BEING SMART
IS NOT ENOUGH

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CHAUTAUQUAS FOR
FIRST YEAR ENGINEERING STUDENTS

by
David L. DiLaura

These notes were written by David L. DiLaura of the
Civil, Environmental and Architectural Engineering Department of
The College of Engineering and Applied Science in
The University of Colorado at Boulder.

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TABLE OF CONTENTS

INTRODUCTION
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You have decided to set a direction for your life, to study engineering. It will be tremendously rewarding; it will also be difficult. Beyond being smart, success at this study requires commitment to academic activity, sturdy self-reliance, organization, and new self-knowledge. This is especially true in your first year. The purpose of these notes is to offer you advice; and the advice is meant to help you succeed in your first year of engineering.

My purpose is accomplished only if you read these notes; and you're more likely to read them if you to know *why* I wrote them. Who am I, after all? And why should you pay any attention to advice from me? I have taught and worked with engineering students for 25 years. For the last seven of these years I have paid close attention to the successes and failures of first year students. I don't mean successes and failures in the abstract. I mean *individuals* succeeding or failing in their first year of engineering. You need to know *how* individuals failed or succeeded in their first year in engineering—that's why I have written these notes.

What did failure mean? It meant individuals, still wanting to be engineers, who hadn't learned the basics of engineering very well. So they got very low grades; barely passing. They found it hard to understand the more advanced material studied later and had a difficult time raising their grade point average in subsequent years. Even worse, some were not allowed to return. They flunked out after their first year. How did it happen? It was *almost never true* that these first year students weren't smart enough. It was always something else. Something that could have been fixed or changed or acquired or abandoned or moved just enough to make the difference. Evidently, being smart was not enough.

What did success mean? It meant individuals learning the basics of engineering and getting good grades. They didn't find it easy, but they did find it *possible*, even inevitable. I observed these students to be actively engaged in their education. They understood that they were beginning a new stage in life, and leaned into (as it were) the difficulties of stepping from high school to college. They took responsibility for their learning in their first year of engineering education. Being smart was not enough.

Observing those successful students, talking with them, and thinking about them and what they did, makes me certain I've seen the things that must accompany smartness. These notes come from thinking about these things and working out how to explain them. They also come from my conviction that what those students did, *you* can do. But, as Mark Twain said, there are few things in life more irritating than a good example. So I know it isn't enough to point out the "good students." You are already eager to duplicate their performance—simply pointing to it doesn't help. You will ask, "I know *what* they did, but how the hell did they *do* it?" So I offer advice.

I understand that giving advice is a risky business, especially when I need to reach across a generation and, in some cases, a gender. There are few things as easy and gratifying to a mature adult as unhinging the jaw or loosing the pen and "giving advice"—self-important, ill-considered, and vague—delivered in senile rapture to a captive and sullen group of the young. That's what *I* remember thinking anyway, when *I* got advice. And though you might have a similar thought in your head at this moment, it's advice that I offer.

As a beginning college student you've gotten a mountain of advice. I wager that most of it was rubbish: vague and unhelpful. Well meaning, certainly, but rubbish all the same. Let me guess: "Be all you can

be!", "Reach for your dream!", "Study smarter", "Use your full potential." What does any of this *mean*, anyway? I don't know, you don't either.

Is this stuff helpful? No, it pelts you with a slogan; an inspirational lazy shorthand. It's cheer leading. "ALL THE WAY DOWN THE FIELD, GO!" Yes, yes, we need to go down the field, "but how the hell do you *do* that?" Cheerleading may help the crowd enjoy the game, and athletes report that they get a lift from it, but it doesn't help them *win* the game. It encourages, but doesn't give you a *method*. We even cheer *ourselves* on: "Gees, I've *got* to study this stuff harder", "I've *got* to get organized", "Damn! I've *got* to start these assignments sooner." You are very likely to mutter such things to yourself early in your first semester. But this too is rubbish, unhelpful rubbish.

Cheering will not help you be a successful student; good coaching might. Good advice is good coaching: but only if it's particular, long-considered, narrowly to the point, shows *how* something is done, and comes from experience. I have written these notes to be so. They are also spare and blunt. If they impress you as negative, remember my purpose is narrow: to *help* you, not to make you feel good. Perhaps "help you" sounds suspiciously like "good for you", provoking a memory of dinnertime urging to eat your Brussels sprouts. But just making you feel good doesn't give you the tools I think you need to have a successful first year. You can probably use the advice of a coach. That's why I wrote these notes.

You'll find no pictures, no cute clipart, no popular characters from the comics pages. Just words and a few graphs. I hope you'll read carefully.

The form of coaching I use is a chautauqua. In 1874 J. Vincent, a Methodist bishop, and L. Miller, Thomas Edison's father-in-law, formed a summer "assembly" for teachers. Held on Lake Chautauqua's shore in upstate New York, it was educational, inspirational, recreational, and an immediate success. Famous teachers, travelers, orators, and public figures lectured on topics helpful and interesting to teachers. Other camps in other places were established,[(0)] and they were all called Chautauquas. Traveling Chautauquas also appeared, moving from town to town, bringing orators and public figures to the people who couldn't travel to the permanent Chautauquas. And so, the name gradually came to mean not only the place, but also the extended series of lectures themselves.

A Chautauqua, then, is an oration, [(1)] a demonstration, a performance, or a lecture, delivered to a large audience. The orations are often informal and usually practical—instruction in a *process* rather than a theory. They are simply *presented*, hoping the audience derives some benefit. But there is no special effort to assure that that happens. Benefit is up to the listener. And that is the case here, so I call these small presentations chautauquas.

I wrote these chautauquas for you as a first year student; next year you will need different advice. I have abused *Italics*; they help give sentences the dynamics of speech. I have used a two-dollar word only when a 25-cent one wouldn't quite work. In that case I offer a definition, since I assume it isn't your habit to bring a dictionary to a chautauqua. I have assumed you're motivated to become an engineer, or at least seriously considering it; and so offer no attempt to attract you to this profession. I have assumed you're not so hurried or so jaded [(2)] that you can't consider carefully what you read here. But rather, I assume that you can find bits and pieces that are helpful, even if the rest doesn't apply or isn't attractive. And finally, I have decided to risk lingering over what you may consider to be obvious, and so risk being a scold.[(3)] I do this because I know the stakes in this enterprise of yours are very large.

Stripped of ornament, these chautauquas are about

setting goals that have the right size and order,
recognizing and acquiring the skills you need to achieve these goals, and

knowing and directing yourself so you can use these skills.

I have several reasons for making these three activities chautauqua topics. I have *explicitly* linked them to student success. I have seen their power and observed how common they are in the lives of successful first year students. I have also observed the mischief caused by their *absence*. They are not just helpful, they are *necessary* for success, they are elemental. And, finally, these three activities are rather "mechanical;" they are performed by following a series of steps—a recipe, if you will. So they are activities within your reach, things that *any* first year student can do. But please don't confuse mechanical with easy.

So being smart is not enough; you need to engage in these three activities: setting goals, acquiring skills, directing yourself. To do that requires understanding, courage and discipline. These chautauquas can help bring about understanding. Courage and discipline *you* must provide: they are the most important components. Let me emphasize that these three activities are *usually not* things first year engineering students are doing when they start college. Successful first year engineering students *eventually* engage in them—but it takes a while.

You are tempted to dismiss these things as well understood; disappointed or annoyed about so much being made of the ordinary. Perhaps you expect "secrets." But the ordinariness of goals, skills, and self-knowledge is the reason for their power. Consider ordinary breathing; everybody does it. Yet any singer, horn player or runner will tell you that breathing must be studied, thought about, and practiced. For these people, simple breathing must become breath control, an integral part of their art. And so it is with goals, skills, and self-knowledge: you must study them. If there is any secret, it is to fathom [(5)] the power that comes from studying these things, making them extraordinary, making them an integral part of your art. It is "art" because your education is a creative act.

Summary

Summaries are interesting. They are suppose to be a useful condensation; "putting things in a nutshell" as the figure of speech has it. A summary can be a powerful test of clarity. If a few sentences can summarize a long harangue,[(7)] and if these sentences sustain careful thought and scrutiny, then things are clear. If the sentences aren't supportable, then either you're being woolly-headed or your author writes rubbish. I will indicate such summaries in the text with the symbol Σ. This is the Greek letter sigma, equivalent to our 'S', and the universal mathematical symbol for summation.

> Σ It is possible to *explicitly* link three activities to first year student success: setting right-ordered and right-sized goals, recognizing and acquiring needed skills, self-knowing and self-directing. These appear to be not just helpful, but necessary. In addition, they are straightforward to perform, within the reach of all. Though not common in *beginning* students, with understanding, courage and discipline, these activities come to characterize successful first year students. Therefore, goals, skills and self-knowledge are the subject of these chautauquas.

A CHAUTAUQUA ON GOALS
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SETTING GOALS IN THE RIGHT ORDER AND WITH THE RIGHT SIZE

Introduction

You are about to change—coming to college does that. Two of the forces that will shape this change are your behavior and the passage of time. By “change” I mean a modification of the person you are—your character. "Your behavior" is useful shorthand for what you give attention to, how you invest your resources, and what you do. So although it’s true that time passes and you change, it is more accurate to say this: *how you behave determines the person you become*. This chautauqua describes how to be *active* in this process of becoming.

Not all aspects of your character are a result of your behavior. This chautauqua deals only with some aspects that *are*. So I omit a consideration of the secret gamble of chromosomes from which you get your eye color, your predispositions, and the physical traits that partly define you. About these you can do nothing. I also pass over those things that come into your life unbidden and unexpected. You, like anyone, are subject to Fortune's blast or blessing. But these things are usually small and usually rare. So this usually true: *how you behave determines the person you become*.

So what determines how you behave? Goals do. The goals you have are your end-points, defining the things you want. They *always* determine how you behave. Always. Recognized or not, evident or not, good or not; goals determine how you behave. And so, subject to outside forces, the goals you have determine the person you become. **You are your own project**.

A few goals are *imposed*, not chosen. These are usually biological, as with the goal to eat and the goal to reproduce. These, and a few other important goals, are "wired in"; they are there to keep you and our species alive. *All your other goals are chosen*; you either set them or adopt them. The difference between setting and adopting goals is important enough to warrant a mild exaggeration in their description.

Setting a goal is a clear and thoughtful *action*, a willing directive of behavior. This implies the consideration and rejection of *other* goals and the commitment to strive and attain the goal that is set. Adopting a goal is a *passive* occurrence: a goal acquired without much reflection, seeping in (as it were) from the circumstances, influences, and forces that surround and act on you. The default condition is adopted goals, and without thought and intervention on your part, adopted goals direct your behavior.

Perhaps you think that only a modest fraction of what you do is anything so mechanical as goal driven; most of what you do seems too spontaneous, accidental, or "natural" to be classified this way. Such a thought only means you don't recognize the goal, or have so long ago forgotten it that its influence is now unrecognized, misunderstood, even denied. Some behaviors become repetitive, almost automatic. You are no longer conscious of the goals that initiated them. That is, you have habits.

Setting goals for first-year engineering

Not all goals *need* to be set. But as you start the study of engineering, some *must* be. What you need and want to accomplish in your first year in engineering requires that you behave in new ways. This requires new goals. This chautauqua deals with new goals and new behavior. Some new goals may

seem foreign, “unnatural”, or inappropriate. This often simply means that they do not arise by default and are not customary for you. Please don't confuse *new* with *inappropriate*.

As with many young people, you have many goals that are simply *adopted*; some good, some bad. Bad goals have initiated *behavior that now works directly against success* in your first year of engineering. And some of this behavior is habit. You need to identify this behavior and change it. This takes some careful thought since circumstance usually has its way with you very quietly. The chautauqua on knowing yourself says more about recognizing old goals and behavior, and changing them if they work against your success.

Of the goals you recognize as yours, it is revealing to determine which have been set and which have been adopted. It is even more revealing to pick a few seemingly spontaneous or "natural" activities and to try to identify the goals they help you achieve. Partying on Thursday night is an activity with goals that are easy to identify. But watching television instead of working on an assignment is more difficult to understand. What possible goal is served by dodging homework and watching the tube? There is at least one, and by this chautauqua's end you should recognize it.

That you understand, recognize, and use the relationship between goals and behavior *doesn't* mean you believe you're a robot or machine. You’re not. It *does* mean you recognize the place and power of choice and that you are dependent on it. You are.

These chautauquas are about your intellectual life during first-year engineering. And so, within the range of goals that determine the person you become, this chautauqua focuses on setting goals that affect your intellectual growth and determine the intellectual person you become. You are tempted to think that you needn’t set goals since The College of Engineering has done that for you: you have a curriculum to follow, courses to take, grades to acquire. The appropriate things will simply “happen to you.” This is only weakly true. These goals are large and abstract; they lack value to you because the *you* is missing. A goal to simply “take the courses” is far too passive and vague. Here, and elsewhere in these chautauquas, I advise you to be *active*. Do not float and drift in the water like a cork, *paddle* in a direction of your choosing.

> S Within the limits of fate and genetics, time and behavior determine the type of person you become. And how you behave is *always* determined by the goals you have. Now some few of your goals are imposed, as by biology; but most are either set actively or adopted passively. Like most young people, most of your goals are adopted. But now you need to exercise the power of choice and actively *set* goals.

Setting goals with the right scope

It turns out that just “setting goals” isn’t always enough. If the goal is too grand, has too large a sweep, is too far away, it is surprisingly *ineffective*; however important it is. It has a weak influence on how you behave because it’s not clear what you should do to achieve it. Very large goals, unsupported by detail, have a scope so large that they are little more than slogans. And, as we agreed, we’ve sworn off slogans. So—curious to say—a goal can be very important and yet ineffective.

So you need to break a large goal into the smaller goals that comprise it. That is, find its component-goals. These, in turn, may be too large to help you, and so *their* component-goals need to be determined. When do the component-goals finally have the right scope? When do you stop? A good test is whether they are more like a recipe than a slogan. Loftiness transforms to grittiness as small goals with the right scope are broken out of big goals. These are much more potent in directing your activities than the large goal. Component-goals are small enough when they *directly* affect the way you spend a *week*. A week is a good span of time to work with. This helps you track your progress, and, if necessary, helps you understand exactly how you missed a goal.

This goal-defining process blends into or becomes weekly planning. That is, eventually *goals become what you write in your calendar or planning book*, they become small or short-term objectives. Notice too, that the *order* in which goals need to be accomplished becomes apparent. You can see that achieving the small goals *is* achieving the large goal. This is how large and important goals are accomplished. *There is no other way*.

I cannot overstate the importance of the *explicit* linking of daily and weekly activities to the large goals in your life. That the link exists is unquestionable; how you behave determines the person you become. If you *know* that your days and your goals are linked, you are more likely to control your days. It will be easier to get the small things done because you will *know* you are getting the large things done. An adage [8] of Benjamin Franklin applies: "Take care of the pennies and the dollars will take care of themselves." We could say: "take care of the days and the semesters will take care of themselves."

An example of setting goals

By way of example, let's find the component-goals of a large, long-term goal you already have: BECOME AN ENGINEER. These component-goals will define appropriate activities for having a successful first year in engineering. As component goals are determined, let's write them down so that hierarchy and order are clear. We'll use indenting to show this; the components of a goal will be written underneath it and indented, like an outline. The smaller the goal, the more it is indented. Let's call this structure a goal map.

This example will also show how the process is applied to other goals. Please follow the details. I hope not only to show you how goals are transformed into planning, but at the same time introduce the three most important goals for first-year academic success:

LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU'RE DOING
BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER

To start at the beginning, we can say that being an engineer means *doing* engineering. That means having an engineering job. To get a good engineering job you need a degree in engineering. So we start with a goal map like this:

BECOME AN ENGINEER
    GET A GOOD FIRST ENGINEERING JOB
        OBTAIN AN ENGINEERING DEGREE

Perhaps your plans are broader. Perhaps your music talent requires attention, or you see a blend of engineering and business in your future, or you want to deepen your spiritual life, or you see a career in one of the armed forces. Then you might have one of these goal maps.

BECOME AN ENGINEER
    GET A GOOD FIRST ENGINEERING JOB
        OBTAIN AN ENGINEERING DEGREE
        OBTAIN A MUSIC MINOR

BECOME AN ENGINEER
    GET A GOOD FIRST ENGINEERING JOB
        OBTAIN AN ENGINEERING DEGREE
        OBTAIN A BUSINESS MINOR

BECOME AN ENGINEER
    GET A GOOD FIRST ENGINEERING JOB
        OBTAIN AN ENGINEERING DEGREE
        WORK IN A CAMPUS MINISTRY

BECOME AN ENGINEER
    GET A GOOD FIRST ENGINEERING JOB
        OBTAIN AN ENGINEERING DEGREE
        BE COMMISSIONED IN THE NAVY

These other goals are shown on the same level as OBTAIN AN ENGINEERING DEGREE Presumably they are equally important and you want to achieve them at the same time as you get your degree in engineering. Are there other important goals you want to achieve during this time? Likely. One of the things I suggest you do at the end of this chautauqua is to add them.

But these goals are still too remote. Picture OBTAIN AN ENGINEERING DEGREE written in your planning calendar at the beginning of each of the 128 weeks you'll spend earning your degree. It's hardly helpful. Let's continue the component-goal process, focusing on obtaining a degree in engineering. What is done with this goal, you will need to do with the others; the process is the same. Though not complicated, this goal defining can take some thought. Let's take the goal OBTAIN AN ENGINEERING DEGREE and establish its component goals. The first step in obtaining an engineering degree is doing well in your first year. So this part of the goal map becomes:

BECOME AN ENGINEER
GET A GOOD FIRST ENGINEERING JOB
OBTAIN AN ENGINEERING DEGREE
SUCCEED IN THE FIRST YEAR IN THE COLLEGE OF ENGINEERING

This makes sense. Although there will be many goals between succeeding in your first year and getting your engineering degree, doing well you first year is essential and immediate. But it's still too lofty, too large. You can't take something like "succeed in the first year" and have it affect the way you spend a *week*. You need to make it more specific, find its components.

You must admit that it's easy to see that from SUCCEED IN THE FIRST YEAR IN THE COLLEGE OF ENGINEERING is a component goal of OBTAIN AN ENGINEERING DEGREE. But as you continue to work down to smaller component-goals it gets more difficult to get them right. Determining the component-goals of SUCCEED IN THE FIRST YEAR IN THE COLLEGE OF ENGINEERING requires giving "succeed" a practical definition. This requires some careful thought. I believe that three of the component-goals of success in your first year are these: learn engineering basics, develop confidence and commitment, and acquire good habits. There are other component-goals, equally important, but I believe these three define the academic part of "succeed."

So your goal map becomes:

BECOME AN ENGINEER
GET A GOOD FIRST ENGINEERING JOB
OBTAIN AN ENGINEERING DEGREE
SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING
LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU'RE DOING
BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER

Notice that the three component goals we've added are on the same level; they are equally important. But are these three component-goals small enough? Not yet. SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING sounds like a slogan, but LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES is a little better; it has more grit. But this, too, needs to be broken down into component-goals. While doing that, it's important to take care with the words; they must accurately reflect and guide thinking. For example, the first component-goal is LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES The "so" makes it clear that good grades *result from* learning engineering basics.

I want to discuss engineering basics, certainty and confidence, and good habits in enough detail to make it clear where these goals come from, and how you apply the same care and reasoning to find *their* component-goals.

> S You set or adopt goals. Adopted goals seep in from the circumstances around you, set goals result from thoughtful acts of choice. To be successful in your first year you need to set goals, some new to you. Set goals are often too big, and so you need to find the component-goals that make them up. This process is continued until component-goals have sizes that you can use to help plan a week's time. An initial application of this process gives three immediate goals for first year success: learn the basics, become more confident and acquire the habits of an engineer. Each of these needs to be divided into finer goals.

First goal of first-year success: LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES

The most immediate academic requirement for a successful first year is learning engineering basics. This gives you the background required for more advanced courses, the confidence required to continue studying, and the grades to show that you *have* mastered the material.

You may think that the goal to SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING has the component-goal GET GOOD GRADES. No—grades, good or bad, *result* from understanding the course material. More specifically, good grades come from:

- having a good understanding of the material presented in your courses, and
- making it clear to your instructor that you have such an understanding.

Think about the second one. You must realize that even if you *really do* understand the material in a course, but are unable to give evidence of that to your instructor, you get a low grade. Your instructor (and the rest of the world) is unable to tell the difference between ignorance and the inability to give evidence of knowledge. You must know the material presented in your courses well enough to *show* that you do. So beware when you hear yourself say: "I know this stuff."

The College of Engineering provides you with the component-goals of learning engineering basics. You are asked to trust us, the faculty, to define "engineering basics" for you: Calculus, Chemistry, Physics and Computing. To avoid repetition, only that part of your goal map we're working on is shown and it looks like this:

SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING
LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
UNDERSTAND THE MATERIAL IN THE BASIC COURSES

Clearly the first step to UNDERSTAND THE MATERIAL IN THE BASIC COURSES is a good initial encounter with the material. This is usually during a lecture in a classroom, with an instructor who uses various verbal and graphic methods to introduce and explain. I include here the recitations that accompany courses that are forced to have very large lecture sections because of student enrollments. Sometimes this encounter will be in a laboratory or on a field trip or a venue [(9)] other than a classroom. During this encounter you need to think, take notes and ask questions.

It is your very great temptation, perhaps even your current custom, to attend class in an entirely passive way. Perhaps you hold that your goal is to be a scribe, writing in your notebook everything said or written by the instructor. Or that you need only be there ready to write: to class on time, notebook and pencil available, alert but empty-headed; other preparation being unnecessary. And

perhaps you believe that all your learning should take place during the lecture; that you should have understanding on the spot.

These notions about *passive* attendance are mistaken. Note taking without thinking and without questions is insufficient. Class notes should result from active listening. Preparation is powerful help in understanding lectures, and studying the appropriate section of the textbook beforehand makes that lecture considerably more potent for you. And lectures do *not* usually produce on-the-spot understanding. Most learning must take place outside the lecture, during study sessions with your notes and your textbook.

There is material in other chautauquas about study, lectures, and note taking. For the time being let's agree to use ATTEND CLASSES ACTIVELY as shorthand for your goal during this initial encounter. This is the first component-goal of UNDERSTAND THE MATERIAL IN THE BASIC COURSES. And *its* component-goals are class preparation, active listening, and clear notes. Your goal map now might look like this.

SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING
LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
UNDERSTAND THE MATERIAL IN THE BASIC COURSES
ATTEND CLASSES ACTIVELY
BE PREPARED FOR CLASS
LISTEN ACTIVELY
TAKE CLEAR NOTES

The next steps in understanding new material are study and practice. The distinction is useful. I reserve the word "study" for that activity involving doubting, reading or observing, paraphrasing or writing, thinking, and finally insight. And I reserve the word "practice" for repeatedly applying what you understand and so making you facile [(10)] with the material. While you're acquiring understanding you usually use a mix of these, especially when you're doing an assignment. The distinction is useful because if you know you *don't know*, you need to study; if you know you can't *demonstrate* that you know, you need to practice.

Good understanding comes from good studying, poor from poor, and none from none. The arrangement is perfectly symmetric. To be efficacious, [(4)] study must possess a *quality* that comes from having sufficient time and the necessary focus and intensity. The chautauqua on studying gives advice about time, focus, and intensity of study. Clearly STUDY EFFECTIVELY is the second component-goal of UNDERSTAND THE MATERIAL IN THE BASIC COURSES and it has the component-goals of PROVIDE SUFFICIENT TIME, and DEVELOP FOCUS AND INTENSITY. Your goal map is

SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING
LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
UNDERSTAND THE MATERIAL IN THE BASIC COURSES
ATTEND CLASSES ACTIVELY
BE PREPARED FOR CLASS
LISTEN ACTIVELY
TAKE CLEAR NOTES
STUDY EFFECTIVELY
PROVIDE SUFFICIENT TIME
DEVELOP FOCUS AND INTENSITY

Finally, your understanding must be more secure, more deeply rooted than the tentative and fragile grasp that results from just lecture and study. Making understanding more permanent comes from its repeated application and exercise; that is, practice. Practice also builds your confidence. And from secure understanding and confidence come good performance on tests. This applies to basic

engineering material especially. I go on at length about this because practice is the most important *missing* behavior in first year students.

Your practice is your assignments. So, the goal is *not* to "get the homework done"; this is too much like “get the laundry done.” Simply getting the homework done or struggling to get ready for tests is a kind of short-circuit. It leads to work done in haste, last minute memorizing, cramming, and an abundant harvest of stress. No, the goal is a permanent and robust understanding, and you get it from practice. As described in the chautauqua on studying, on-going practice is an easily managed and much superior substitute for “studying for the test.”

I have a way for you to think about practice. Consider the parallels with almost any activity in sports: the serve in tennis, the putt in golf, a stroke in swimming, the pass in football, a move in soccer, a shot in basketball. Only *practice* brings improvement. You heard in your childhood that “practice makes perfect.” And this is often applied to sports. But it isn’t quite true. It is more accurate to say “*perfect* practice makes perfect.” So, assignments carefully done, carefully reviewed when you get them back, and carefully re-done are the perfect practice you need.

I have another way for you to think about practice. Consider whether you *own* or *rent* the understanding of the material presented in your courses. Renting is an essential but temporary arrangement, owning is a permanent condition and usually a sound investment. Making the understanding-of-important-material your property requires buying it; the price is practice. Once you own an understanding it will always be in your possession. I am sure you *own* an understanding of arithmetic and algebra. But I bet you *rented* an understanding of the cloud of irregular verbs that pestered you in high school foreign language courses. Can you imagine losing the understanding of arithmetic? Only if some physical or mental catastrophe overtook you, would it be possible. Can you imagine losing the understanding of French or Spanish irregular verbs? Has that already happened? Likely. The reason is lack of practice.

Renting will be the usual condition when you first encounter new material, especially difficult material. Don’t be alarmed by how fragile your grasp is; this is *likely and appropriate*. Paying the price and becoming an owner is the goal. Renting to own, if you will. Clearly, PRACTICE is the third component-goal of UNDERSTAND THE MATERIAL IN THE BASIC COURSES. And it has the same component-goals as study.

With these things in mind, the your goal map now look like this:

SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING
- LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
  - UNDERSTAND THE MATERIAL IN THE BASIC COURSES
    - ATTEND CLASSES ACTIVELY
      - BE PREPARED FOR CLASS
      - LISTEN ACTIVELY
      - TAKE CLEAR NOTES
    - STUDY EFFECTIVELY
      - PROVIDE SUFFICIENT TIME
      - DEVELOP FOCUS AND INTENSITY
    - PRACTICE
      - PROVIDE SUFFICIENT TIME
      - DEVELOP FOCUS AND INTENSITY

There is one last step: as we agreed, these things need to be detailed down to the week. It is here that your instructors help you. In each course you'll be given a syllabus.[11] It is a detailed outline of the course, giving the topics covered in lecture, assignments and their due dates, and the dates for tests and examinations. Specific small goals involving class attendance, study, and practice can be set from the syllabus. Providing sufficient time to accomplish these tasks comes from time management. A later chautauqua offers advice about that. Finally, the goal UNDERSTAND THE MATERIAL IN THE BASIC COURSES has pieces small enough to be weekly planning.

> S Learning engineering basics means understanding the material from your courses in Calculus, Chemistry, Physics, and Computing. The component-goals of this large goal come from considering the order in which things happen: first encounter in the classroom, study from your notes and textbook and practicing your understanding with assignments. Your first encounter benefits you most if you are active; thinking, taking notes and asking questions. ATTEND CLASSES ACTIVELY is our shorthand for this. STUDY EFFECTIVELY is the process of doubt, reading/observing and thinking that yields insight. PRACTICE is the necessary repeated application of what you have studied and is essential if you are to demonstrate your understanding and so get good grades. Sufficient time and focus and intensity are the component-goals of study and practice.

Second goal of first-year success: BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU'RE DOING

Naturally enough, you entered The College of Engineering with a limited understanding of engineering. So, before you is the task of setting out to be an engineer, while at the same time learning who engineers are and what they do. It seems—well, backwards, or at least simultaneous. But there's no practical alternative. Becoming certain *about* engineering requires that you know something *of* it, and so you must study it. So I believe the second component-goal of SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING is to become certain and confident about studying engineering *and therefore more committed to it*. Certainty and confidence bring commitment, and commitment brings motivation. And motivation is what keeps you going.

It is very likely that you're certain about engineering in a vague way. You liked math and physics in high school, or you've always enjoyed and wanted to build things, or perhaps you have a relative who is an engineer. Your attraction to technology and your urge to design and build probably defines engineering enough to separate it in your mind from history or sociology, and maybe from physics. But perhaps not enough to make clear what discipline within engineering you should pursue.

Please don't assume that these things simply "become clear." Perhaps you think becoming certain about a career happens something like this:

> You are walking along the road looking for "the right career" or "the right kind of engineering for you." You are hoping to come upon what you want: the right career; *a thing already complete and outside yourself*; something you find, pick up, discover. You need only keep walking, with your eyes on the ground, and to keep looking until you find it. And once you find your career, you will be rock-certain about it.

This is *not* a very accurate metaphor for what usually happens. If you are an open option student it is particularly important to understand that "looking and finding" are *not* descriptive. It's more accurate to see the process as building, as construction. You *make* a career from opportunities you encounter, from self-knowledge, and information you acquire. You are not following a path, you are making one.

In this sense you begin to build your career in your first year; it emerges from knowledge gained about yourself and about engineering. If you don't know enough about yourself or engineering to make career decisions, don't make them. You are under no pressure to make such decisions as you start

your first year in engineering. As knowledge about yourself and engineering grows, directions for you will emerge. And so will your commitment and certainty. Such growth is gradual and incremental.

Notice that I write “opportunities”, “paths” and “directions”; all in the plural. It is very likely that you can be prosperous and content in any of several engineering disciplines. It is actually *unlikely* that there is only one appropriate for you. I observe that it is the style, care, and passion that an engineer brings to a career that are important; the precise discipline practiced appears to matter less. I note this to encourage you to explore and to reduce whatever pressure you feel to “pick something.”

Most courses you take in your first year are not engineering courses. They are critically important but they don't describe engineering. But there are introductory and projects courses that *do*. Offered by various departments in The College of Engineering, these courses are designed to provide information about their respective disciplines. They are your first source of information, so taking one or more is a reasonable goal to help you become certain. Another reason to strive to achieve the component-goal of becoming certain is that the striving puts you in contact with engineering faculty; they too are a source of information about engineering disciplines.

A second information source is the many books written as an introduction to engineering. The appendix lists the ones I prefer. A third information source about engineering fields is the student organizations in The College. Many are student chapters of professional engineering societies, focused on one engineering discipline. Others are parts of student government. All offer an opportunity for you to learn about engineering. You'll find a listing of student organizations in Appendix 3.

Focusing only on the second part of your goal map, and the component-goals of certainty, we get this:

BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU’RE DOING
BE CERTAIN ABOUT AN ENGINEERING DISCIPLINE FOR YOU
TAKE ONE OR MORE INTRODUCTION TO ENGINEERING COURSES
READ AN INTRODUCTION TO ENGINEERING BOOK
PARTICIPATE IN A STUDENT ENGINEERING ORGANIZATION

The component goal is becoming confident. Confidence is knowledge, not a feeling. As used in this chautauqua, it means the knowledge that your studying *does* bring understanding and that your practice *does* produce ownership. Confidence is part of your ability to perform difficult tasks; knowing you can get through them, assured of the positive result. But be careful about this. Confidence *does not* make studying easy. Difficult concepts are difficult to learn and there are some that are very important for engineering; and you will need to learn them. Though you can’t get around the difficulty, you can move through it.

"Move through it"—what does *that* mean? Well, trying to perform a task that’s difficult, while at the same time fighting off your fear of failure, is an ordeal. The charged emotion of failure compromises and short-circuits intellectual effort. It is a remarkably *different* task if it’s *only* difficult, performed *without* fear. If the difficulty remains, but the ultimate accomplishment is reasonably certain, then anguish is absent. There is a deep satisfaction that arises from doing difficult tasks, and they can be accomplished without fear. The difference between difficulty mixed[12] with the fear of failure, and “mere” difficulty, is profound. The difference is confidence.

Confidence is a knowledge that results from *your own* observation of *your success* at performing successively more difficult tasks. It is built from proof that your studying and practice bring you results. It is difficult to make a plainer statement. The verb there is “built”; confidence is not found or taken or given. The power that confidence brings comes from the indisputability [14] of the evidence: *you* see it; no one tells you, no one interprets, no one between you and what you accomplish.

Now do not mistake the silly puffery [13] of artificial self-esteem for confidence. Telling you to "be confident!" pelts you with a slogan. Cheerleading yourself with "I can do this!" is equally useless. No praise or "support" can substitute for this knowledge. Confidence is far more potent than any feeling that comes from what someone says to you.

To acquire confidence you need to clearly view your own success, in detail. If you pay close attention to yourself and what you're doing, looking at you as a stranger would, you'll see your progress. You must review carefully and periodically your progress, and remember yourself before you learned the material you know. Your progress can be reviewed by looking at past assignments and tests; not to find fault, but to remind and make apparent the distance you have traveled. A remembered image of yourself "before you knew" is a striking witness to your progress and ability.

So we add the component-goals for becoming confident to the second part of your goal map ant it becomes:

BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU'RE DOING
- BE CERTAIN ABOUT AN ENGINEERING DISCIPLINE FOR YOU
  - TAKE ONE OR MORE INTRODUCTION TO ENGINEERING COURSES
  - READ AN INTRODUCTION TO ENGINEERING BOOK
  - PARTICIPATE IN A STUDENT ENGINEERING ORGANIZATION
- BE CONFIDENT OF YOUR STUDYING AND PRACTICE
  - PAY CLOSE ATTENTION TO YOURSELF AND WHAT YOU ARE DOING
    - PERIODIC OVERVIEW OF YOUR PROGRESS AND SUCCESS
    - PICTURE YOURSELF *BEFORE* YOU LEARNED NEW MATERIAL

S Certainty about engineering and confidence in your ability to master it provide motivation. Becoming certain about your career in engineering needs to be an active pursuit; things will not simply "become clear." You will not find your career, you will build it from opportunities and information. Introduction to engineering courses are the best way to acquire the information you need. This has the benefit of bringing you in contact with engineering instructors. Reading one of the books that summarize engineering and participating in student organization are other ways to learn more about engineering.

S Confidence is the knowledge that you can accomplish difficult tasks. This knowledge is built from evidence of your own success, and not from praise or "support." It requires that you pay close attention to yourself and your progress. A periodic review of that progress and a remembering of how you were is the process by which you see the evidence of your own power.

Third goal of first-year success: BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER

It will take four or more years for you to finish your engineering education and several years of professional life before you are a mature engineer. During these years you will acquire the technical competence you'll be expected to wield as well as the customs, characteristics and habits of a good engineer. These include adherence to ethics, high professional conduct, care with detail, economy of method, and circumspect [15] problem solving. It is these things, mixed with technical competence, that the public recognizes as engineering. And the person who embodies these is afforded the income and respect of an engineer.

Now no one expects you to have all this polish and ornament now or even after you finish your first year. Most of these habits you can't acquire now; you're too young, don't yet know enough and don't have the necessary experience. But you can and should make a beginning. There *are* two habits that should be immediate goals: taking great care, and ethical behavior in all professional circumstances.

Taking great care is: the conservative, cautious, methodical attention to detail; the presence of mind required to arrange things so that they are not done in haste; and the repeated and careful checking of results. That these habits are important is beyond argument, given engineering's large safety and economic consequences. The enemy and opposite is carelessness, the one sin that cannot be forgiven an engineer. As with medical surgery, **there is no room *at all* for carelessness** in professional engineering work. Poor judgment is to be regretted, bad information cause for teeth gnashing, and missing a deadline a serious lapse of professionalism. But carelessness is unconscionable. (16)

You can begin acquiring the habit of taking great care. Striving to achieve this goal makes you more careful, since carefulness is a habit acquired by degrees. Additionally, your increasing carefulness will help you achieve the other goals that have been discussed in this chautauqua. The component-goals of taking great care are: adequate planning, no work done in haste, and careful measured review of work.

The third part of your goal map begins with this:

BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER
TAKE GREAT CARE IN YOUR PROFESSIONAL WORK
PLAN ADEQUATELY
NO WORK DONE IN HASTE
CAREFUL REVIEW OF ALL WORK

The next component goal is understanding and practicing ethical behavior. Practicing professional ethics means an adherence to the code of behavior established for engineers. During your first year in engineering, ethical behavior is more a matter of avoiding unethical or unscrupulous actions. The college circumscribes your actions in this regard by establishing policies concerning academic dishonesty. In addition, a course syllabus often describes what is considered academically dishonest actions.

Codes of ethics are in place because the engineering community has come to understand that ethical behavior must be an habitual aspect of professional life, because small matters lead to large, and corner-cutting to large lapses. It is believed that infractions corrode the individual and the profession. I hold that belief and think you must avoid even small infractions of academic dishonesty.

It is very likely that during your first year in engineering you will be sorely tempted to academic dishonesty: copying a friend's assignment, letting a friend copy yours, or sneaking a peek of a neighbor's exam. Your action will seem isolated, generally harmless, and a one-time lapse caused by a temporary tight spot you're in. Rubbish. Never forfeit your honesty for a grade. You can achieve the goal of ethical behavior by avoiding the tight spots that tempt you to dishonesty, and by thinking about this issue in advance to help you have the courage to control your behavior, should it be necessary.

If we add these component-goals to the third part of your goal map, it looks like this:

BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER
TAKE GREAT CARE IN YOUR PROFESSIONAL WORK
PLAN ADEQUATELY
NO WORK DONE IN HASTE
CAREFUL REVIEW OF ALL WORK
ADHERE TO THE CODES OF ACADEMIC HONESTY
KNOW THE POLICIES OF THE COLLEGE AND YOUR COURSES
AVOID THE SITUATIONS THAT PROMPT DISHONEST ACTS

S A good engineer has technical competence and a set of habits appropriate for the profession. Although you are beginning to acquire technical competence, many of the habits of a good engineer you are not yet ready to obtain. There are two however that you can begin work on immediately: taking great care and adherence to ethics. Taking great care is attention to detail, planned activity not threatened by haste, and repeated checking of results. In your first year, ethical behavior is avoidance of academic dishonesty. Avoiding the situations that tempt dishonesty and having the courage to control your behavior help make ethical practice a habit.

Conclusion

Putting all this together gives a goal map that defines most of the academic goals for a successful first year:

BECOME AN ENGINEER
GET A GOOD FIRST ENGINEERING JOB
OBTAIN AN ENGINEERING DEGREE
SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING

LEARN FIRST YEAR ENGINEERING BASICS AND SO GET GOOD GRADES
UNDERSTAND THE MATERIAL IN THE BASIC COURSES
ATTEND CLASSES ACTIVELY
BE PREPARED FOR CLASS
LISTEN ACTIVELY
TAKE CLEAR NOTES
STUDY EFFECTIVELY
PROVIDE SUFFICIENT TIME
DEVELOP FOCUS AND INTENSITY
PRACTICE
PROVIDE SUFFICIENT TIME
DEVELOP FOCUS AND INTENSITY

BECOME CERTAIN, CONFIDENT, AND COMMITTED TO WHAT YOU'RE DOING
BE CERTAIN ABOUT AN ENGINEERING DISCIPLINE FOR YOU
TAKE ONE OR MORE INTRODUCTION TO ENGINEERING COURSES
READ AN INTRODUCTION TO ENGINEERING BOOK
PARTICIPATE IN A STUDENT ENGINEERING ORGANIZATION
BE CONFIDENT OF YOUR STUDYING AND PRACTICE
PAY CLOSE ATTENTION TO YOURSELF AND WHAT YOU ARE DOING
PERIODIC OVERVIEW OF YOUR PROGRESS AND SUCCESS
PICTURE YOURSELF *BEFORE* YOU LEARNED NEW MATERIAL

BEGIN TO ACQUIRE THE HABITS OF A GOOD ENGINEER
TAKE GREAT CARE IN YOUR PROFESSIONAL WORK
PLAN ADEQUATELY
NO WORK DONE IN HASTE
CAREFUL REVIEW OF ALL WORK
ADHERE TO THE CODES OF ACADEMIC HONESTY
KNOW THE POLICIES OF THE COLLEGE AND YOUR COURSES
AVOID THE SITUATIONS THAT PROMPT DISHONEST ACTS

This goal map makes clear the process that is necessary to achieve the large goal: SUCCEED IN YOUR FIRST YEAR IN THE COLLEGE OF ENGINEERING. You have other large goals and they should receive the same attention and development. You should write this development down, though you're tempted to perform such an analysis in your head and leave it there. Few have the power and clarity of mind to evaluate schemes and work through the details without some type of record. Having it in front of you, if only on a computer screen, helps expose foolishness and mark progress. If it's your custom to keep a diary, that's an ideal place for this work.

Having produced these goal maps, you may have your chin in your hand, shaking your head, doubting their value. True, unaccompanied by mechanisms to obtain them, goal maps have the triviality of a connect-the-dots puzzle. But studying them reveals the skills you need to achieve these goals. And these skills are the topics of the next chautauquas. They are

Time management
Active class attendance
Effective Practice
Knowing yourself
Effective Studying

They are all essential. I list them in the order of how *unlikely* they are to be found among first year students' skills. Time management is *by far* the one found most lacking; but time management must have a purpose, so I write about Effective Studying, Effective Practice, and Active Class Attendance first.

Questions to answer, things to think about, and exercises to perform

1) In this chautauqua we said that thee of the components of first year success are learning engineering basics, developing confidence and commitment, and acquiring good habits. These deal with only the academic side of your college life.

    a) Consider the other dimensions of your life and add at least two other goals to the list of component goals for success in your first year
    b) Take what you believe to be the more important of these two and, applying the same process described in this chautauqua, build a goal-map that you think you can use as part of your weekly planning.

2) Thinking about your own behavior over the past year or two, identify and describe three goals that you have *adopted* and three that you have *set*. (This is likely to require considerable thought and be hard to do, but the value of it should be apparent.)

3) When one of your classmates dodges their homework, sitting in front of the tube instead, what goal is governing this behavior?

4) Choosing an engineering discipline (a major) should be one of the goals of your first year in engineering. The following questions may make it easier to identify and understand your own requirements for contentment in a particular field of engineering. Naturally, there are no "right answers." But whatever the answers, they will help you, even *before* you begin to learn about different engineering disciplines.

    a) If you imagine yourself in an engineering job, how large a role do you think people contact must have?
    b) Do you see yourself as a manager?
    c) Do you see yourself as a business owner?

d) Do you want to work with computers a lot? A little?
e) Do you want your job to have you outdoors a great deal? A little? Does this make any difference?
f) Do you imagine that you'll like small tasks, worked to completion, or large projects for which you'll contribute a piece?
g) Do you want to focus on a series of (perhaps small) tasks or an extended (perhaps large) project?
h) What is it that makes you bored?

A CHAUTAUQUA ON STUDYING
-
UNDERSTANDING HOW YOU LEARN

An assessment of your studying

I begin this chautauqua by assessing your studying. Now, when working with a large group, only *trivial* assessments are correct for *every* person; *important* assessments can be correct for *most*, not all. Though it's a delicate business, I think an assessment for most first year students is the best place to start:

> You "did well" in high school, but you didn't work very hard or very long. You weren't challenged to your full capability, not anywhere near it, not even once. By full capability I mean your capacity to understand, your power to penetrate difficult material, your ability to work; *not* simply how much you know. You think your full capability is a modest extension of what you did a few months ago in high school. You think you're now using your full capability to master the material in your courses. And you think that whatever escapes you or whatever you don't understand, is simply beyond your capability. Rubbish. This simply isn't true.
>
> You have *no idea* what your full capability is; you do not yet have this knowledge. But you feel, no doubt, that you *most certainly do*; you feel you *have* encountered things that were beyond you. But what you mistake for a limited capability is actually a flaccid(17) ability to sustain intense study. That is, it is your habit to give new material a comparatively small, brief dose of your power to understand. If it's difficult, and nothing happens within, say, half an hour, you assume that the material is simply beyond your capability to fully understand. Rubbish.

This is no reflection on your high school or its teachers. They helped you pass from adolescence to very young adulthood—a tough job. There were many things that received attention, and "academics" was but one, and rightly so. And high school academics had a broad audience with an aim to reach *most* students. Your talent is such that this target was *below* your ability, so there is no wonder that you weren't challenged to your limit. Now you claim you want to be an engineer, so academics should be your focus and you need to find your *real* full capability. You can call this learning to learn.

I push my assessment further.

> *You have not yet perceived the difference between your raw intellectual power and the stamina you have to engage it intensely for a sustained time. Your full capability results from both, and your stamina is the weaker of the two*. And so you mistake an underdeveloped ability to engage in sustained and intense study for insufficient intellectual power. You know that you cannot change your intellectual power, but you do not realize how much you can improve your ability to engage it in a sustained and intense manner. This has truncated(23) your efforts in the past and has produced an inaccurate understanding of your abilities. You believe that you are functioning at your full capability. Rubbish.

I am *not* asserting that we all have the same intellectual power. That is not the case. I *am* asserting that understanding difficult material results from both intellectual power *and* its intense and sustained use; that is, study. Some gifted few are granted the ability to fathom difficult things with what seems a mere glance. The rest of us must study these same things intently and at length to eventually

understand them. Most things you have encountered that were “beyond you" were simply things not given enough time. So I believe that the ability for sustained and intense study is the most important intellectual skill you can develop in college. It is likely to take a couple of years.

I push my assessment further yet.

> Your full capability is far beyond anything you currently imagine. *Indeed, other faculty and I understand your capability better than you do*. Our understanding is one that you do not fathom and in which you do not believe. And *that* is the tension between you and us. That is why we push you to study, that is why we *must* push you; we are certain that we know more about of your capability than you do.

S It is very likely that you do not know your full capability for study, that you assume whatever you don’t understand after you “study it,” is beyond your capability. Your current capability is limited by an inability for sustained and intense study: study that is not distracted and lasts long enough. You should not confuse this inability with insufficient raw intellectual power, because though you can’t change your natural intellectual ability, you can acquire the skill of sustained and intense study.

The role of study

It is likely that you did most, if not all, your high school learning in the classroom. Your teachers offered detailed explanations and repeated examples that produced understanding on the spot. You only needed to stay awake and pay attention. It was, in many respects, a passive activity. And so homework was exercising things already learned in class.

It cannot be this way in college; there is too much material that must be covered at too rapid a pace for there to be on-the-spot complete understanding in the classroom or lecture hall. Lectures for college courses provide a framework for understanding concepts and their application. There simply isn't time to work through all the details and all the necessary examples. And since these are required to clearly understand the material, *you* must do this, usually with the aid of your textbook. You must understand that in college most learning takes place *outside* the classroom, during study times that *you* must arrange.

So, your learning depends much more on *your own activity* than it ever did in high school. You must learn how to learn. This is part of your preparation for being an engineer; our profession will require that you keep up with new developments while you work: this is called “life-long learning.” Thus, learning needs to be centered on you and the material, *not* on the instructor and the lectures.

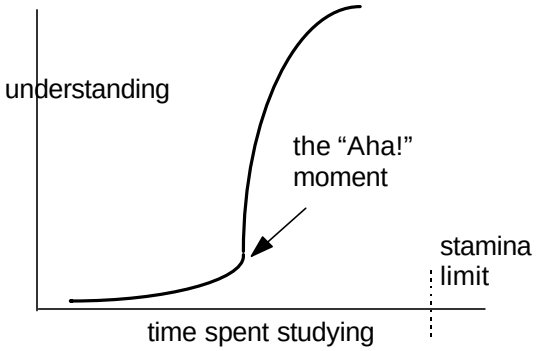
So studying is the skill at the very center of what’s required to achieve your goal of having a successful first year in engineering. As with most skills, study is a process that is learned, and can be improved. Knowing how you study and how you can study more effectively is essential to success in your first year in engineering.

S The process of learning in high school was teacher and classroom centered, and on the spot learning was usual. In college, the process of learning is centered on you and your study. The instructor is a guide and facilitator, and the classroom the place where material is introduced and an overview given. Most learning takes place outside the classroom, during your hours of homework and study.

Effective Study

The need for sufficiently prolonged and intense study can be seen if you think back to some one thing you've studied, found difficult, but finally mastered. Perhaps algebra is a good example, seen first in the sixth or seventh grade. For example: $3x^2 = 10$ made sense only after you understood the concept of an unspecified placeholder, x, able to be manipulated and "solved for", taking on values, presumably for some useful purpose. This took a while. The more subtle concept of algebra as "arithmetic with its content removed", required some time and thought to become clear; and once it did, algebra became a powerful tool that was easy to use. Think back, if you can; 3x could mean 3 apples or 3 feet or 3 of anything. Can you recall how strange the concept was? How abstract? And how bewildering all the various algebraic operations were? But now this material is confidently yours.

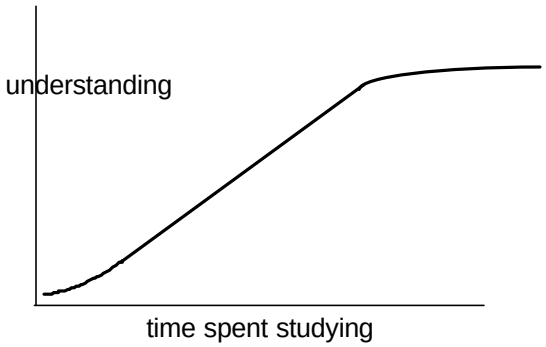
So understanding algebra's basics required sustained study on your part. This is certainly true of *understanding* The Calculus; as with, for example, the definition of the derivative using limits. Sustained study is required to learn almost everything that is challenging. Here's how you might depict this process graphically. Plot the amount of understanding on the vertical axis against the time you invest in studying it on the horizontal axis:



This is how most of us come to understand new material

This schematic [25] shows the relationship between your investment in study and the resulting understanding. There is usually a certain time you have to spend studying, working, reviewing, questioning, and thinking about something before you finally "get it." This is the prelude to understanding. After this initial investment, you "get it", you finally understand. That is the moment when you say or feel "Aha!", when you smack your forehead with the palm of your hand. Surely you have had this experience. This "Aha!" moment (A-moment) comes before your stamina limit, represented by the vertical dashed line. This is the limit on the amount of time you study, caused by fatigue or the surrender to distractions.

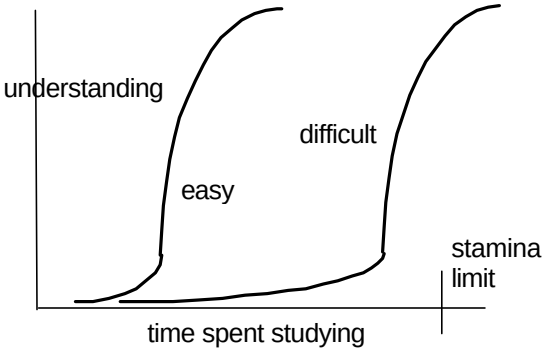
The A-moment is a universal phenomenon, as is the shallow flat part of the understanding curve that precedes it. If you think carefully about your own study, you'll detect this relationship. So it's a mistake to think and behave as if the progress you make in learning difficult things graphs this way:



This is **NOT** how understanding usually comes about

It's a mistake to think that if you spend just a little time "warming up", then your understanding grows more-or-less as you "put in study time." No, there is *not* a near-linear relationship between study and understanding of difficult material. Beware of just "putting in study time"; that won't work for most things you need to learn in engineering.

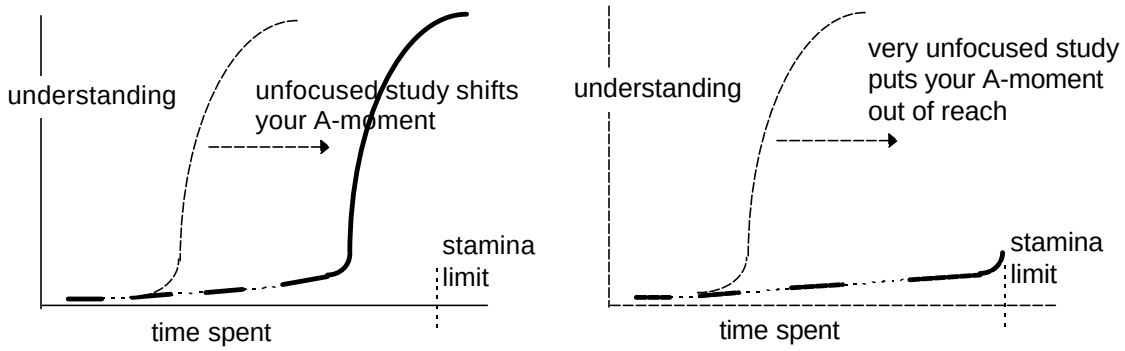
Pushing this a little further, you can graph the progress you make for easy and difficult material:



The difference between studying easy and difficult material

For some very difficult and important concepts, you'll spend a lot of time with your understanding *seemingly* not growing very much, if at all; this is represented by the first flat part of the graph. That's certainly OK, even expected. This prologue to your understanding is necessary, it's when you're thinking, becoming familiar with the material, making connections—things are "sinking in." You must be patient, provide yourself with the time, and continue working. You will reach the time when the A-moment comes and your understanding jumps.

Unfortunately, your A-moment can be moved further out, making it more difficult to reach. Only one thing at a time can have your attention, and if your study is interlarded [(26)] with distractions and daydreaming, it takes more time to reach your A-moment. The more you yield to distractions, the more frequent and extensive the daydreams, the less focused and intense is your study. In the worst case, you put your A-moment beyond your stamina limit; you cease to study before you understand. These graphs give an idea of how this works.



I describe time on the horizontal axis as simply “time spent” rather than “time spent studying”, since it includes time spent studying and time for whatever else has captured your attention. Time wasted is represented by sections of dotted line.

I am sure you’ve experienced the stamina limit: you become too tired to concentrate; or you’ve surrendering to daydreaming or distractions and are simply staring at the book with your eyes glazed and your mind filled with other things; or you’re more interested in what’s on television or the radio. The stamina limit is a function of your alertness, your physical surroundings, your vulnerability to distractions, and the strength of those distractions. And because you can control these things, you can move your stamina limit, you can increase it. *Moving it out as far as you can is one part of reaching your full capability*. The further out you move your stamina limit, the more you are able to understand, since you are able to study with greater duration.

> S Your understanding comes in jumps. You study new material, focus your attention on it, and finally understand. You reach this point—the Aha! moment—only after some initial investment: studying, working, reviewing, questioning and thinking. This initial investment is small for easy material and large for difficult material. Your A-moment must come before you reach your stamina limit; when you can no longer study because of fatigue or complete surrender to distractions. Unfocused study increases the time it takes to get to the A-moment, and in extreme cases you reach your stamina limit before you get to your A-moment.

Learning from cycles of study

Some classmates seem to "get it" quicker than you, or “get it” when you don’t “get it” at all. You ascribe [(27)] this to their being smarter. This comparison isn’t helpful, and you should not adopt this type of intellectual victimhood. It is more accurate and helpful to recognize that their A-moment comes sooner than yours does. Your A-moment may be further out because that’s where it is, or further out because you’ve *pushed* it there with your own bad habits. Whatever the case, you need to know that once you get to *your* A-moment, your understanding can be just as complete.

Sometimes you can’t reach your A-moment. You haven’t pushed it farther out, you’ve simply hit your stamina limit without yet understanding the material. You’ve "hit a brick wall”, as they say. In this case you need more information, or a different point of view, or simply a rest. But don’t leave your studying until you can formulate *specific questions* that express what you don’t yet understand. For example, a mysterious step in deriving a formula, or how the chain rule for derivatives is applied to $\sin(x(\ln(x^2))^m)$, or why O_2 and H_2 are common but Fe_2 isn’t. Putting your missing understanding in your own words is an important part of studying. This narrowly defines what you don’t yet understand, and helps limit the vague and discouraging feeling that comes from the ambiguous “I just don’t get it.” If your questions are at all involved *write them down, don’t leave them in your head*.

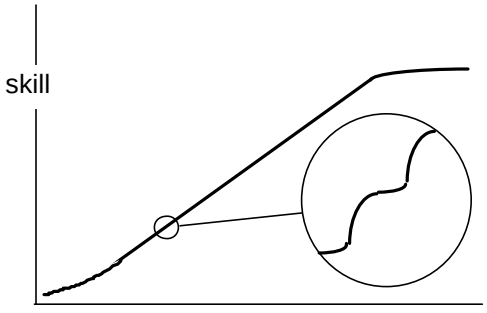
Take your questions to class and ask your instructor, or take them to your teaching assistant (TA), or take them to your study group. Your instructor or TA or classmates can offer another explanation or point of view, one different from the textbook or given in lecture, and this may be what you need. Sometimes getting to your A-moment requires getting away from the material for a while.

In any event, you must return and study the material again. Frustration and discouragement about not "getting it" work against this. You must argue with yourself as necessary, invoking self-discipline to study the material again, with the expectation of reaching your A-moment. *Returning to study* is another part of reaching your full capability. This is mature learning.

Effective practice

Unlike understanding difficult material, *practice* has a nearly linear relationship between time invested and results. As you practice by working on homework and solving problems, your skill, confidence, and command of the material grows. Each problem is a small step, with its own A-moment; but the steps are small, perhaps not even detectable, and your progress is nearly continuous. As I think you can see, most kinds of practice have this is characteristic. You need to devote sufficient time in order to become skilled. This relationship also holds for things that you need to memorize: calculus rules, identities, procedures, or symbols for the chemical elements.

A *practice graph* relates time invested and skill, and looks like this:



The steady increase of skill results from continuing investment of time. This increase is made up of very small steps.

This is also an accurate graph for progress in washing the dishes, doing your laundry, or even working on some CAD drawings. Though this graph describes progress in those activities, it does not reflect the realities of studying difficult material. This is why you need to distinguish between study and practice. Study, which can require significant time for you reach your A-moment, precedes practice, which gives you skill, confidence and command of the material.

S "Effective study" is intense and sustained study, a short-hand for study not undermined by distractions and daydreaming, study that is focused on the subject at hand, and lasts long enough and repeated enough to bring you to your A-moment. "Effective practice" is different from study; it is the homework problems and exercises that make you skilled, proficient, and confident.

Careful reading as part of effective study

Casual reading ranges from page turning through an exciting novel to languidly,[(27)] even carelessly, reading the daily paper. This intake of information is usually strictly sequential, since there is little or no repetition, no re-reading. You do not monitor your grasp of what's read, the material is usually on a low enough level that monitoring is not necessary, or even desired. Stuff simply comes in; words are recognized, action is noted, and simple comprehension is sufficient to follow what's going on. You

read as quickly as your eye movements and the size of your "visual gulps" allow. There is a passivity about this kind of reading. Usually there are mental images generated, especially when reading very vivid writing; you can say that your mind's eye is active. But it's stimulated by the voices of characters or of the author; *your mind's voice is quiet*.
Studying involves reading, but reading that is characteristically very active, and it is accompanied by other activity. Specifically, your mind's voice is active and sometimes your mind's eye. You are questioning, thinking, and checking your own understanding. Don't mistake *just* reading for studying. Reading brings words into your mind, they may even be "voiced" in your head, but you mind's voice is quiet. An active mind's voice is a kind of talking to yourself with your mouth closed. This is different than just recognizing words. Some study requires an active mind's eye: picturing relationships, considering geometry, or recognizing patterns. For most engineering material an active mind's eye *and* voice are required.

Reading complicated material carefully enough for study requires an activity very different from casual reading. Careful reading has the following attributes. Not all are present all the time.

1. Pace. You are reading at a rate no faster than that at which you understand the small bit of material in front of your eyes, and *not* by how quickly your eyes can move and you can (merely) recognize words.

2. Active mind's voice. You are questioning, evaluating, interconnecting, and re-expressing what you are reading.

3. Writing and note taking. You are actively recording main ideas, confusions, questions, or summaries.

Once acquired, these careful reading attributes can become strong with exercise. Here are some ways to develop these three habits of careful reading.

1. Pace

   Reading with the aid of a 3" x 5" card will keep you from moving along at a pace driven by how fast you move your eyes and how quickly you simply recognize words.

   - Read while holding a 3" x 5" card directly under the sentence you're reading, covering the lower portion of the page. This lets you see only one sentence, equation, or statement at a time. It prevents you from racing ahead. This simple mechanical assistance is useful whether you're reading a textbook or studying your lecture notes.

   - Don't move the card until you understand what is in front of you or can formulate your own statement of what you don't understand.

   This kind of reading is especially important when working with a textbook.

2. Active mind's voice

   As you move through and think about small sections of material, ask, "what does that *mean*?" and give an answer with your mind's voice. Use your mind's voice to give

   - an explicit statement of the meaning of what you've read, and

   - a paraphrase of the material.

If you can do this then you have an indication that you understand the material. This second characteristic of careful reading—an active mind's voice—helps verify the outcome of your reading.

Using your mind's voice forces you to use *your* words, which is a good test of what *you* know. Your mind's voice is essential for knowing when you know, knowing when you can move on; or knowing when you must re-read a section of material, knowing when you must invest more time. *Using your mind's voice prevents you from mistaking mere recognition of the words in an explanation, for an understanding the explanation itself*.

3. Writing and note taking

Writing is the third important part of careful reading. It reinforces the activity of your mind's voice by forcing you to formulate your own expression of what you're studying with enough clarity to write it down. This applies to both what you do and do not understand.

- Augment your class notes with notes made while you read. Record the main ideas, important points, and necessary detail.

- If you are completely stumped, write down the very specific thing you do not understand in your notebook. This serves as the specific reference for a question to be put to your instructor or teaching assistant.

- Sketching a drawing, diagram or graph helps summarize the ideas or concepts you're studying.

If you mind's voice is active and you are writing as you study, you should be able to know when you don't know and when you need to re-read the material.

Highlighting is *not* a substitute for writing. The books you use in your first year are very dense and almost everything in them in important. So highlighting fails to signal "important" things; rather it becomes a kind of bookmark, smeared through the entire book. Highlighting is too passive to benefit you. It fails to test your understanding and therefore fails to make you certain you understand. If you choose to mark in your textbook, *write*. Put in your own notes, explanations, commentary; add labels or reminders to drawings or graphs; or identify connections to your lecture notes.

> S Careful reading is part of effective study. Careful reading is accomplished by reading at a pace sufficiently slow to permit understanding of each bit of information in front of you. An active mind's voice is also part of careful reading. Questioning and paraphrasing are activities of the mind's voice, which demonstrate to you that you understand. Writing and note taking are also part of careful reading, forcing you to summarize your understanding with words, drawings, sketches, or graphs.

Intensity and endurance of study: managing distractions

In my initial assessment of your study capability, I wrote that you don't know your limit. You don't know it because you haven't ever reached it. You have not yet developed the skill of highly focused study: study without capitulation to distraction—and you have not yet developed your endurance: the ability to study for an extended time. You should think about your recent study sessions and ask yourself: Was your mind's voice active? Were you asking yourself questions about the material? Did you take additional notes? How often did you catch yourself with your mind on other things? What were the *uninterrupted* spans of time during which you focused on the material at hand?

The answers I get from *beginning* first year engineering students are typically these:

Was your mind's voice active?	"My what?"
Were you asking yourself questions of the material?	"No"
Did you take additional notes?	"Almost never"
How often did you catch yourself with your mind on other things?	"Pretty often"
What were the *uninterrupted* spans of time?	"3 minutes"

The last answer is interesting. There is usually a general reluctance to admit that "hours of studying" are actually inefficient stretches, holding short spans of focused work mixed with distractions and wanderings. Yet this is usually the case, especially for students who have not considered their own study carefully.

Effective study is characterized by *activity*: you have an active mind's voice and eye, and are writing. These in themselves help keep you from being distracted. But they don't make your attention invincible. So it's best to manage or eliminate distractions, even though it can take considerable work to change your habits in this regard.

Some distractions come from your environment: usually input to your audio and visual senses. You should arrange things so that these don't get in the way. So I think it's best to work and undertake *serious study* in a silent environment. I do not mean the dead soundlessness of an anechoic [(29)] chamber, but rather an environment having only a background and unintelligible murmur, as in the library or study hall. There is little point in fighting off input from your visual and auditory senses, while you trying to understand difficult material.

It is, perhaps, your custom to have "some background noise" while you "work": music on the walkman, the radio, or the television. You think, perhaps, it doesn't affect you; that you can concentrate regardless of what's going on around you. Rubbish. Psychological studies have revealed that music or other stimulus to our sensory systems *does improve* performance on tasks that are repetitive, boring, but require vigilance. Working on a CAD drawing in the computer lab is an example. But these studies show that such a stimulus *degrades* performance on tasks with very high cognitive activity requirement, such as studying. So there are things that you can, even should, do with music or television in the background; *studying is not one of them*.

If it is your habit to study with music or television, you owe yourself the experiment of studying without any of these things. Some students report that their discomfort in this situation is due the silence, a kind of distracting emptiness. The silence is said to have considerable "weight" and becomes a distraction itself. But active study should completely fill this empty mental setting. Reading, an active mind's voice and eye, and writing should "take up all the space." This is the fastest way to your A-moment.

Some distractions arise from your mental or physical state. Studying requires your most acute mental alertness, and fatigue certainly affects this. Don't schedule study time when you know you'll be fatigued. If you're too fatigued to study, reschedule your study time and do something else. Don't just "put your time in." Your physical environment is important and should be chosen with care to make sure it's helping you. You should be comfortable enough for a few hours' work, but no more comfortable than that. Naturally, your study place should not present distractions that require considerable effort on your part to overcome.

S Managing physical or sensory distractions is easiest if they aren't there. You will find focused study easiest in a quiet environment. Research shows that some work that we do benefit from a stimulus like music. Work such as the repetitious yet vigilant activity of CAD drawing improves if agreeable music is available. But music hinders activity with a high cognitive component, like study. If you currently study with

music or the television, try studying without these powerful forms of sensory input. If this is you habit, you may find at first that the silence is itself a burden. But focused study with an active mind's voice will fill this void, and you won't notice the silence. Good time management can help you avoid distractions such as fatigue or hunger. Schedule important study times to avoid these.

Intensity and endurance of study: managing your attention

Surely you've had the experience of catching yourself with your attention focused on something other than the task at hand. You are daydreaming or your "mind has wandered", as it's put. These internal, or mental, distractions are difficult to manage. Your attention can only be focused on one thing at a time, so these distractions greatly affect your study. How does this happen? Well, either

- your study is not very active so almost any thought can intrude, or
- you're not interested in what you're studying, or
- you have something important and powerful on your mind.

Keeping your study active is the best way to avoid daydreaming. An active mind's voice and writing can keep your attention where it needs to be.

Your mind may wander because you're not interested in what you're studying at the moment. But you can no longer afford the luxury of having to "be interested" in all that you study. Yes, you need to "be interested" in engineering, but you cannot expect *each* thing that you must understand to attract you, *especially initially*. That is unreasonable. That you find the object of your study boring, even tedious, should not lead you to behave as if it were unimportant. There are some things in engineering that are *boring and important*; and you must learn them, along with those things that happen to attract your interest. Some things will become interesting only after you understanding something about them.

If you have important and powerful thoughts that continue to capture your attention, then perhaps you shouldn't attempt serious study. Settling an important and distracting personal matter may be the most efficient thing to do. On the other hand, once you're in the middle of very active study, you may not be pestered. That is, this internal distraction may pose a difficulty only at the beginning of your study session. You need the discipline to start, and then things will be easier. Easi*er*, not easy.

In each of these circumstances your attention bucks, and you need to rein it in. Pulling yourself back from stray thoughts is an act of discipline required if you're going to reach your A-moment. The repeated need to pull your attention back can be discouraging, weakening your will to study. Do not let the *repetition* discourage you—it is the very thing that brings you control. As you gain more control, your lapses of attention will be less frequent and briefer. Extended and intense sessions of study are exhausting; leaving you a little out-of-balance, even sore. The parallel to a physical workout is exact.

Some of the power to manage your attention during study comes from knowing study's value. This knowledge requires that you review your own studying, so you *see* the progress that you are making, or not. Ending a study session by reviewing what you've accomplished establishes a habit of reflection that improves your studying. Knowing you'll scold yourself for daydreaming will help keep you from daydreaming. And recognizing the amount of understanding that study bring you makes you certain of study's value. You will observe your habit of study becoming more focused once you make your studying one of the things you know about.

Studying with your lecture notes

As I describe above, you should not expect to have lectures produce sufficient understanding on the spot. Lectures *alone* are often insufficient because

- lectures provides a framework; you must work through the details,
- a lecture's pace may be too quick for you to get to your A-moment, and
- not all the course material can be covered in lecture.

You need to study outside of class to augment the lectures and come to a sufficient understanding of new material. Your lecture notes should be an integral part of this process. In the chautauqua on active class attendance, I advise that notes taken during lecture are only the first step in understanding new material. The second step is a revisiting and studying; done soon after you produce lecture notes.

In this second step you complete your notes: filling in details; annotating [28] with words, phrases or drawings; recording the understanding you've reached; and forming questions about the material. This second pass over you notes involves studying, remembering, and writing. This is *not* "reviewing your notes", a usually passive process that is mistaken for study. You should *not* work with a highlighter, but rather should write additional things in your notes. Highlighting your notes is a passive process that merely records that you recognize things. Do not mistake this for annotation.

It is likely that the lectures are introducing, explaining and amplifying material that is in your textbook. If this is the case, your second pass should be done using the textbook. Read your notes and the textbook, alternating as you move through the material presented in the lecture.

You should *not* assume that this second pass over your lecture notes is unnecessary if you do your assignments. Your assignments are easier to perform if you first have gone over your lecture notes as described here. More importantly, you may be able to complete the mechanical parts of your assignments—"turning the crank," as it's put—without really understanding the material. And so you risk mistaking a completed assignment for proof that you understand the material; a mistake that only reveals itself during a test.

This second pass over your notes, performed very soon after you take them, is one of the very best ways to be prepared for a test. Good performance on a test usually requires an understanding of new material sufficient to solve problems and proficiency enough to allow you to work quickly. This sufficiency and proficiency is more surely acquired from the steady process of a daily or weekly working through your lecture notes, than from the eleventh-hour cramming that's usually described as "studying for the test." You will be tempted to simply accumulate notes as the weeks pass, and look at them again only as part of "studying for the test." You must be more active than this.

Studying your notes on a regular basis has time management consequences. On a set of notes that you produce in a one-hour lecture, you might spend another half-hour studying and annotating. You need to schedule time for this. This process also has the benefit of preparing you for the next lecture.

Studying with others

Studying with others can help you reach your A-moment or push it away. *Practicing*, that is, working on assignments, with a *few* other students is usually very helpful. Discussion of the problem, consideration of different points of view, and common evaluation of a solution are benefits of practicing with others. But you'll need to be vigilant, because you'll be tempted to be passive, especially if the study group has more than four or five members. In your eagerness not to hold the group back and put a momentary but uncomfortable spotlight on yourself, you're more likely to simply copy results down. The important intermediate steps of reasoning or calculating can be missed or not understood. Remember: the goal is *not* to get the homework done, but to understand and become facile with the material. You are more likely to be active if your study group has only three or four members.

I believe that you should study difficult material alone or with only one other person. In groups of three or more you are less likely to be active, and under more pressure to behave as if you “get it”, whether you do or not. That is, it is more difficult to have an active mind’s voice, to write and to move at the pace *you* need when you are in a group of three or more. Working in pairs, however, can often be helpful. In this case, your mind’s voice becomes your usual voice as you talk to your study partner. You can both write, either in notebooks, on paper you’re sharing, or on a chalkboard. Perhaps most importantly, your study activity involves another person with another point of view to the material; shared explanations can help you both understand. And, working in pairs can be a powerful assist in resisting the pull of distractions.

Knowing when you don’t know

Part of studying is knowing when you *don't* know the material. Being certain that you don't know is a critically important step in learning. It is the clear signal that you need to study more, that you are not prepared for a test, and that you will not remember or understand enough to do well on an examination. Though not likely to be your first reaction, being certain that you don't know should be welcome information; it removes the ambiguity that can lead to poor performance. Being certain that you don't know is *positive* information, not negative.

Surely you've had (and if not, likely will have) the experience of leaving a test muttering "Geez, I thought I *knew* that stuff." Having it demonstrated that you *didn't* know was useful, but the information came late. You needed to know that before the test; you would have had the opportunity for more study. The key phrase in the quotation is "I thought . . ." It is easy enough to *think* you know, and to hold this perception in vague terms, which makes it difficult to be very *certain* about how much you know. You err on the false positive side; thinking you understand more than you do, thinking you have a firmer grasp on concepts and their applications than you do. You must set aside assumptions and develop the habit of being certain about what you know. More starkly: *assume you're ignorant until you prove to yourself that you're knowledgeable*.

Thinking you know and understand arises from fatigue, impatience, frustration and not looking at yourself carefully; and it's all quite natural. There are some practical ways to know when you don't know. First, I want to dismiss something that *does not* work. If you sit in front of your textbook or lecture notes, flipping the pages, recalling what you see, you are very likely to mistake *mere recognition* for certainty and understanding. Additionally, this procedure does nothing to test what you're able to remember. As with other aspects of study, this fails to reveal what you need to know because it is far too passive. Strange to relate, you must be more active to know when you don't know.

Here are some activities that can reveal when you don't know. The first is the most difficult and the most revealing. Summarize the material you've studied. Don't do this immediately after you've studied; even an hour's wait will make this activity more meaningful. Without the aid of your notes or textbook, write down the facts, equations, formulae or procedures that you've studied. Don't pad with "filler", write *only* what is pertinent.[30] Make sure you have no assistance, just blank paper and your own understanding. When you're done, review your summary using your lecture notes or textbook. Be very critical; if you haven't written it down *exactly correctly*, then you don't know. If you've left out a very important point, then you don't know. Compare your summary to what you should have written. If you find it incorrect or incomplete, and catch yourself thinking or saying "Oh yeah, that's right; well, that's what I meant", then you don't know.

A second way to know when you don't know is to take a practice test. Many students have taken the courses you're taking. Some of the tests they took have been collected in "test files" and are available in the Peer Advocates' office on the second floor of the Engineering Center. This is perfectly legitimate; these tests are made available for studying. Get a test for your course and take it. Conduct

yourself exactly as you would if you were taking the test in your course. When you go through this practice test the first time, give yourself only the time you will have for the real tests in the your course. Evaluate what you managed to accomplish in the allotted time. Then go back and try to finish the test completely. Note how long it takes you to do this. Poor performance of this exercise indicates that you don't know.

A third way to know when you don't know is to carefully evaluate your homework. After a homework assignment is returned to you, review it until you understand the *exact reason* for each mistake or omission. Do not misunderstand; that you *made* a mistake will be clear, and *what* the mistake is will also be clear, what will not be obvious is the *reason* for the mistake—*why* you made the mistake. You need to make the important distinction between errors caused by your lack of understanding, and those caused by carelessness or haste. The former indicates you need to study more, the latter shows the need for some self-diplomacy. It is a great mistake to simply check your score, put your paper in your notebook, and comfort yourself with "I'll need to review this stuff for the test."

S Lectures provide a framework for the material in your first year courses and are sometimes paced too quickly for you to attain you're A-moment in class. For these reasons it is important to study your lecture notes on a frequent basis. Review, annotation, and reference to your textbook not only help you prepare for the next lecture but also are the best ways to prepare for tests. Study with others can help you, but you must be careful not to become passive in a large study group if it moves a pace that is inappropriate for you. Study with another one classmate can be a very effective way to study difficult material. Knowing when you don't know is an important part of study. Self-tests, test files, and assignment reviews are effective ways to know when you don't know.

Questions to answer, things to think about, and exercises to perform

1) To assess your current study skills it is helpful to look back to high school and answer the following questions.

    a) How many hours a week did you study?
    b) Did you do much studying outside of school? Outside of "study hall?"
    c) How often did you come to understand new material in the classroom?
    d) How often was homework the study of new material, as opposed to "turning the crank?"
    e) Was it your custom to study alone or in groups?

2) Surely you have experienced the "Aha! Moment." Think back to an occasion and describe it.

    a) What was the subject of your study?
    b) How long was the prelude to understanding?
    c) How representative do you find the schematics of the "Aha! Moment" in this chautauqua?

3) Did you play a sport in high school? If you did, think about and describe how practice was a part of this activity for you. Describe in more detail the similarities between sports practice (sufficient time, focus, and intensity) and the intellectual activities of study and practice.

4) How do *you* answer these questions about your study?

    a) Is your mind's voice active?
    b) Do you ask yourself questions of the material?
    c) Do you take additional notes?
    d) How long are the *uninterrupted* spans of time that are focused on the material at hand?

5) You have already spent time this semester studying engineering; evaluate its quality.

a) Where do you study? Evaluate this place, considering the issues discussed in this chautauqua.
b) How often do you find yourself distracted while you've studied? What were those distractions like? Think about (and plan!) what you will do in future study sessions to reduce their power over you.

A CHAUTAUQUA ON LECTURES
-
ACTIVE CLASS ATTENDANCE

As I wrote in the chautauqua on goals, lectures are an important encounter with new material. They are a very efficient way for a few faculty to introduce and explain new material to many students. And at most universities simple economics requires this efficiency, especially in first-year courses.

I predict that most of your first year courses will have instructors who are particularly good, and the courses will be particularly well run and organized. So, barriers to understanding new material will be as low as you are likely to encounter in your academic career, and your opportunity for success will be as large as it is likely to be. Your courses are, however, reciprocal [(34)] processes; they work if you contribute, and they work *well* only if you actively contribute.

The word there is "contribute", not participate. I don't imagine there can be participation in your 250-student chemistry class; a crowd that size usually induces some strong feelings of anonymity. But you must *contribute* to the discovery, explanation and learning that begins in the classroom and the lecture hall. The contribution is activity: preparation before the lecture, alertness during lecture, studying the material after the lecture, and questions during recitations. You need to see these as your minimum responsibilities for your education.

The role of lectures

As mentioned in other chautauquas, lectures provide a *framework* for understanding new material. It is not possible to cover all the material for a course in every detail in a semester of lectures. Nor can you expect lectures to necessarily produce understanding on the spot. Understanding new material and familiarity with important details requires study, in addition to attendance at lectures.

You must *not* consider this a shortcoming, or a reluctant compromise imposed by large classes and the university's inability to deliver individualized instruction. The learning that you do in your first year in engineering must rely heavily on *your own activity*; lectures are only part of the process. This is consistent with the requirement that you learn how to learn: so-called "life-long learning." As I wrote elsewhere, your learning needs to be centered on you and the material, *not* on the instructor and the lectures.

But lectures continue to have an important role in your first year in engineering. They explain the most important concepts and show you how to think about the material. In this sense they guide your study. To get the very most from your lectures requires three things: being there, being involved, and being prepared.

Being there

It is in your best interest to get to class on time. In the engineering industry, being late for a meeting is a considerable breach of professionalism. A good engineer maintains professional decorum [(32)] by always being prompt. If this is not your habit, acquire it; and getting yourself to class on time is a good way to do that. Being prompt for class helps you acquire the habits of an engineer.

Though you won't always agree, as an instructor I can tell you that class time races by and there is never quite enough time to cover the material. Preparing lectures is considerable work and good lectures use *all* of the time available. If you're late, you're going to miss something. And though some

instructors develop a rhinoceros' hide, and don't *seem* to even notice that you disturb the entire room by arriving late, all instructors find it rude. It's also disruptive to the students that are already in class. I do not tolerate lateness in my classes and require an apology, delivered to me and the whole class, from those who are tardy.

Being late is an all-around bad practice.

Lectures work when they are delivered with care and enthusiasm by the instructor and are followed by you with alert care. Alert means rested and ready to work at listening and comprehending. You must *arrange* to be alert in class; it is a matter of time management, *not* just "how you happen to feel." So, you should not be just out of bed and groggy, nor fatigued and ready for a nap; not full and sleepy from those two quarter-pounders and fries, nor edgy and distracted by an empty growling stomach. Your time is arranged around your class schedule, so should your mental state.

Being involved: listening and taking notes

Note taking begins with listening and seeing. Careful listening is not at all like the passive intake of television viewing—*that* is more like hypnosis. Large class size and lack of preparation will tempt you to be passive and to put yourself on "intake mode", your mind's voice being silent. This is a mistake. Careful listening requires full attention, with your mind's voice and mind's eye *active*. You are not "just listening", but trying to judge, evaluate and see relationships. If your mind's voice and eye are active you won't wander or permit distractions to have your attention. This is how you listen intently.

So "listening" to a lecture means you are paying close attention to the presentation *and thinking*, getting the meaning or information presented. You may not understand *all* of it, but you are not missing the main points. Taking notes means recording the meaning or information of the presentation; if you don't get the meaning, then recording the words of the presentation. In this regard, reading the appropriate material in your textbook before the lectures makes it easier to take notes.

Notes taken during lecture should be a study aid. Writing is the *first step* in understanding new material and must not be your only reaction to a lecture, to be looked at again only just before a test. Notes are your initial assessment of the main points and important detail presented during lecture. Though it's true that writing initiates understanding and remembering, the very tentative nature of this is usually over-looked. This initial process is incomplete; you cannot get everything down in your notebook with a completeness that you need. And it is unlikely that you can understand well enough everything that you write down. There is no escaping the fact that *sometimes* you will simply be a scribe during lecture. You cannot produce a complete and detailed summary of new material from *just* a lecture.

The *second step* in understanding new material is a revisiting and studying of your lecture notes; completed soon after you produce them. Here, you complete the notes, filling in details, annotating with words, phrases or drawings that record the understanding you've reached, and recording questions about the material. This second pass over your notes makes them complete *and* makes them useful to you. This is *not* "reviewing your notes"—a usually passive activity, not involving writing, that is mistaken for study.

Use a spiral-bound notebook. Loose-leaf notebooks are convenient, but the opportunity for losing pages is too great. Use your notebook in a way that accommodates the second pass. I recommend something like the following. On each page, draw a vertical line from top to bottom about 1/5 of the way over from the right edge of the page. Use the left-hand 4/5 of each page to record notes taken during class. Leave the right-hand 1/5 for:

- unresolved questions that occur to you in class,
- derivations that are provided just for completeness,
- signs to indicate that you're uncertain about that part of the lecture,
- tangential things presented in class that might be helpful but not essential, and
- writing that you do during the second pass through your notes.

There is nothing imperative about this format; others can work just as well. Whatever method you use should permit and encourage a second pass through your notes.

When you take notes, clarity, neatness, and utility are the goals.

Clarity means your notes convey the order, relative importance and detail of the concepts and equations that are presented. Number and date the beginning of each lecture. The relative importance of main ideas and subsequent subordinate ideas or details can be made clear by the *structure* of your notes. Use indenting to help you with this; main ideas, key phrases, important equations are written beginning at the far left of the 4/5 page you're writing on during lecture. Indenting from there signifies a related but subordinate item. This is a loose outlining. If a *process* is being presented, number the steps as you go along and leave enough space between items to eliminate ambiguity. Drawings, figures and graphs should be large enough to be labeled clearly.

Neatness helps reduce ambiguity in your notes. Messy notes are hard to read and easy to misinterpret. Neatness is easy to bring about; it's little more than good habits:

- leave enough space between things for later annotation,
- use a pencil so you can erase and rewrite if you need to, and
- write knowing that you will come back to *study* what you are putting down, as if a stranger were going to read it.

Utility means your notes are an aid to study, helping you understand new material. Part of their utility is completeness. So, write down *all* the important points, steps in the process, parts of the equation. You should not assume you'll go back later, remembering with sufficient detail what was said or written on the board, and then fill in the holes. You won't; write it down as you hear it or see it.

An effective lecture is a real workout for everyone involved: you, your classmates, and the instructor.

Being Prepared

Preparing for lecture can involve completing a reading assignment from the textbook. The instructor evidently needs you to read and understand some material from your textbook to prepare for the next lecture. A reading assignment gives the lecture its maximum clarity and benefit. Do it. It is a mistake to think you can go back and pick up the reading later without there being much consequence. Showing up to lectures "cold" significantly reduces their effectiveness.

Part of preparing for the next lecture is finishing your work on the previous one. Naturally, material is presented in a way that builds; you need to keep up. The second pass over your notes for one lecture should be completed before you attend the next, and the second pass should be *study*, not just "review" or reading. This gradual investment of study is more effective than an intensive, and often frantic, session when you "study for the test." Preparing for class *is* preparing for the test. It is very tempting

to just take notes from lecture to lecture and not really look at them until you're getting ready for a test. This always wins the first place-award for ways to make your life difficult.

Poor Lectures

Even very good instructors have off days, and give lectures that are poorly planned or delivered, or worse, are inscrutable.[36] You and your classmates are bored and confused. Or it may be your lot to have a course taught by an instructor who isn't very good. The temptation will be very great to become passive in lecture; or worse, not attend. In this case, stay focused on the material. It is virtually impossible for even poor lectures to convey *no* information. It may be difficult to get to, but it is likely to be there. You will need to work harder in these cases. You should be more willing to ask questions, even in large classes. Certainly you should be prepared to rely heavily on the textbook, recitations, and the teaching assistants, if the lectures do not help you. Never let an instructor get between you and the material you need to learn.

But be very careful about identifying "poor lectures" and dismissing them as useless, especially at the beginning of a course, especially in your first semester. It may take some time for you to adapt your learning style to the teaching style of the instructor. You are probably more flexible in this regard than you think, and the fit might become better than you first imagine. Besides, you cannot expect an exact match of styles, particularly in large first-year courses. The Chautauqua on You says more about learning styles.

I remind you again that the center of learning has shifted from the instructor and the lectures to you and the material you need to learn. A good lecture is not *necessarily* utterly transparent, presenting material in a way that provides *immediate* accessibility and understanding. Some good lectures are themselves exercises in the vigorous process of learning, demand hard work from you. Other good lectures convey difficult material and you can expect to leave with only a framework of understanding. Only further study will bring you to your A-moment, and no mere lecture can substitute for this.

Questions to answer, things to think about, and exercises to perform

1) You've probably taken two or three weeks of lecture notes so far this semester. Analyze how effective a study aid they are.

    a) Find two or three willing classmates in one or two of the courses you're taking, and ask them to get together with you to look over discuss each other's lecture notes for one or two recent lectures.
    b) It's probably helpful if each of you bring copies of your notes for everyone else.
    c) Think about the differences you find between the sets of notes—there may be things about them you would find helpful to adopt.
    d) Have everyone in this small group attempt the describe the process they use to take notes. (this is tough to do.)

2) Identify the course you're taking this semester that has the most interesting lectures.
    a) Can you pinpoint why they are so attractive? What are the reasons?
    b) Are your notes in this course different in quality from your other courses? How?

A CHAUTAUQUA ON TIME MANAGEMENT
-
MAKING THE HOURS COUNT

The role and importance of time management

Consider the time required achieving your first year academic goals. You carry 16 credit hours of courses in the semesters of your first year. This means you spend 16 hours per week in classes. The assignments and study for these courses require, on average, between 2 and 3 hours outside class for every hour you're in class. Let's say 2-1/2. This is 16 x 2-1/2 = 40 a week. So, the total for *academic activities alone* is about 56 hours per week.

The 2-1/2:1 ratio isn't a rule, it's simply how things are. It is the average of what I've found required to do very well in first year Calculus, Chemistry, Physics, and Computing. Courses may start slowly, but they soon require about this much time. This average ratio of 2-1/2:1 includes study, assignments, recitations, and laboratory work. You are tempted to think I'm exaggerating, hoping to make a dramatic point. No—this is simply a realistic assessment of what you need to do to be successful.

Not every week will have 56 hours of academic work in it, but most will. If you average 8 hours of sleep a night, then 56 hours is 50% of the time you are awake each week. And with these hours you must accomplish many different tasks. *Any* professional in *any* field would assure you that you cannot have a successful work week of 56 hours, allocated to diverse activities, without time planning, setting priorities, and discipline. This is time management.

Time is your most valuable resource. If you clearly understand your need to control how you spend time, and if you summon the discipline to exercise that control, then academic success in your first year in engineering is likely. Time management is a skill you must learn in your first year; only effective study is more important. Time management will have increasing value through your academic career and will be essential when you begin your career as a professional.

In addition to attending classes and studying you must have leisure. You *cannot* have a successful first year if all you do is study. You need time to relax, time for exercise or athletics, and time for your social life; you *must* have time for these. I suspect you don't need convincing about this. However, simply "having some leisure time" is not sufficient. A subtle thing requires your attention here. The *kind* of time you have for leisure is important. By this I mean its concentration, its configuration, and its place in your week. These are important because they affect the character and quality of your leisure: how far away, in "mental distance", you get from your studies, and the vividness of your memories of leisure time.

Relaxation, exercise and socializing are important enough to deserve blocks of time, rather than just scraps or bits of time, the odd moments when you're not busy. Blocks let you organize more interesting activities and let you get more involved in them. This works better than using small bits, even if the bits do add up to the same total as the block. When the week comes to a close and you look back at what you did, you don't want to feel that *all* you did was study. Bits disappear, even after only a day. Blocks spent relaxing, exercising or playing sports, or socializing help you see that there was time *not* spent studying; time spent taking care of the rest of your life. Your own leisure is too important to be *only* the result of what happens to be going on around you; the default condition. I am not arguing against spontaneity, but rather that you take an active role in this important part of your life.

An assessment

And now, another rather delicate business. The first step in learning time management is to assess your current time management ability. Essential to this is looking at the recent past, seeing how you managed your time. So I ask you to think back to high school for an accurate picture of your time-habits; it's only been a few months.

Based on what I've learned from first year students, I can poke your memory a bit:

> In high school your homework assignments and tests were neither difficult nor frequent, so you worked infrequently. You had a just-in-time approach to study: starting your work just before it was due. This lack of serious on-going challenges left you without the habit of steady, ongoing studying.
>
> In high school your schedule was often fixed for you by the school, your classes were grouped together; you were "in school" for an uninterrupted block of the day. There was not a significant amount of unoccupied time. This didn't leave you with the ability to use isolated blocks of time: an hour here, an hour there.
>
> In high school you had *lots* of time for all the things you *had* to do and *wanted* to do. And you managed to get done what you had to do with the just-in-time approach. This didn't require much ability or exercise in planning and scheduling your time. More importantly, the consequences of missing something were not large.

So, I safely assume you don't have time management skills. *Most* first year engineering students don't. You should know that in the very large first-year introduction classes that I have taught recently, approximately 50% of the students state that they had 1 hour or less (!) of school work to do *outside* of school, *a week*. So, the "work week" was approximately 5x6 = 30 hours, about half of what is required for your first year in engineering.

You need to acquire time management skills. Please don't think you can place your hand over your heart and solemnly resolve to "be organized" or "do every assignment ahead of time" or "study every night", and that such a resolve will do any good. You will learn that simple resolve is a very weak force in your life. It is powerless against long-standing habits. But time management provides a *method* for change and for getting the gritty things done that, when accomplished, bring about a successful first year in engineering.

A method for time management

Planning and follow-through are the components of time management. It sounds simple—it is. It sounds easy—it isn't. You plan how you spend time in a series of steps, and you follow-through by having the right habits. Here are the steps and habits of a time management program for your first year in engineering.

1. Recognize time as a resource
2. Understand your current time allocations
3. Know how much resource you have and how it's spent
4. Plan and re-allocate your time resource
5. Maintain time management habits
6. Stay in control

I'll explain each and give some suggestions for performing them.

Recognize time as a resource

Time is something you *spend*, a thing *invested*, from which you expect a *return*. It is too passive to hold that time is simply something that "goes by." Considered as a resource, time has three characteristics that need to be explicitly[18] considered if you hope to manage it.

- Time is spent only once
  An hour spent well or poorly is gone all the same. So you cannot "make up the time" that you misspend; you must displace some other activity in the future. I am not advocating a manic preoccupation with the fleeting minutes, rather a consciousness of the single-expenditure nature of time—it helps suppress procrastination.
- All time is not the same
  Different hours find you with different energies and moods, so you need to schedule your activities with this reality in mind.
- How time is spent always results from a decision *you* make
  Only *choice* changes how you spend time. Time is *your* resource and you should always be making explicit choices about how it's spent. The default conditions around you should have little influence on how your time is spent.

These characteristics demonstrate that planning is critical to time management. Consider, for example, preparation for a test. The time *available* for preparing is limited and available only once. That you actually use enough to prepare requires scheduling and discipline. You still have other work do, so studying for the test needs to be fitted in. The time you schedule for studying needs to account for when you are most alert. Cramming for the test has you studying late and therefore fatigued, and under stress because you are distracted by fear. Not having enough time to prepare is the result of *your* decisions to spend the available time on other things. You don't "run out of time"; you fail to plan and follow through.

Understand your current time allocations

It is a mistake to open a planning book and simply concoct [19] a schedule that you expect to follow. The chances of this working are vanishingly small. Follow-through *must* be based on realistic expectations. It cannot require the immediate cessation of long-standing habits or immediate reliance on new ones. You must begin by knowing your current habits; seeing and then evaluating them. Only after you know your habits is it possible to draw up a realistic time management plan. Then, since it's likely that you'll need to change some habits, your planning can include the process of gradual change. So, the first step in planning is acquiring an accurate account of what you're doing now.

This accounting step in your time management plan should be performed for a week early in the semester. Appendix 3 of these notes contains daily log sheets for recording how you spend time. Complete a daily log for each day in your accounting week. The daily log gives increments of 1/2 hour because you need to know how you spend your days at that level of "granularity." Don't imagine you can remember how you spent each 1/2 hour at the end of a long day; do some recording during the day. Here is a good way to gather the data you need to fill out the daily log.

> Buy a very small spiral notebook, no bigger than a pocket. Pause 5 or 6 times during the day and jot down the times and activities for the past few hours. Don't let more than 4 hours go by without recording your activities. Try doing this at
>
> - mid-morning,
> - noon,
> - mid-afternoon,

- after dinner, and
- bed time.

At day's end, transcribe your activities from the little book to the daily log. Do this for each day of the week.

It is essential to be honest and accurate with this record of your activities. For example, if you finished dinner and then hung out with your roommate for 45 minutes, record it that way. Don't record dinner as taking 45 minutes more than it did. If it takes 45 minutes to get ready and get out the door and walk to class, record it that way. Don't lump activities together. It is very likely you will find fractions of hours you can't account for. Record them as "unaccounted for."

Don't let the fact that you're accounting for your time influence what you're doing. Your friends will, no doubt, notice your little notebook and make snide references to geeks or Sherlock Holmes. Pay no attention.

Know how much time resource you have and how it's spent

You have a week's worth of data and unless something peculiar happens, this can be taken as representative of what you do. Tabulate the time spent in the following kinds of activities. Use at least all of these categories, and add others that may apply such as "work" or "church".

- Night sleep
- Meals
- Exercising or sports
- Class
- Study
- Doing homework
- Socializing
- Watching television
- Naps (day sleep)
- Unaccounted

It's important to try to keep the studying and homework categories separate. The same is true for socializing and watching television. You may need other categories; add whichever are necessary to get a good overview of your time habits. You'll find it helpful to convert the times you found in the all the categories but sleep to fractions or percentages of the hours you're awake in a week. Arrange them by size, from the largest fraction to the smallest and study these values.

Make sure you know much time was unaccounted for. Time management begins with knowing where your time goes. If you know how you've spent your time, you can look back, make a judgment, and plan for a change if that's what you decide to do. But you can't do these things if you don't have an accurate idea of how you spend your time. If you can't account for 15% of you time; you should repeat the accounting activity for another week.

You will be very surprised by this tabulation. But don't start muttering "I resolve"; do the next step in the time management process.

Plan and re-allocate your time resource

Using a copy of the weekly log in Appendix 3, fill in the time that is devoted to classes, meals and other activities that don't allow much flexibility. In another chautauqua I discuss class preparation. Based on that, I recommend you allocate at least 1 hour each weekday for studying your class notes and preparing for lectures. Then, using your time accounting from your typical week, determine how much time you need for studying and doing homework. Put this time into your weekly log. The best and least difficult way to study successfully in your first year is to study in a frequent, steady, regular way. Work part of the morning or afternoon, and in the evening. It is best if this time is spread uniformly through 6 days of the week. Don't schedule important studying at the end of long days; you will be fatigued and unable to exert and focus yourself as you should. I suggest your log leave one day a week *completely open* for leisure and activities unrelated to your courses.

This weekly log is a template[36] for all the weeks in your semester. Leave enough space in the blocks to record and annotate [28] what you did. Copy this weekly log for each week of the semester. Then use the syllabus from each class to schedule the dates for tests, examinations, projects and papers throughout these weeks. At this point, you may only have a very rough estimate of how much time you will need to prepare for a test or work on a project. Whatever that is, allocate that time, working backwards from the due date, using reasonable time increments scheduled into parts of the days that have not already been scheduled. This will show you the weeks that require more study and preparation time.

A perfectly useful alternative to generating the log pages described here is to transcribe this information into any one of the commercially available weekly planners. If you purchase one of these, make certain it has enough space your you can schedule each day. These planners can be very elaborate with places for addresses, notes, and other things you need to record and recall. They are very useful and worth the investment. But if money is an issue, your own log pages kept in your notebook will serve just as well.

Now, into these weekly logs or your planner, schedule the leisure time you need. Time for football games, parties, sports, or television. Consult your week of accounting to keep this realistic. I advise you to treat television as a low form of leisure, that should be scheduled like other activities. What's left is unscheduled time: time between classes, late at night, around meals. Some will be in small pieces that make it hard to use it for certain things. However, most unscheduled time will be in large blocks and is a significant part or your resource. You should keep it free for that purpose.

So you have a time plan for your entire semester. Part of it is very tentative, but the important demands for your time have been recognized. Compare the weeks from your weekly log to your week of accounting. The larger the differences, the more vigilant you will need to be about adhering to your time plan.

This plan is tentative; it will and should change as the semester progresses. You will need to study more, assignments will take longer to perform, and the material will increase in complexity and you'll need more time to study enough to master it. All this is normal and expected. As you learn more about the semester your time plan should change. Time that was originally unscheduled becomes scheduled.

Maintain time management habits

Your planning book won't do much good if it isn't within reach; keep it with you. Due dates you already know about should be recorded. Due dates for assignments you get as the semester proceeds should be recorded, right in class as you get the assignment. Dates with friends, student organization meeting times, and any other thing or event that affects your day should be recorded.

Consult your week's log often. You should be able to arrange things so that there are no surprises. It will help you to maintain time management habits if you have some feedback. So it's useful to annotate your week's log with the time *actually* spent studying and doing homework, socializing, and playing sports. This serves as a quick and useful diary of your activities. It gives you clear and supporting evidence that you do maintain a schedule, or a necessary and unavoidable rebuke that you do not. Either is helpful.

Stay in control

If your log has "study" scheduled, then study. Don't permit yourself to procrastinate.[20] If you find you're just too tired or distracted to study or do your homework, *re-schedule the time*. Move this study time forward to a time block that is unscheduled, or displace something that has been scheduled. But don't just not do it; *always* re-schedule.

By re-scheduling I mean *writing* this postponed task into an unscheduled block of time, not just "making a mental note". Writing it down will, of course, help you remember; more importantly it's an *action* that generates a mild formality and perhaps added commitment. This habit of re-scheduling is especially important for the time scheduled for work on preparing for tests or working on projects or papers.

Make sure you don't *unknowingly* surrender control of your time to your friends, your roommate, your parents, your girlfriend, your boyfriend. When someone suggests something that would seriously change your time allocation, think about it. It's easier to say no than to get those hours back. There's nothing wrong with spontaneous changes to your time allocation; just be sure you have enough unscheduled time to use, or have something that can be displaced or dropped without causing problems—sleep is *not* one.

Poor planning or failure to follow the plan almost always causes "Running out of time". Of course you encounter some unexpected demands on your time, but those demands are very infrequent. I use "demand" to distinguish an *intervention* from an unexpected *opportunity* to spend time. An intervention is likely to be unavoidable; an opportunity should always be evaluated.

You should *never* run out of time. If you find that you have, you should review what happened so that you know *exactly* why. You need to know whether: not enough time was allocated, you failed to re-schedule, or you simply didn't do the work or spend the time you had scheduled. In the first case you need to adjust your time allocation. The other cases are more complicated. You may find yourself not re-scheduling or not doing some work because you feel that you can afford to let "a few" small things slip. You cannot. In the chautauqua on goals, the link between large goals and small was made clear; achieving the small goals *is* achieving the large goal. *There is no other way*.

So, asking yourself if you "feel like working on an assignment" is the wrong question. Ask yourself, rather, if you "feel like having a successful first year in engineering." The answer to the first question is often "no", and that to the second is certainly "yes." There is certainly nothing wrong with not feeling like working on an assignment. Trouble begins when your behavior is governed only by that immediate (and temporary) feeling. You need to remind yourself that larger issues are involved. This kind of *self*-diplomacy, *self*-assessment, *self*-argument is what *self*-discipline means most of the time.

Summary

So perhaps it appears that time management turns you into a programmed robot: marching around; checking your schedules; checking your watches—you have two of them in case one breaks—the perfect geek. I admit that the accounting and scheduling *appear* excessive, even silly. But I cannot overstate the value of *knowing*, not thinking or guessing, how you spend and plan your time. The week of accounting is necessary, and the scheduling is necessary. These activities might seem *unnecessarily* or *stiflingly* analytic to you, and therefore strange and "geeky." But that is only because they are not your current habits.

Time management is an essential aspect of professional life. It is something that all busy professionals do. It's a small investment with a big return. All but a few intransigent [21] students find it powerfully helpful and are glad to have learned how to do it.

Questions to answer, things to think about, and exercises to perform

1) Perform the time accounting exercise described in this chautauqua.

2) You are likely to be very surprised when you look over your week of time accounting. The time you waste, the time you have trouble accounting for, and the time you spend in front of the tube, will be more than you imagined. The tube is likely to be a particular problem.

    a) If you need to change your habits in this regard, *how will you go about do it*?
        i) Are you the type of person that uses abrupt change? Going "cold turkey,"
        ii) Are you the type that needs to change gradually? "One step at a time."
        iii) Have you talked about this with your new friends and classmates? What plans, if any, do they have?
        iv) What physical and social things will you need to modify if you what to see your habits change?

    b) Small amounts of time (an hour or less) can be hard to use. What things, perhaps not related to academics at all, can you do with these small blocks of time? College life can be rich with new experiences, ideas, and activities. Some of these don't require large amounts of time. If you don't have anything in particular in mind, where can you go, what can you do, to find out?

3) There is a big difference between

    - knowing how you spend your time and choosing to spend it in various ways, and
    - *not* knowing how you spend your time and spending it in *those same ways*.
    -

    In both cases time is spent in the same way. So where's the "big difference?"

    a) Carefully explain this difference. Here's some help:
        i) How does the exercise of choice effect you as a person?
        ii) How does being passively subject to the default condition around you effect you as a person?
        iii) What personal characteristics does an act of choice exercise?

    b) Explain why scheduling time is the link between attaining your goals and the passing of the days and weeks.

A CHAUTAUQUA ON YOU
-
PRACTICAL ASPECTS OF KNOWING YOURSELF

Knowing yourself

Let me make certain you understand that I'm not attempting to "be psychological." I don't believe that you need to plumb the depths and listen to the whispers of your soul to have a successful first year in engineering. You *do* need to know with considerable clarity how you study, work, and socialize, and what your needs are for food, rest and exercise. This chautauqua is about practical self-knowledge, and *not* why your favorite color is blue. Even so, this requires habits of self-observation you probably don't have. This seems perhaps—well, silly. How can you *not* know you? You're you aren't you?

It is probably your assumption that because you *are* you, you *know* you very well. This usually isn't the case. As with the rest of us, because you *are* you, you have to *live* with you. Living with yourself requires a certain "filtering" of the picture of yourself you keep in front of you. Not everything that is you, is apparent to you. And aside from "filtering", there are some things that you do, or don't do, that don't command much of your own attention. They are things that have not been important in the past, or are such long-standing habits that you're no longer conscious of them. For example, you probably didn't know how much television you watch each week—only the time accounting exercise in the last chautauqua showed that to you.

There are three important reasons to know yourself well as you begin your career in engineering: the need for time management, the need for study and the need to manage your new environment.

As you read in its chautauqua, time management is an important skill you need this first year. Managing your time requires specific information about yourself that you probably haven't noticed or used in the past. As I mentioned in that chautauqua, you need to *know* your needs for rest, food, and exercise; you need to know their limits, high and low. Now I'm sure that you've *satisfied* these needs in the past, but I bet that you did so without knowing their extent [(31)] or the cost in time. It is not possible for you to establish a reliable and practical time management program unless you know your needs for rest, food, and exercise.

The demands for study, doing homework, working on projects, and writing papers are greater than anything you experienced in high school. So you need to observe and understand how *you* study, how *you* read, how *you* are distracted. Then you can compare your current habits to those you'll need for a successful first year in engineering. You also need to know when you need help with difficult material, when you need help from your instructor or when you need to arrange for a tutor.

Your first year in engineering is the very first step in a new stage of your life. There are new demands and new opportunities. You have, perhaps for the first time, no family around to support and guide, scold and nag, help and praise. You are on your own—but not by yourself. If you are observant, you'll see opportunities around you for friends and experiences that will help you grow. And with these classmates you can establish a community. I use "community" to name the group of friends and classmates in which you become welcomed, feel equality and, when necessary, find comfort. Part of building a community is knowing your own needs for it, contributing to it, and participating in it. Friends and community can be the richest part of your college experience.

There is another thing you'll see if you are observant: powerful forces that can reduce the control you have over your life, forces to conform, to compromise, to give up. Examples are the pressures to use drugs and to abuse alcohol. These should have no place in your life. These forces are there, even if

you aren't observant and don't see them; they will be at work, nevertheless. So you need to learn how to keep in control. You need to learn more about yourself than you know now.

The view of a stranger; a way to know yourself better

Sometimes family and friends can help you understand or recognize things about you and your habits. You go to them because they view you "from the outside"—their view can be more objective than yours. Looking at yourself "from the outside" is a skill you should acquire; it provides self-knowledge you can acquire no other way. What does "from the outside" mean? It means knowing yourself by looking at you and your habits as a respectful, interested stranger would: objective, non-judgmental, observant, and interested in details. Looking at yourself as a stranger is an important skill. No judgment, at least initially, just attention to the facts. This is much more difficult than it seems at first.

One reason for this difficulty is that you probably confuse being *comfortable* with yourself, with *knowing* yourself. You probably were very self-referent, maybe even self-absorbed, in high school. This is a natural part of becoming an adult. And we all want to think well of ourselves, it's part mental health. But one habit you may have is thinking almost everything you do is OK, or good enough. A stranger might say that you've made peace with carelessness, and signed a truce with half-hearted attempts. This can certainly make it hard to perform at your full capability. It is now time to look at what you do with the eyes of a stranger.

Perhaps you don't feel this way at all. Perhaps you feel you can't do anything right, your performance is never satisfactory. You may have become comfortable with this view of yourself. A stranger might say that you've given up without a very good reason, and are simply feeling sorry for yourself. This, too, makes it hard to perform at your full capability. And the view of a stranger is what you need.

Looking at yourself as a respectful, interested stranger means observing what you do carefully. Making *sure* you see requires that you look at a record of what you've done. Reviewing your activities helps you see how you spend time and how well you adhere to your schedule.

Looking back on one week is good way to do this. Please don't think you can keep all this in your head and then put your feet up on Sunday afternoon, remember the details and "review the week." You can no more do that than you can flap your arms and fly. The detail you need will not be available. No, you need to look at a written record. This is the great value of annotating your weekly time management log; it provides the detail and certainty you need.

I again recommend that you take just one minute at day's end, consult your log, and note in the blocks for that day whether you did the scheduled activities. This should include work and play. If you didn't do your scheduled work, note that and record the reason. Remember there will *always* be a reason. You may not like what you write, but write it anyway. This becomes a "one minute" diary of activities related to academic success in your first year in engineering. These weekly plan annotations should include at least the following:

- homework assignments
  - completed on time
  - performed with care
- study sessions
  - quality: distractions? focus?
  - sufficient time
- test preparation
- leisure

At week's end take just 5 minutes, read over the record, summarize your observations, and then *write them down*. There is something helpfully external about observations you make and then *write down*. *Reading* them helps you assess their correctness in a way that just *thinking* about them doesn't permit. Remember, the goal is to develop an objective view of practical issues, not to figure out why you like blue.

Read this summary and make judgments. You will probably *not* to be very critical. This self defense is natural. But if you really want to perform at your full capability, change habits that are getting in the way of your success, or get habits that will aid your success, you will need to welcome this new view of yourself.

I believe you will find that just two weeks of this activity brings you a habit of looking at yourself as a respectful stranger might, and that your self-knowledge grows considerably. So even though this process appears to be somewhat artificial—and if not that then certainly compulsive—it need not last very long, for the benefits are immediate.

Acquiring practical self-knowledge

Here are some practical, fundamental questions about yourself you should be able to answer, and suggestions about how to answer, if you can't. These items can help you define the requirements for activities in your week and reduce stress that might be caused because something is missing or you "run out of time." The answers to these questions can be very helpful in your time management process. They are here because I have found these, in particular, to raise important issues for many first-year engineering students.

How much sleep do you require to be alert during the day?

Successful time management requires you know how many hours you're awake during the week. Obviously you need to know how much sleep you need. Please understand this is *not* the number of hours you'd sleep if you slept until you woke up, with no alarm or morning light. This is the number of hours you need to feel refreshed and rested most mornings. Everyone has a different sleep requirement.

You may need to experiment to determine this. Once you've settled into a routine on campus, try more and less sleep than you usually get. Evaluate how you feel. *It is not unusual for sleep habits to change a lot when you utterly change your environment and disconnect yourself from familiar surroundings and people*.

You should consider your need for an afternoon nap. Some active and effective professionals take naps. Naps can often make the last half of your afternoon more productive by having you more alert and rested. Would they help you? A nap in the afternoon may be much more effective for you than additional sleep at night. If you need a nap, take it. You will need to have the time and this will require some time management.

It is universally recognized as a bad idea to get your nap during an afternoon lecture.

What are your eating habits?

What is your most important meal during the day?
How much time do you need to devote to this meal so that you enjoy it and have the time you need? Do you like to take this meal in the company of others?

Change your eating habits significantly only after some thought. Don't skip meals or hurry through them if that has not been your habit. Some change is unavoidable. I still recall my shocked reaction to "dorm food", having been raised on my sainted mother's Italian cooking. Gads! On the other hand, I have a faculty colleague who says he discovered "dorm food" to be a gourmet delight compared to *his* mother's cooking.

How much physical exercise do you want and need?

It will be a mistake to ignore your need for physical activity and/or participation in sports. You may find out that because you are studying more than you ever have, your need for exercise is greater. And if you get more exercise, you may need more sleep. Time management will be especially important here.

How much and what type of socializing do you want and need?

College life can be a deep and rich experience with many dimensions. The academic and intellectual dimensions are probably sufficiently well defined for you as a first-year engineering student. The other dimensions are probably not. Your social life, in whatever form, should be the subject of a little thought on your part.

Interpersonal growth, fun, even joy, can come from your social life. Because these things are so important you should make sure that the life you establish in college makes room for them. You should think about how you socialize now and, perhaps, how you might what that to change.

It is likely that you left family and friends back home; you need to meet new people. How will you do that? Do you have people in the your classes or in your dorm that you need to reach out to, “break the ice?” Or is it your habit to wait until someone does that to you? Can you afford to wait for that now? You may make friends you will have for the rest of your days, if you take the initiative.

What role do music, sports, outdoor activities, talking, dancing, and parties have in your social life? What amount of time do these things require if they are to bring you pleasure? Spontaneous socializing can be great fun, but organized things like hikes, meals, and concerts can also be fun. They will need some planning.

How much Television has it been your habit to watch?

Television watching is usually wildly *underestimated* by students and can be a “silent demon” that significantly shortens their week. Use your time management accounting log to measure this in hours per week. You need to be very honest about this.

Do you watch "The News" every night around dinnertime? Does that lead to early evening television watching? Do you watch "The News" at the end of the evening and then some late-night programming? Does this keep you from a full night's sleep you need before an early morning class? Do you watch "The News" after lunch, and slide into some afternoon programming? Better to read a newspaper.

Are there programs you really enjoy and want to see every week? How many hours is that? How much of the stuff that you watch can you do without? Is television your way of combating boredom?

Knowing accurately the number of hours you watch television can be difficult. Some people claim not to be affected by television when it's on in the same room. "I just need background noise while I do my work." Rubbish. You need to precisely understand that it's still a distraction and reduces the focus of your reading or studying. Television is a powerful sink for time and attention.

Do you know how much you've learned, how much progress you've made?

This item is important because it is one way you become confident. In the chautauqua on goals I make it clear that confidence is built from *your own* observation of *your own* learning and performance. In addition to confidence, observing your own learning and performance is a significant factor in maintaining your motivation.

So you need to see that you are succeeding, and *seeing* requires that you *look*. You need to look at your homework, your examinations and the lecture notes that you acquire if you are to get an overview of your own progress. You need to look backward every once in a while.

Because the pace is rapid and because you're so close to your work, the default condition is *not* to look back: you get back homework and examinations, check your score, and put them away. If you do this, your own work is a blur and the result of that work is *not* evident. The default condition is to look only forward, since that's where your next assignment or examination is coming from. So it's easy to be dismayed or even overwhelmed by how much there is left to study and understand, and so not see how far you've come.

A backward look is essential to see the result of all your hard work and the hours spent studying. This positive feedback is very important. It will help your motivation, commitment, and stamina. Here are ways to observe your own progress; the last is particularly powerful.

- Every other week, review the notes you have taken during the classes for a course. This review should *not* be study, but rather a reminder of how much ground you've covered, how much material has been presented and how much you've studied. It will give you the overview of your progress. If you've taken the time to annotate these notes during the times you've studied your view of your own investment and accomplishment can be even more emphatic.

- Look over the assignments you've gotten back. Again, not with the intention of study, rather to remind yourself of the material you now understand and the problems you now know how to solve.

- Recall from memory a view of yourself as you were at the beginning of the semester. Specifically, recall yourself in the state of ignorance that defined you at that time. Consider your new knowledge and new skills, recalling the hours you've worked and studied. This particular form of looking back is difficult, but results in a clear and unmistakable view of the progress you are making. I think it important for you to have a remembered vision of *you* not knowing what *you* know now. This

produces a certainty and a confidence that can be acquired in no other way. Making it personal makes it powerful.

Knowing you and how you learn

We all learn in different ways. Knowing the process by which *you* learn is an essential part of having a successful first year in The College of Engineering. Though categorization has to be handled with very great care, it can be useful in this process.

One well documented and widely used method to categorize people and to understand how they learn is the Myers-Briggs Type Indicator. This has come to be a widely used tool in understanding types of people. The mother-daughter team of Katherine Briggs and Isabel Briggs Myers developed a series of questions (an "instrument" as the psychologists have it) designed to uncover the preferences of an individual. These preferences are used to place the individual in a structure based, in part, on the idea of psychological types of Carl Jung. These types are based on the following ideas.

a) Everyone has an orientation to the world that indicates whether their interests draw them
   i) To the outer world of people and events (Extroversion, **E**), or
   ii) To the inner world of ideas and actions (Introversion, **I**).
b) Both of these basic types of people consciously process information primarily through either
   i) Immediate and practical experience (the senses, **S**), or
   ii) Possibilities and the meaning of experience (the intuition, **N**).
c) Decisions are made on the basis of this information by either
   i) Logical, objective analysis (thinking, **T**), or
   ii) Personal, subjective values (feeling, **F**).
d) Behavior is the result of either
   i) Adaptation to situations and spontaneity (called perceptive, **P**),or
   ii) Adherence to structure, plan, and order (called judging, **J**).

Remember that these are *preferences*, not rigid categories. The two types or poles in each of the four areas means that this structure has 16 types of individuals. The bold letter after each definition is used to label these types. Most engineering students are types **ISTJ** (29%), **ESTJ** (26%), **ENTJ** (20%), or **INTJ** (17%). Think about it, it shouldn't surprise you. Very few engineering students are of type **ESFP** (5%). Student Services will administer the Myers-Briggs "test" to you on campus for $25—which includes a session that explains the results.

As you can see, *most* (92%) engineering students are Thinkers (**T**) and Judgers (**J**). The split between 1) Extroverts (**E**) and Introverts (**I**), and 2) Sensors (**S**) and Intuitors (**N**) is roughly equal. This is also true of professional engineers.

Can all this be used for something other than a fancy horoscope reading? If we apply it to learning, we discern[37] important differences between people. Think about how you learn and identify your preferences and characteristics from the following pairs. There is no intended relationship between issues in the same column.

Need to begin working from detailed, concrete, specific information and build up to a large organization	Need to see the large organization ("big picture") before details make any sense or are even interesting.
Are comfortable working through new material alone.	Talking and explaining material to others helps your own understanding

Can come to an understanding from things explained with written words and symbols (like mathematics)	Need to see a picture, a graph, or some geometry related to the material
Comfortable with a process that tells you what to do	Need to know why something is being done.
Uncomfortable with equipment until you understand how it works	Enjoy tinkering with things, taking them apart, seeing what's inside.
Even though it takes longer, you like to be given just a bit of guidance and then go off on your own.	Want enough explanation so you don't wander around; you want to get the job done.
Like short working sessions and want to see progress after each one	Want and need long stretches of uninterrupted time to get your work done
Hearing something described is sufficient to trigger your imagination and your mind's eye, so that you understand	Need to see something written down or based on a figure or diagram
Can write fast	Write slowly
Like a problem with an obvious end or limit and are uncomfortable with fuzzy things	Don't particularly mind a sloppy, fuzzy, "open-ended" problem.
Not very good at memorizing and recall	Can memorize and recall details

If you know how *you* learn, you can detect situations that are not a good match to your learning style. This is the first step in either changing the situation or modifying your custom. Lectures and your textbook may not give you what you need or take you through the steps required for *you* to learn. If you know what's missing, you can add it.

Knowing when you need help and what to do about it

There will very likely be times when you feel overwhelmed by all that you have to do. I believe it important to determine whether you feel that way because you really *are* overwhelmed or simply because you feel stress.

If you are overwhelmed, you need help. Some help you can provide yourself, some will need to come from others. How can you tell if you really are overwhelmed? The symptoms are likely to be: not getting assignments done, poor grades, not keeping up with the presentation of new material. If these things are happening, determine the cause. Here are some likely ones:

- Poor time management
- Insufficient study time
- Tutoring required
- You're not suited to engineering

The very first thing to do is evaluate you time management activity. In the unlikely event that there really isn't any more time in your week for study, then you probably really *are* in over your snorkel. See your academic advisor and initiate a plan to reduce your work load.

It is more likely that you need to study more. Remind yourself that you're not in high school and that achieving the goal you've set requires more work than you first thought. If you need to study more, re-work your daily and weekly time management plans to provide more study time. Then study more. It sounds easy—it isn't.

If you are studying a lot, but just not "getting it", try working with a tutor. Part of the transition from high school to college is learning how to shift the center of learning from an instructor to you. This can be a

difficult skill to acquire. There is certainly nothing wrong with needing some help during this transition. Tutoring can provide the one-on-one or small group instruction required to help you make this transition. Tutoring can provide alternative explanations for new material, encouragement, and an environment in which you feel free to ask lots of questions. You should have no hesitancy to work with a tutor if you know that you are overwhelmed.

It may be that you are not suited to be an engineer. You should not permit yourself to reach this conclusion until you've first eliminated the other causes I've listed. And you should not permit yourself to reach this conclusion by yourself. Getting out of engineering is a big step and you should get your academic advisor involved in deliberations that lead to that action.

It may be that you *feel* overwhelmed, but really aren't. It is important to know whether this is case, because you need to do different things if you are overwhelmed or "simply" feel that way. Here are some causes for feeling overwhelmed:

- Reaction to difficulty
- Stress due to worry
- Insufficient leisure or social contact

Obviously, you should not give up because things are difficult. It is likely that you are *not* used to study and reaching understanding being difficult. As I mentioned before, your talent is such that you probably went through high school without strenuous exertion—so don't panic during what may be your first encounter with real intellectual difficulty. *Remember to separate and set aside the fear of failing from the difficulty of a task*. You probably have evidence that you *can* do difficult work; you need to become used to doing it without succumbing to the fear of failure. I assure you that you will come to welcome difficult tasks as being worthy of your talent, education, training, and experience, and as a source of deep satisfaction when they are completed.

Worry is an irredeemably useless activity. Being concerned enough about the work you need to do should prompt planning and commitment, not worry. You will soon acquire evidence that you can do the work that is required. If you let it, this will build your confidence. If you worry and are stressful, remember to look back at the recent past and note what you have accomplished. Don't let the difficulty of what you are doing be a source of worry and stress. Doing difficult things is the nature of engineering.

Your feeling of being overwhelmed may come from not having enough recreation or social contact. Be careful you don't confuse this with not having enough time to just sit around. Recreation and social contact can provide a balance to studies, sitting around may not.

Things that may get you into trouble

You are going to be asked to go out partying on Thursday night—to stay out late; too late to get up early enough for class on Friday. This will become a four-day weekend that you cannot afford. It will be a mistake to make this a habit.

Some first-year engineering students choose to join a fraternity or sorority. "Greek life," as it is called, can be the foundation of an active and enjoyable social life, and the source of friends that last a lifetime—rewarding in many ways. "Rushing" and accommodating the demands of joining these organizations will require a great deal of time, and will require considerable time management. I am academic coach for one of the fraternities on our campus, and have come to know the extra effort men must make to find the time for "house activities" and their studies. I'm sure it is the same for sororities.

As important as these organizations can be, they should not come between you and a successful first year in engineering.

Things that *will* get you into trouble

There may very well be a time when you are at your wit's end, without an assignment done, unprepared for an exam, not finished with a lab report, or without a computer program that runs. The temptation to act unethically will be very great, almost overwhelming: to copy a friend's assignment, to cheat on an exam, to fudge and copy a lab report, to copy a program and change a few lines of code. Do not let these situations catch you by surprise—for you will be panicked and imbalanced by them, and do the wrong thing. You can be prepared in two ways. First is the obvious one: plan so that you have enough time to do your assignments and prepare for exams. The second is not obvious: think in advance about being in such a situation, as a kind of rehearsal for how you will behave. Having considered this issue in advance will help you. If you find yourself in a very bad spot, do the ethical thing: "take a hit," rather than be dishonest. In most cases in The College of Engineering, the sanction for academic dishonesty is failing the course; better to get a zero on an assignment or an exam, and leave your character intact, than to compromise your honesty, flunk a class, and have to repeat it.

You are going to be invited to drink and take drugs. As I stated elsewhere, drug use and alcohol abuse should have no place in your life. Have you thought about what you should do? Have you thought about what you *will* do? Drinking, for most readers of these notes, is illegal (yea, right). Drinking until you're drunk affects your mental ability for *two days*—not just Friday morning or Sunday morning. If nothing else, you cannot afford the lost time.

It is tempting to surrender to cowardice and dodge the issue of sex. But I will give this advice—and warning—to the men in my audience: That you are horny entitles you to nothing but perhaps a cold shower. You may now feel, or come to feel, that a date should include sexual release for you. But if a woman says "no"—no matter how quietly, how indirectly, how tentatively—and you force the issue, you will not be having consensual sex, but rather be committing rape.

APPENDIX 1
THE MANAGEMENT AND STRUCTURE OF THE COLLEGE OF ENGINEERING

Like any large organization, The College of Engineering has an organizational structure. It's a good idea for you to have at least a rough idea about this structure. There are two kinds of structure within the college:

- academic
- college-wide governance

ACADEMIC DISCIPLINE STRUCTURE - THE DEPARTMENTS OF THE COLLEGE

The primary units within The College of Engineering are based on the separation of engineering disciplines. Each discipline is considered distinct enough that faculty and students in that discipline are grouped into a department. Here are the departments in The College of Engineering.

- Aerospace Engineering Sciences
- Chemical Engineering
- Civil, Environmental, and Architectural Engineering
- Computer Science
- Electrical and Computer Engineering
- Mechanical Engineering

Each department has a Departmental Chair - he or she runs the show. Some departments have associate chairs to help perform the necessary organizational work. Each department has a central office in The Engineering Center and their location in on the building directory in the lobby. Each department has a staff that helps with departmental work.

Departments have the power and responsibility to

- establish a curriculum,
- monitor your progress as you take those courses, and then
- grant you a bachelor's degree in that discipline, if you complete those courses successfully.

"Curriculum" is Latin for racecourse. In English it means something perhaps just as strenuous but less athletic: a sequence of required and recommended courses in education. The plural of this word follows the Latin: curricula. Some departments have more than one curricula in the discipline(s) that form it. And they grant more than one type of bachelor's degree. Departments have curricula and degrees for a master's and a doctorate, also called "graduate degrees."

In addition to these six departments, The College of Engineering has two programs that grant only graduate degrees: The Integrated Telecommunications Program and The Engineering Management Program

When you "declare a major" you make clear to the college what engineering discipline you want to study, what curriculum you are prepared to complete, and what bachelor's degree you wish to earn. When you declare your major, you are affiliated with an appropriate department. You will take many of your courses (especially those in your junior and senior years) from faculty in that department. People

from that department will provide academic advising. But declaring a major doesn't mean you're getting married. You can (and should) change your major if you find your interests and talent is in a different discipline.

The college doesn't force you to declare a major as a first year student. If you really don't know which engineering discipline you want to pursue, you shouldn't declare a major. In this case, you are an "open option" student. College staff will provide academic advising.

Remember there is much more information about the departments, their curricula and the degrees offered, in the advising guides. These are available in the racks on the wall in the lobby of The Engineering Center.

College faculty belong to a department (usually only one). A faculty member can have one of several ranks (listed from lowest to highest):

Instructor
Senior Instructor
Assistant Professor
Associate Professor
Professor

There are also faculty who are not a permanent part of the instructional staff of a department: Adjunct Professors and Research Professors.

In addition to these faculty members there are graduate students that help with courses. These are Teaching Assistants (TA).

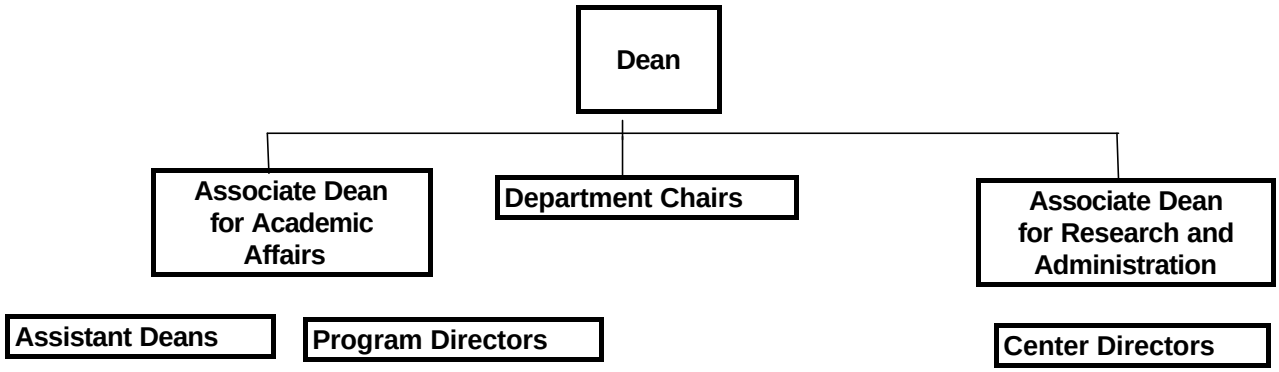
RESEARCH, DEVELOPMENT AND OUTREACH STRUCTURE - THE CENTERS OF THE COLLEGE

In addition to departments, which function as its principal academic units, the college also has centers that provide focus and facilities for engineering research activity, development in areas related to engineering, and delivery of education to the business community.

BioServe Space Technologies Center
Center for Advanced Decision Support for Water and Environmental Systems
Center for Advanced Manufacturing & Packaging of Microwave, Optical, and Digital Electronic Systems
Center of Aerospace Structures
Center for Applied Parallel Processing
Colorado Center for Astrodynamics Research
Center for Combustion Research
Center for Entrepreneurship
Center for Low-Gravity Fluid Mechanics and Transport Phenomena
Center for space Construction
Colorado Space Grant Consortium
Center for Separations Using Thin Films
Joint Center for Energy Management
Center for Space Environmental Health
Optoelectronic computing Systems

COLLEGE-WIDE GOVERNANCE - THE DEAN, ASSOCIATE DEANS, ASSISTANT DEANS, AND STAFF

A college-wide governance structure covers and spans The College's departments like an umbrella. It looks roughly like this



The Dean

"Dean" is a very old word. It comes from the Latin *decanus,* which means *leader of ten*. This was used in monasteries, the original European universities. The word eventually was applied to the leader of the entire monastery or cathedral. And today it usually means the leader of a college.

The dean provides direction, governance, and management for the college. The dean is ultimately responsible for the academic, instructional, and financial well being of the college. The rules of the university require the dean to be a faculty member of the college, not just an "outside manager."

To assist in the work that needs to be done in the college to keep it running smoothly, the dean has appointed two associate deans.

The Associate Dean for Academic Affairs

This associate dean is in charge of academic affairs in the college. This associate dean oversees classroom instruction, student and faculty performance, curriculum, and student organizations. In addition, this associate dean helps form and establish academic policy for the college.

The Associate Dean for Research and Administration

This associate dean is in charge of the research activities in the college and therefore oversees the various research centers in the college. In addition, this associate dean oversees some of the administrative activities in the college including the Engineering Center building and some financial and evaluation matters involving college faculty.

The Assistant Dean

Dr. James Sherman is Assistant Dean and director of student services. Dean Sherman is your first contact when you have an academic question or problem involving college policy. He is also an advisor for open option first-year students.

The Directors

Dr. Sherry Snyder is director of student programs. These include Peer Advocates and The Student Ambassadors. She is also the college's principal contact with engineering student government. Along with Dean Sherman, Dr. Snyder is the academic advisor for open option students.

Ms. Bev Louie is director of the Women in Engineering Program.

APPENDIX 2
STUDENT GOVERNMENT AND STUDENT ORGANIZATONS

The student government in our college is The University of Colorado Engineering Council or UCEC. This is the umbrella organization for student activities in the college. UCEC consists of:

- Officers elected by the entire College of Engineering student body,
- At-large representatives for the entire engineering student body,
- Representative to the campus-wide student government, the University of Colorado Student Union, or UCSU, and
- Representatives from all student organizations in the college, elected by members of those organizations.

As discussed above, student organizations are a good way to find out about engineering. They can also be part of a new community for you. Here is listing of the student organizations in the College of Engineering. These are often (though not always) student chapters of professional or national organizations. Membership is open to all engineering students.

Name	
Architectural Engineering Institute	AEI
Association for Computing Machinery	ACM
Asian Engineering Society	AES
Associated General Contractors	AGC
American Institute of Aeronautics and Astronautics	AIAA
American Institute of Chemical Engineers	AIChE
American Society of Civil Engineers	ASCE
American Society of Mechanical Engineers	ASME
Biomedical Engineering Society	BMES
Engineering Ambassadors	
CU Flying Club	
Institute of Electrical and Electronics Engineers	IEEE
Illuminating Engineering Society	IES
Mexican American Engineers and Scientists	MAES
National Society of Black Engineers	NSBE
Society of Automotive Engineers	SAE
Society of Hispanic Professional Engineers	SHPE
Society for Industrial and Applied Mathematics	SIAM
Society of Women Engineers	SWE

In addition to these organizations there are honorary societies. These societies are often for students studying a particular discipline. All of them have a membership that is by invitation which is usually based on academic performance. Patterned after fraternities and sororities, these organizations have names formed from Greek letters. Here is a listing.

Name		Engineering Discipline
Tau Beta Pi	ΤΒΠ	All
Chi Epsilon	ΧΕ	Civil and Architectural
Eta Kappa Nu	ΗΚΝ	Electrical
Omega Chi Epsilon	ΩΧΕ	Chemical
Pi Tau Sigma	ΠΤΣ	Mechanical
Sigma Gamma Tau	ΣΓΤ	Aerospace
Theta Tau Beta	ΘΤΒ	All
Theta Tau	ΘΤ	All

APPENDIX 3
WORKSHEETS FOR TIME MANAGEMENT

One Week Time Management Accounting Log

	1	2	3	4	5	6	7
6:00-6:30 am							
6:30-7:00							
7:00-7:30							
7:30-8:00							
8:00-8:30							
8:30-9:00							
9:00-9:30							
9:30-10:00							
10:00-10:30							
10:30-11:00							
11:00-11:30							
11:30-Noon							
Noon-12:30							
12:30-1:00 PM							
1:00-1:30							
1:30-2:00							
2:00-2:30							
2:30-3:00							
3:00-3:30							
3:30-4:00							
4:00-4:30							
4:30-5:00							
5:00-5:30							
5:30-6:00							

	1	2	3	4	5	6	7
6:00-6:30 PM							
6:30-7:00							
7:00-7:30							
7:30-8:00							
8:00-8:30							
8:30-9:00							
9:00-9:30							
9:30-10:00							
10:00-10:30							
10:30-11:00							
11:00-11:30							
11:30-Midnight							
Midnight-12:30							
12:30-1:00 am							
1:00-1:30							
1:30-2:00							
2:00-2:30							
2:30-3:00							
3:30-3:30							
3:30-4:00							
4:00-4:30							
4:30-5:00							
5:00-5:30							
5:30-6:00							

APPENDIX 4
References for First Year Students

Introduction to Engineering By Paul H. Wright Published by John Wiley & Sons, Inc.	A good overview of the things common to all the fields in engineering and to the things that make them different.
Introduction to the Engineering Profession By John D. Kemper Published by Harcourt Brace Jovanovich	Gives an idea of what the practice of engineering is like.
Introduction to Engineering By Leroy S. Fletcher and Terry E. Shoup Published by Prentice-Hall	
Careers in Engineering and Technology by George C. Beakley and H. W. Leach Published by Macmillan	Details various careers in engineering.
Studying Engineering, A Road Map to a Rewarding Career By Raymond B. Landis Published by Discovery Press	Written by a dean of an engineering college, this book offers advice to first year students in engineering.
Study is Hard Work by William H. Armstrong Published by David R. Godine	A new edition of a classic address to students in university.
On Becoming an Engineer - A Guide to Careeer Paths by J. David Irwin Published by IEEE Press	A modern guide to the principal aspect of engineering activity.
Good Teaching - A Guide for Students by Richard A. Watson Published by Southern Illinois University Press	A spicy and biting little book that talks directly to you, telling it like it is.
Teaching Engineering By P.C. Wankat and F.S. Oreovicz Published by McGraw-Hill	Has some excellent material on the Myers-Briggs Type Indicator
How to Study By R. Fry Published by Career Press	Here are play-by-play, blow-by-blow descriptions of methods for reading, studying, taking notes, and taking test. It's not written specifically for college students, but it's pretty good.

Here is a master link that lists links to virtually all major engineering societies in North America:

http://www.engineeringjobs.com/index.html

Notes and Vocabulary

0. A chautauqua was established here in Boulder more than 100 years ago. It was popular with teachers from The Rocky Mountains and The South. The auditorium and cabins are still in use and stand on land that is now a Boulder City Park. It is a splendid place for a hike.

1. Oration: a prepared speech, sometimes formal and ceremonious

2, Scold: an old woman who finds fault and complains

3. Jaded: tired, as with boredom; weary and indifferent

4. Efficacious: having the desired effect

5. Fathom: to understand and see implications

6. Pernicious: actively and thorough harmful

7. Harangue: a long and blustery speech

8. Adage: an old saying, a proverb

9. Venue: the locality of an action

10. Facile: work being done with ease

11. Syllabus: summary or outline of a course of study

12. 'Alloyed' is probably a better word: blended into and made part of

13. Puffery: vain and unfounded boasting

14. Indisputable: beyond argument

15. Circumspect: cautious, aware of consequences

16. Unconscionable: beyond reach of guilt or conscience

17. Flaccid: weak, limp, flabby

18. Explicit: made apparent

19. Concoct: made from a mix of things

20. Procrastinate: delay, put off

21. Intransigent: unwilling to compromise

22. Grandiose: overly grand and bragging, uncommon largeness

23. Truncate: to cut off part of

24. Ascribe: assign cause

25. Schematic: structural diagram or outline

26. Interlard: place frequently within, intersperse

27. Languid: drooping as from exhaustion, slow disinterest
28. Annotate: to mark with comments
29. Anechoic: without echo
30. Pertinent: related to the matter at hand
31. Extent: the size, space or limit of a thing
32. Decorum: proper and accepted behavior
33. Satiated: full to the point of unpleasantness
34. Reciprocal: mutually corresponding
35. Template: a pattern for making an exact copy
36. Inscrutable: not easily understood
37. Discern: to perceive or recognize clearly