize your thoughts, and use assignments as learning tools, then you would be ready for a test at any time. Learn as you go means you're always prepared.

That is, of course, a bit overstated. In the real world, a “big test” in the offing makes even the best student nervous, and everyone bears down to some degree to get prepared. For someone who has done it all wrong, whose notes are just words copied without context or explanation, who does nothing between classes, and who never discusses coursework with anyone, and who *does* assignments thoughtlessly—just to have something to pass in—an upcoming exam is justifiably terrifying. It's these students who do everything wrong who ask embarrassing questions like, “What's this test going to cover?” or, “What chapters should we study?” They're clueless and they know it.

But let's assume you've done all the right things. You still want to do the best you can, and that means review, because stuff tends to slip out of memory, particularly when you have three or four other classes to attend to. But I mean “review” literally. It means learn again, not learn for the first time. No one can “learn” the content of 15 or 20 lectures in two days. Unless it's all completely trivial, that just can't be done. Learning a second time (real review), on the other hand, is a snap compared to learning from scratch. So, review for an exam *should not be stressful*. If you're in a state of panic because of an exam it's because you've been doing the wrong things all along.

But you're smart. You've done the right things. How do you do the review?  
***Don't go it alone***

If you've done the right things you already have a study partner or two. Schedule firm times and places to spend an hour or so reviewing. Estimate how many days it will take to review all the material and get an early start. Don't worry about reviewing too far in advance of the exam! If you *talk* about the content and *write* summary paragraphs or descriptions, make labeled diagrams, or solve problems on paper, you won't forget—it's guaranteed. Remember, stealing a “nerd trick” will make you a better student.

### ***Get Satan behind thee***

The absolute worst thing you can do is to fall for the crazy notion that the way to prepare for an exam is to compress it all in the last 12 to 18 hours before the test, and

keep it up right to the very last minute. I could always predict with great accuracy who was going to do poorly on an exam. They were red-eyed, gulping coffee to stay awake, and frantically flipping pages even as the test papers were being distributed. They had done it all wrong.

“Pulling an all-nighter,” as the cute expression has it, is based on the completely erroneous belief that the only thing that college work requires is short term memory. Were that true, “last minute” study would make at least some sense. But the truth is, most college work demands thinking about, and using, a storehouse of information firmly lodged in long term memory. “All-nighter” students can usually recall a lot of terms and certain “facts,” but can’t do anything with them.

Remember, your thinking and remembering are functions of your brain, and that’s a biological organ, and significantly, it’s one with limited endurance. In short, it becomes less efficient the longer you put demands on it without rest. Trying to study 12 hours without sleep has the same effect on your brain as trying to play basketball for 12 straight hours would have on the rest of your body.

So, a final rule: “Always get a night of restful sleep the night before an exam.” Some students are afraid of this rule. They are afraid that sleep will somehow wipe out all they’ve been studying. But it doesn’t! It’s another of those things that have been researched and the results are consistent. There is, in fact, a small but significant *increase* in the ability to recall or reconstruct when learning is followed by sleep. So if you want your brain in tip-top condition for an exam (and who wouldn’t?) do your reviewing in one or two hour periods spread out over several days, and get a real night’s sleep before the exam.

#### ***During the exam***

I’ve heard students, going into an exam, say, “I’ve done my part; it’s out of my hands now.” That idea betrays the erroneous notion that all the hard work is done in advance, and during the exam you just pour out what you’ve learned. Well, sometimes. But exams in the tough courses often shock beginning students because they can’t find much that looks familiar. There’s a reason, and a solution.

Demanding teachers prepare exams that require performance, where performance is much more than recall. A lot of college instructors produce what might be called “application questions” for their exams. All that means is that you can’t just *write* what you know, you have to *use* what you know to answer a question or solve a problem that you haven’t seen before. Only a malicious teacher would question students on material that had never been discussed, assigned, or included in required reading. It seldom happens. So when seeing something that looks unfamiliar, convince yourself that it’s only a question that is asking you to *apply* something you already know. So it is that concentration and focused thinking are often just as necessary *during* an exam as before it. If you have learned well, and reviewed properly, you can be confident that you have the necessary knowledge. It just takes some hard thinking to see how it applies to a particular question.

## A Summary

No one learns unless they want to. I have assumed here that you do. But learning is a biological process that relies on the brain, a physiological organ that demands the same maintenance the rest of you does. Don't abuse it. The best ways to learn have already been discovered, there's no need for you to rediscover them by making a lot of old mistakes all over again. So it is that what you read here might be disappointing. Instead of new tricks or clever ways to beat the system, it says learning is the only way, and that learning is difficult and requires effort. But we do know how to do it, and when it's done right, it is marvelously satisfying.

I wish all readers of these pages the best of luck in their college days. But as I do so, I'm reminded of the words of the biologist Pasteur who said, "Chance favors the prepared mind."

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Dartmouth MA Dec. 2002

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