

Michigan Introductory Program

Instructor's Guide

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Welcome to the Michigan Program

As most of you know, there has been a national movement to “reform” the teaching and content of calculus and precalculus. Michigan’s Introductory Mathematics Program is being used as a model for colleges and universities throughout the country. Our program takes a fresh approach which is designed to help students learn to think about the fundamental ideas of mathematics.

The texts emphasize the underlying concepts and de-emphasize rote memorization. The concepts are presented from a variety of symbolic, numeric, visual, and verbal points of view. Since our goal is to prepare students for further study in all mathematical subjects, there will be a strong emphasis on mathematics in everyday life and many of the applications will come from the physical and social sciences.

We use a teaching style which expands on the traditional lecture format. It incorporates cooperative learning into the classroom and organizes students into homework teams. The focus in our classes is on student learning rather than teaching.

The purpose of this guide and our professional development program is to help accustom you to the new program. Throughout the term the instructors will have a weekly staff meeting to share ideas on what is working and what isn’t working. Since our program is still fairly new, the courses evolve with each year’s infusion of new teachers; we will be counting on you to help us make them successful.

Your class is often a student’s first experience with a university math course, and the quality of your teaching can make this first experience either rewarding or distressing. In the coming days and weeks we will try to help you master some of the principles and techniques of good teaching, but ultimately your success will depend on your ability to interact productively with your class. Your class will respond to your enthusiasm for the material and to your genuine efforts to help them understand.

The Course Goals

Establish constructive student attitudes about the value of math by highlighting its link to the real world.

Develop a wide base of math knowledge: symbol manipulation,
 understanding of concepts,
 geometric visualization,
 problem-solving,
 predicting,
 generalizing.

Strengthen general academic skills: critical thinking,
 writing,
 giving clear verbal explanations,
 understanding and using technology,
 working collaboratively.

Develop the student's ability to form valid judgments based on quantitative information.

Increase the amount of student-instructor contact.

Persuade more students to continue in subsequent math and science courses.

Student Learning

Learning versus teaching.

When we think about teaching, many of us imagine ourselves at the front of the classroom with all eyes on us. We think in terms of syllabus, coverage of material, and lecture notes. Teaching at Michigan is different and we'll talk about what you, the instructor, should be doing later; now we want you to imagine that you are sitting at a table with a small group of students working on a problem or watching over the student's shoulder as he or she experiments with a new concept or struggles to apply old ideas in a new setting.

Learning versus training

Learning is not the same as training. Training emphasizes rote learning, speed, and efficiency.

The Army is expert in training: "Take the rifle apart and put it back together--blindfolded--in less than thirty seconds." Training has a place in this course. Of course, we want students to know that the derivative of the sine function is the cosine function and that $\int x dx = x^2 / 2 + C$. This aspect of the course is addressed in the homework and the gateway tests. In this section we consider how students *learn*..

How students learn.

Students learn by *thinking* and *doing*, not by watching and listening. Learning is an active process; it is something the students must *do*, not have done to them. The Calculus course is structured around student activities--in the classroom and outside the classroom in homework teams. They are encouraged to experiment and conjecture, to describe and discuss.

Students learn by working on *real-world problems* in which they have an interest--or at least in which they can see that others might have an interest. They are motivated by the visible or tangible, and they use this to "anchor" the more abstract concepts. Most of our students will not become mathematics majors; few of them share our interest in the subject for its own sake. Even those who will become mathematicians benefit by seeing how the ideas of calculus can be applied. Students learning calculus in a real-world context will gain a deeper understanding because the concepts are often presented numerically and graphically as well as algebraically.

Students learn by *working together*. They are encouraged when they see their classmates struggling as they are struggling; they are rewarded when they have a good suggestion or a sudden insight. Problems seem less daunting when there is someone else with whom to work. Even dealing with the graphing calculator is more rewarding and fun with a partner.

Students learn by *talking* about what they are doing--by explaining what they have discovered, by discussing a common strategy for to attack a problem, by asking questions. Students have little or no experience talking about mathematics; this takes time and practice. The results can be rewarding. In the first year of the project we knew the method was working when an entire homework group would show up together at the Math Lab and then proceed to hash the problem out themselves without any help from the tutor. They were learning much more than if someone had explained how to work the problem.

Students learn by *writing*. Writing forces students to organize their ideas and experience. Often, real learning begins only when the students begin to write out the meaning of a particular problem or function. The more students are required to write and the more they see other students' writing the better they get in expressing their ideas and understanding mathematics.

Students learn by *reading*--when they are *actively engaged* in the reading. Early in the course you will need to discuss with the students how to go about reading a chapter and how to best learn from the reading. This will help the students get the idea of what they are supposed to be doing when they read. It can head off the massive frustration that is likely to result from just turning them loose with what may be the first math book they have ever had to read. Don't try to *cover* everything in the book in class. This just discourages students from reading the book on their own and does a disservice to the students. Early on we learned that if the instructor tried to lecture in detail over everything in class, the students objected to the book--they found it confusing, ambiguous, and hard to read. In those classes where the instructors didn't "overcover" the material and trusted the students to read the text (always giving them hints on what to look for and any problems they might run into) the students liked the book. They found it readable and helpful.

Almost all of these activities - cooperative learning, talking about mathematics, writing about mathematics, reading mathematics - are often unfamiliar to our students. They are used to learning how to solve template problems by appropriate symbol manipulation, and they have been encouraged to consider the task "done" when they circle the "answer." You will have to encourage them and repeatedly justify these new and difficult activities. Just affirming that "It is hard, it is supposed to be hard, and you have what it takes to do it!" can go a long way in supporting your students.

As a reward you will see students blossom, including students who never before liked or did particularly well in mathematics. You will see creative students succeed who never developed the discipline to master algebra and trigonometry. And, as a consequence of this success, you will see them begin to work on those skills. You will see good students take off on their own, exploring ideas and connections you never imagined. You will see your students as individuals with different strengths and weaknesses, not just as points on a normal distribution.

Some of the material in this section was adapted with permission of the authors from the Instructor's Guide that accompanies the math textbook *The Calculus Reader* by David A. Smith and Lawrence C. Moore, Published by D. C. Heath and Co. 1992.

Student Reactions to the Course and Typical Problems

These courses come as a shock to most students. This is not the way calculus (or precalculus) is “supposed to be.” Most University of Michigan students were admitted because they performed well in traditional courses; our approach may be unsettling and painful. You can sometimes head off student uneasiness by being very specific about exactly how the course may be different from what they were accustomed to and why.

This isn't calculus! I've had calculus and this isn't it!

This complaint usually comes from exposure to the traditional high school calculus course where they spent a lot of time with symbolic manipulation. They may be a little disgruntled because they hoped that taking calculus in high school would give them a head start and possibly lead to an easy “A”. Assure them that it is calculus but that we are purposefully using a different approach--that they will understand how calculus is used and gain some valuable skills that will help them throughout college. Tell them that it's hard, that it's supposed to be hard, and that they have what it takes to do it.

My instructor isn't teaching; we have to teach ourselves.

Students are used to template learning. They think that a “good” instructor should simply lead them through each problem step by step. Real understanding, the kind that lasts, comes from struggling with the ideas. In this course we are trying to develop problem-solvers.

This course is taking too much time.

The University's rule of thumb is that a student should allocate at least two hours of study time for each credit hour, so they can expect to spend 8-10 hours a week minimum on calculus. We are requiring new types of work; they may be inefficient in performing it. We have to help students learn to read, write, work, think, and cooperate without spending endless hours of wasted effort. Talk with students in or out of class; listen carefully to what they say about study habits and related matters. Remind them of the Math Lab, both as an environment conducive to getting work done and as a source of help with whatever may be slowing them down.

Why are we having to do all this writing? Writing has nothing to do with mathematics!

Certainly traditional calculus courses do not emphasize writing. Many students adopt the strategy of writing as little as possible; their expectation (not necessarily a conscious one) is that the instructor will supply the right words to make sense of the mathematical symbols. “If I write something out, then I stand a better chance of being found wrong.” You should make the case that writing is a crucial part of the thinking process, and that it will help them understand the material.

Our homework problems are completely right and you're taking all these points off.

This stems from the common student view of grades as reward or punishment rather than feedback. Tell them that they are not competing against other teams. Explain what you mean by good work. They may think of a homework score such as 15/20 (which they convert to 75%--a high school C) as well below average, whereas you probably consider it to be a score indicating good progress.

I've never gotten grades like these.

From the point of view of many of our first-year students, a great deal hinges on getting the very high grades they are accustomed to getting in high school. The mean high school grade point average (recalculated using only their strictly academic classes) of the entering freshmen is 3.6, so most of our students think of themselves as “A” students. There is bound to be some resentment as students acclimate themselves to college grading standards. Just try to be both realistic and encouraging.

I can't read the textbook--it is too confusing and ambiguous.

Often this type of complaint comes from the fact that when they read the book they cannot find a "formula" for answering the problems at the end of the chapter as they are accustomed to doing with math books. Help them understand why the book is written the way it is and that the problems are meant to be hard and to require sustained thinking. Once they get used to thinking hard and develop some problem solving skills, they will find that everything they need to work out the answers is provided in the text. Let them know that one of the reasons for having homework teams is to help them learn the skills they need to succeed.

Make sure they understand that reading mathematics is not like reading the newspaper. It is unlikely they are going to get everything they need the first time through. Help them learn how to read the text. Make sure they are trying the embedded exercises; encourage them to mark up the text, and ask to see their copy when you hear this complaint. Encourage them to discuss their reading with other students in the class (teammates or not), to ask questions in class, and to use the Math Lab.

We never know if our answers are correct.

There is a fundamental problem here. Students are conditioned to believe that the only way to know that an answer is correct is to see if it agrees with the back of the book or if the teacher says it is right. They need to be encouraged to look at problems in alternative ways, to see if the answer is consistent with intuition. Spend some class time on checking procedures. For example, it is not enough to tell students that derivative calculations can be checked by doing one or more difference quotients on their calculators--make them actually do it and share the results with each other.

It isn't fair for my grade to depend on the work of others.

Group work is a new idea; cooperation is a new idea. Tell students that there is research evidence that even the best students' grades can improve if their group is working together properly. Many students' normal mode of operation is cutthroat competition. Remind them that there is not a preordained number of A's, B's, etc. Point out that when they go to work in the real world, their performance will be judged on how their group works. Also, if you adopt some form of evaluation of individual efforts, this may help students accept the grading scheme as "fair."

Someone in my group isn't doing enough work.

One of the skills students need to learn is how to work together. Part of their responsibility is to ensure, as much as possible, that everyone is contributing. In most jobs they will work in later, they will be told to get together with certain people and do something. Their boss is not going to be impressed if they are not able to work together.

This said, it still may be the case that one or more members of the group is (are) not doing enough work. Remind the students that teams will change. If a member of the team does no work on the homework or a project then his or her name need not appear on it. Students may find it difficult (especially at the start) to leave off the name of a non-contributing teammate, but this is one aspect of making the students responsible for what the group produces.

Instructor Reactions to the Course and Typical Problems

Giving up lectures: Lecturing is a very satisfying activity for us. We can organize the materials, display the logical structure, and introduce just the right examples. When the period is over, we feel that we have given a good account of ourselves, a good performance. It is hard to accept that this may not be the best way for students to learn. However, respectable educational research suggests that prolonged lecturing is the classroom activity least likely to result in learning.

Giving up control: When you move to a classroom mode that is more student-directed, you will feel as if you are giving up control of the class. You cannot necessarily tell what students will want to discuss, what suggestions they will make. It is likely that students will ask questions for which you do not know the answer. This is painful the first couple of times it happens. However, it is very enlightening to the students. When you say, "I don't know what happens if we let $b=10,000$; let's try it and see," they realize that it is not a personal failing when they have to admit that they don't know the answer. To become good learners, they need a good learner as role model.

Listening to students: One of the things you will learn as you read student papers and hear them discuss topics in their groups is that they are not thinking what we thought they were thinking. They have some surprising ideas fixed in their minds; a new, more useful concept cannot take the place of a faulty one until the old notion has been dealt with.

This course has taught us to work harder at listening to what the students are telling us, not assume that we are going to hear or read one of the most "five common errors." One of the instructors told us that he always thought his students learned from an organized, interesting, informative lecture. He had always asked a few questions to be *sure* that the students were understanding. When he started to use cooperative learning in the classroom (after giving one of his thoughtful, informative lectures), he got a chance to listen in while students told each other what they thought they understood. He was amazed at how little of his careful, clear lecture they understood.

Dealing with writing: Many mathematicians admit that they do not like to deal with student writing. One of the reasons they went into mathematics is that they did not like to write a lot of papers! The type of writing we are expecting of the student, expository writing, is not particularly hard as writing goes. Previous instructors have found themselves to have the ability to improve their students' writing level dramatically simply by stressing the importance of carefully written solutions.

When you are working with student writing it helps to be very explicit about what you want students to do – what you expect an assignment to look like. You will find that the more writing the students do the better they will get. This is especially true if you ask various students to read what they have written out loud to each other in small groups and to the large group.

Working too hard: It is hard teaching a new course for the first time; this course is newer than most. Instructors commonly report that teaching this way requires more emotional energy than teaching traditional math classes. If you actually know whether or not students are learning, you tend to maintain a higher level of personal engagement - you worry about them.

There is a tendency in dealing with things we are unsure of (grading student writing, for example) to compensate by being too conscientious, spending too much time on the work. At the beginning, it is helpful to allow a limited amount of time for dealing with each paper. Nothing terrible happens if you do not make a comment that you might have made if you had more time. The students understand time pressure.

You will find it useful to set a goal for the average time you will spend on each paper or set of homework, and then push yourself to keep up with that pace. This will vary somewhat with the nature of the assignment, but if you are taking much more than two hours per homework set, your students are making you work too hard. The

better their work , the easier it will be for you to grade it. Be very explicit about what kind of papers you will accept. Tell the students that carefully done homework will always lead to a higher grade.

Profile of the Fall Term Students in the Introductory Courses

Math 105 Data, Functions, and Graphs ~25 sections

Students take this precalculus class either as a preparation for the calculus sequence or in order to satisfy a variety of University course requirements. They have typically taken 4 years of high school math. However, their placement scores, which are based on the combined results of a short precalculus test, their Scholastic Aptitude Test (SAT), and their overall high school grade point average (GPA), indicate that they lack some skills and mathematical maturity. For students in the college of Literature, Science and the Arts, the course satisfies the quantitative reasoning requirement and also fulfills the distribution requirement for mathematical and symbolic reasoning.

Math 115 Calculus I ~60 sections

This is the first course in the standard 115-116-215 calculus sequence. Students in this course have different backgrounds. Some had a good high school course in calculus, some have had rudimentary high school calculus, and many have had only precalculus. The overwhelming majority of the students enrolled in this course are not math majors, but are required to take calculus for some other field such as engineering, business, or one of the natural sciences. For students in the college of Literature, Science and the Arts, the course satisfies the quantitative reasoning requirement and also fulfills the distribution requirement for mathematical and symbolic reasoning.

Math 116 Calculus II ~30 sections

Some of the students in this course have taken 105 and then 115, while others are just entering the University prepared to take second term calculus. New freshmen in 116 generally have taken a year of advanced placement (AP) calculus in high school.

Math 156 Applied Honors Calculus II 6 sections

The sequence 156-255-256 is an honors calculus sequence for engineering and science concentrators.

Math 175 Combinatorics and Calculus 1 section

The sequence 175-176 is an honors sequence in combinatorics, dynamical systems, and the development of calculus in the context of dynamical systems.

Math 185 Honors Calculus I 4 sections

The sequence 185-186-285-286 is for mathematics, science, and a variety of other concentrators who want a calculus course with a somewhat more theoretical approach.

Math 215 Calculus III 8 lecture sections

This is a lecture (~100 students) in multi-variable calculus combined with a Maple computer lab.

Math 216 Introduction to Differential Equations 6 lecture sections

This is a lecture (~100 students) in linear algebra and differential equations combined with a weekly MATLAB computer lab. The students are largely in engineering and science.

Math 295 Honors Calculus I 1 section

The sequence 295-296-395-396 is the theoretical, intensive course.

Being an Instructor in the Uniform Course System

As an instructor (GSI or faculty) in one of the large, introductory, multi-section courses you will be in complete charge of the day-to-day activities of a precalculus or first-semester calculus class of about 30 students. The Math 105 and 115 classes are scheduled to meet for three days per week for an hour and a half. Since these are only 4 credit hour courses, you can use the extra half hour per week of class time as you wish, e.g. office hours. The University semester lasts approximately 14 weeks.

Your precise teaching assignment (days and hours) will not be made until just before the start of the term after both the undergraduate enrollments and the graduate student instructor's own course schedules are finalized.

All the introductory courses are run according to uniform guidelines in an attempt to ensure that each student has every opportunity to learn the course material. All sections cover the same material. All the students in a given course take two common exams and a common final. These exams are graded by all of the course's instructors working together in a session which immediately follows the exam.

Each of the introductory courses is under the supervision of a faculty coordinator assisted by a small team of department members who serve as a professional development staff.

Responsibilities of Instructors

- Explaining the course's goals to the students
- Planning and carrying out the classroom instruction using a variety of teaching methods including lecturing, active learning activities, going over homework, etc.
- Assigning and grading homework
- Writing and grading quizzes
- Participating in proctoring and grading uniform midterm and final exams
- Assigning final course grades (according to uniform guidelines)
- Holding office hours (3 hrs. weekly minimum), with one of the hours held in the Math Lab
- Attending weekly course staff meetings
- Conducting all classes personally except in an emergency; notifying the coordinator in an emergency
- Notifying the course coordinator of any problems related to teaching
- Delivering all course announcements to students
- Being prompt
- Responding to e-mail quickly

Responsibilities of the Course Coordinator and Development Staff

- Providing a course syllabus and assignments
- Giving guidelines for the pace of the course
- Planning and running the course staff meetings
- Providing assistance with teaching
- Visiting and observing classes
- Conducting midterm small-group feedback sessions with students
- Writing uniform midterms and final exams
- Directing the uniform exam procedures
- Directing the uniform exam grading sessions
- Assigning letter grades for uniform exams

- Handling student complaints
- Approving the instructor's final course grades

Feedback and the Evaluation of Your Teaching

All instructors who are teaching 105, 115 or 116 for the first time will receive feedback on their teaching from both students and course staff. Following is a list of the processes that will be used.

Observing your class Course staff will be visiting all new instructors' classes within the first month of the course and they will give you feedback on what they observe. Although you may feel nervous about being observed, the tension usually disappears when the class gets underway. It helps to remember that the observer is there to help you gather data and information to improve your teaching. You will be contacted before such a visit. In previous terms the instructors have found the experience to be positive.

Getting Informal Feedback from Students You can usually find out how your students are reacting to your teaching by asking them. For example, you might ask them whether you are doing enough examples or whether the homework assignments are too easy or too hard. The Math Department will give you an informal questionnaire to have students fill out early in the term, and the responses will give you guidelines about necessary adjustments.

Early student feedback If you are teaching an introductory course for the first time, there will be an early student feedback session following the first exam. The procedure is that a course staff person will observe your class for the first hour of class. During the last 25 minutes of the class you will leave and she/he will facilitate a small group feedback session with your students. One or two days later the two of you will discuss the results and develop possible responses.

Additional observation toward the end of the semester For some instructors who may be working on basic teaching skills, a third observation will be done toward the end of the term.

End-of-Course Student Ratings At the end of each term the Center for Research on Learning and Teaching (CRLT) sends all instructors a set of evaluation questionnaires for each class. The questions on these forms have been chosen by the Department (see sample form in the appendix). The packet comes with detailed instructions. Read the instructions very carefully. Generally, you will leave about 15 minutes for students to fill out the forms at the end of a class period during the last week of class. *Instructors will not see individual ratings or the results of these ratings until after the grades are turned in.* The actual forms and a statistical summary will be returned to you some time in the subsequent term. A copy of the summary goes to the Department. Plan to keep your evaluations both as a record of your progress and to assist future writers of teaching references. Since there is evidence that student ratings are more effective in helping instructors improve their teaching if the instructor discusses them with another person, it is a good idea for you to go over them with a colleague, a consultant from CRLT, the course coordinator or one of the other course staff.

The Uniform Grading System

Semester Grades All introductory math courses are graded from A to E, with pluses and minuses attached to the A's, B's, C's and D's but not the E's. (*However, the grade of A+ is rare and is reserved for students who excel on course-wide criteria.*)

All sections of a course use the same grading guidelines to standardize the evaluation process. All students take the same uniform midterm tests and a common final exam.

There are three components to the student's grade. As the instructor, you are responsible for the determining the section component and using it to adjust the student's final course grade. The grading scheme from the student guide is reproduced below.

Evaluating the section component. Since we consider cooperative learning to be an essential feature of the introductory program, we require that team homework count for at least 40% of the section component. Aside from that, it is up to you how to determine the section component of the grade. For example, you may choose to give weekly individual or group quizzes and/or daily reading quizzes; you may choose to collect individual homework; you may choose to give credit for in-class work, presentations, extra credit, good team evaluations, etc. It helps to choose a system that encourages study habits that you believe will contribute to student learning.

Informing the students. It is important that you explain your system for evaluating the section component clearly and carefully in your first day handout so that your students know how they will be evaluated. It is also important to ensure that the feedback you give students on their section work accurately reflects the impact it will have on their grade. There are many simple ways to achieve this. One is to grade section work with a median of approximately 70%. If that does not suit your class, or your grading, an alternative is to announce the median score each time you return graded work.

The Grading System: Reproduced from the Student Guide

Grades in this math course. All sections of this course use the same grading guidelines to standardize the evaluation process. Your final letter grade in the course will be based on three components:

- 1.The uniform component.
- 2.The section component.
- 3.The gateway component.

Your uniform component will determine your baseline letter grade for the course. Your baseline grade will be adjusted by the section and gateway components as described below to determine your course letter grade.

1. The uniform component. There are two uniform midterm exams and a uniform final exam. Each of these exams will be taken by all students in all sections at the same time, and are graded by all the instructors working together. Your uniform component score will be determined from your scores on each exam as follows:

Midterm Exam 1	25% of uniform component score
Midterm Exam 2	35% of uniform component score
Final Exam	40% of uniform component score

After each exam, a letter grade will be assigned to your uniform component score using a scale determined by the course director specifically for that exam. We do not use the "10-point scale" often seen in high school courses in which scores in the 90's get an A, in the 80's get a B, and so forth; the level of difficulty of the exams will be considered. The scale for the uniform component score will apply to all students in all sections.

2. The section component. To help you learn the material, you will be given a variety of reading assignments, team homework, individual homework, quizzes and other in-class activities. Your instructor will decide how the section component is determined for your particular section and grade the section work. The section component has the potential to change your final course grade by at most one third of a letter grade (e.g., from a B+ to an A-, or from a C to a C-). There is one exception to the one third letter grade—see below.

The one third of a letter grade is used as a "correction factor" for students whose exam component and in-class performance within their section differ significantly from one another. For example, if you have struggled on exams but your in-class performance puts you among the best in the class, your course grade may be raised by at most one third of a letter grade. On the other hand, if you perform well on exams but do not do well on the section component work, your grade may be lowered. If you have participated in section activities, your grade may be lowered by only one third of a letter grade. Students who do not seriously attempt to contribute to the section component of the course (i.e., quizzes, team homework, etc.) may have their final course grade lowered by up to a full letter grade. The majority of students will find that their in-class performance and their exam scores are quite reflective of one another. Thus, in the majority of cases, no adjustment is made to the base-line grade.

The best way to gauge your in-class performance is to keep an eye on the median grade in your section for each assignment and quiz. It is not useful to compare quiz and homework grades with students from other sections, because instructors write their own quizzes and determine the grading rubric for homework in a section.

3. The gateway component. There will be one or two (depending on the course you are taking) online basic skills gateway test(s) which you need to pass by the deadline announced in the course schedule. These routine tests are repeatable, and in general do not pose a problem for students who are keeping up with the course work. You may practice each test online as many times as you like, and you may take a test for a score as often as twice per day until the deadline. The gateway tests do not have the potential to raise your baseline grade, but if they are not passed by the deadline, the gateway component will automatically reduce your final grade in the course. Deadlines and grade penalties will be announced in your class. All sections of your course have the same deadlines and penalties assigned to the gateway component.

Section averages. Course policy is that a section's average final letter grade cannot differ too much from that section's average baseline letter grades. This means that the better your entire section does on the uniform exams, the higher average letter grade your instructor can assign in your section. It is therefore in your best interest to help your fellow students in your section do well in this course. In other words, cooperation counts!

Grades at the university. Many students who come to the University of Michigan have to adjust themselves to college grading standards. The mean high school grade point average (recalculated using only strictly academic classes) of our entering students is around 3.6, so many of you were accustomed to getting "straight A's" in high school. Students' first reaction to college grades is often, "I've never gotten grades like these." However, a grade of 15/20 on a team homework assignment (which you might previously have converted to 75% - a high school C) may well be a good score in a college math course. Your own instructor is your best source of information on your progress in the class.

Describing the grading system to students. You should state explicitly how you plan to arrive at semester grades - what exams will be given, approximately what weight they will have in the overall assessment of the student's work, how team homework is counted, how much quizzes will count, etc. The in-class component of the grade can be based on quiz scores, individual homework, class participation, or whatever you find appropriate. It is important to not to assign letter grades to the in-class component of the grade because the grades you award at the end of the term will have to be in alignment with the performance of your class on the uniform exams.

Assigning final semester grades. The procedure for calculating semester grades will be discussed in course meetings as the term progresses.

Grade books and records. Keep a good, clear record of your grades in a secure place. Don't lose it. Record all scores which will count towards students' grades. Many grades complaints can be prevented by keeping accurate records. It's easy to forget to record grades before returning papers, so record everything, including all grade changes, immediately. Students are very serious about their grades and expect them to be treated as a strictly private matter. You do not need to keep a record of students' attendance unless you choose to, however, you may want to note any extended absences.

Complaints about your grading. From the point of view of University of Michigan students, a great deal hinges on getting the high grades they are accustomed to getting in high school. Many first term freshman have never had a grade lower than an A! They will often argue persistently over one or two points. This is not a sign that they don't respect you. Of course, you should treat all student complaints about grading mistakes or unfairness in a serious manner.

Reporting Student Grades / Progress / Difficulties During the Term

Progress updates

You should be prepared to give students an assessment of how they are doing in the class. Early in the semester, students may want your advice on whether or not to drop the course. During staff meetings you will be given an indication of what would be appropriate advice.

Reports to counselors

If a student, particularly a freshman, is struggling during the term, it is important that you fill out an Academic Progress Report. The counselor can then look at the student's overall academic situation and give the necessary support. There are several types of formal reporting forms which can be used to communicate with advisors.

- Midterm Estimate Forms are sent out by the Comprehensive Studies Program (see "University Support Offices") to track the progress of students.
- Academic Progress Reports can be used to inform the Academic Counseling Office (see "University Support Offices") of any student in academic difficulty.
- Athletic Progress Forms are sent out to the instructors of athletes.

Advising students

Students may ask your advice when they are having difficulty in the class. Try to give them an accurate (but kindly) description of their status. Sometimes they are simply in the wrong course. And sometimes poor performance results from inadequate study time. Often students are not aware of the time demands of a math course (sometimes calculated at three hours of study for each credit hour). If you think that a student would benefit from more tutoring than you can provide during your office hours, suggest the Math Lab or the other sources of tutoring listed in under "Tutoring Facilities". When talking with a student who is performing poorly, you should think of it as providing information which the student can weigh in consultation with an academic advisor. You should carefully avoid attributing the student's failure (or success) to race or gender, and certainly don't suggest that the student may have a learning disability since even well-intentioned suggestions of this kind can be devastating. If the student seems to have more extensive academic or personal problems, this guide gives sources for additional help. (See "University Support Office: Academic and Personal".)

Gateway Tests

All instructors are to periodically give gateway tests on basic skills, e.g. differentiation. Students will be required to pass the gateway tests, but they can retake each test as many times as necessary in order to pass. We have found that students like being able to retake the tests, and it encourages them to continue studying until they know the material.

The first test will be given during class time. Each additional test will be given and monitored during your office hours or administered in the Math Lab. There is a system of computerized practice tests on the Web, but the actual tests are administered in on-line in a proctored gateway testing center. You will be told the particulars of the procedure during a staff meeting.

Quizzes

- The timing of exams is built into a syllabus, but you should give quizzes more frequently. Quizzes needn't be long to be effective, 15-20 minutes is plenty of time
- All material which is handed out to a class should be written neatly and clearly. Try to get another instructor to check your quizzes for errors, because it's easy to make mistakes.
- Coordinators may ask to check your quizzes before you give them. The coordinator may have samples of quizzes given by instructors in previous years. Feel free to borrow each other's quizzes and share the work.
- Try not to bother with make-up quizzes; just announce that you'll drop one or two instead. If you have to give one, you may be able to borrow one from another instructor.
- Proctor quizzes carefully. Begin by having students spread out in the room and put away all other books and papers. The most frequent form of cheating is copying another student's work, so tell them to keep their eyes on their own papers, and make it clear to students that you are paying attention. (see The Instructor-Student Relationship, Dishonesty and Cheating)
- When you return quizzes, you may not have time to go over each question in class. You can either go over problems which were missed by many class members or distribute a solution sheet.

Uniform Exams

The introductory courses have two common 90 minute exams and a 2 hour final exam. All of the instructors are expected to monitor the exams and help in the collaborative grading of the exams. Find out when the exams are going to be given and put those dates on your calendars. Don't plan any other activity for that evening.

Exams I and II

Before Exam Day

- Date:** The dates and times of the two exams are in the course syllabus. All the students in the course will take the same exam on the same evening (6:00-7:30 p.m.). Note that these exams start on the hour, not at ten minutes after the hour.
- Location:** The exams are given in several large auditoriums scattered throughout central campus. Each auditorium will have several sections assigned to that location. The room assignment for your section will be sent to you via e-mail in time for you to announce it repeatedly to your class. The office (2084 EH) will post a complete listing of the exam rooms for all large courses. Make sure that both you and your students locate the exam room ahead of time.
- Communicate the time and place clearly to your students:** Make sure you announce several times the room designated for their exam and what they should bring to the exam.
- Who writes the midterm exams:** The course coordinator writes the uniform exams. Suggested problems are always welcome. The composition of the exam will be discussed in course meetings.
- Copies of practice exams:** A collection of previous exams is included in the Student Guide which should have been purchased by the students at the beginning of the semester.
- Extra review sessions:** If you want to hold extra evening or weekend review sessions you must fill out a room reservation form (2084 EH) ahead of time.
- **Conflicts and alternates:** In general, there are very few circumstances in which a student will be allowed to take these exams at any time other than the regularly-scheduled time. The course coordinator will tell you how he/she wants each individual case handled, however, the faster you report potential conflicts to the coordinator, the more easily they can be resolved.
- Announcing results of the exams:** Don't promise students their grades immediately. You will often not know the results until the following day (or occasionally even longer).

Exam Day

- Classes meet at their ordinary times on the day of the midterm.**
- You will be given a written schedule of the routine for the evening of the exam.** This will include directions on how to proctor effectively. You should be prepared to arrive early and stay until the end of the team grading session which starts immediately after the exam and usually lasts late into the evening.
- Start the exam on time. End the exam on time.** Immediately take the finished exams to the designated room in the Math Department. Consult with the coordinator about any student who misses the exam.

Grading the Exam

• You will be assigned to a grading team and your team will grade a specific problem (or page) for all the sections. This means that you will never grade an entire exam. You will have a team leader and she/he will direct the smooth facilitation of the grading. Your team will be given a solution sheet with an outline of how to award partial credit. As grading progresses your team will establish policies about how to grade specific types of mistakes. It is important that your grading stays consistent and conscientious until the end of the session. After all the exams have been graded, each scores is totaled and recorded. Then you can leave and take your students' exams with you.

Getting the Results

- You will get a summary of the scores which will associate a letter grade with a range of scores. This will be the first time that you can give your students a letter grade.
- The letter grades are arranged so that the median score is near the B- / C+ line.

Returning the Exams

- You should check the point totaling on your students' exams before you return them.
- You will get a complete grading guide for the entire exam. If a student believes that something was incorrectly graded, note the spot and take the exam back. Look it over to see if it was graded according to the guide, if so, don't change anything. If there was a mistake in grading, fix it yourself and adjust the score. The coordinator may want a record of grade changes.

Final Exam

Before Exam Day

- Study days: The time schedule provides for study days between the last class and the final exam.
- Date and time: The date and time are published in the university Time Schedule under the heading, "Examination Schedule" and they appear in the syllabus.
- Location, Extra review sessions, Alternates, Grading the final, etc.: The general procedures are the same as for previous exams.
- Inform students about when you will be holding office hours during study days and exam week.
- Tell students when and how their course grades will be available and when they can pick up there final exams. The department offices don't give out grades. Leave yourself plenty of time to decide on course grades, and try to schedule some time for students to discuss their final grades with you. Often a sympathetic explanation will forestall later grade complaints.

Filling Out and Submitting Course Grade Sheets_ (see "End of the Term")

Math Lab

Location: B860 East Hall, 936–0160

Hours: Mon–Thurs 10:00am–4:00pm and 7:00pm–9:00pm
 Fri 10:00am–2:00pm
 Sun 2:00pm–4:00pm

The Math Lab provides tutorial help for students in all the introductory courses. It is staffed by graduate students and advanced undergraduates. As an instructor of one of the introductory courses, you will be asked to hold one of your weekly office hours in the Math Lab. Any student in your class who needs extra help should be strongly encouraged to see you during your own office hours, but the Math Lab with its convenient hours is a good alternative.

If a team is having difficulty with a homework problem, please suggest that they go to the Math Lab together. When students have questions about the substance of the homework, we want the students to figure out as much as possible for themselves. Sometimes they need a hint, sometimes they need to reread the instructions or the relevant section of the book, sometimes they need to be given direct help, and sometimes they need to be told to go back and work on it. When a whole team comes in to get help, it is a good time to help them learn to work together and it may only take a few hints or steering-type questions to get the group unstuck. For the tutor (or the instructor) knowing how much and how little to say is an art that takes experience and restraint.

The TI-83 Calculator

Each student will be required to buy a calculator. The Math Lab will offer two calculator clinics at the start of the term to help those who need it. In previous years some of the instructors were worried at the prospect of teaching students to use the calculator. It turned out to be a non-issue. Many students will come already knowing how to use the calculator, and they tend to help other students who need it. Encourage anyone who is having trouble to go to the Math Lab to get individual help.

As the term progresses you will be given a few calculator programs to distribute to students by transferring them to each other's calculators.

Mechanics of Starting and Running the Term

Pacing the term

The progress of the term is regulated by the syllabus which indicates how much material is to be covered, when tests and exams will be given, and the dates of holidays and vacation. You should make tentative plans about what you plan to cover during each class meeting and when you will schedule quizzes and review. Since the elementary courses proceed quickly, you may not have time to explain everything in the text or answer all of the students' questions. Stress the fundamentals and present the new material clearly so that the students leave the class prepared to do the homework. Students tend to catch on to the ideas as you progress, and you will often have a chance to revisit a topic later in the course. If you get behind or ahead of the syllabus, let the coordinator know and ask him/her for suggestions about slowing down or speeding up.

Handling papers

- Be careful with students' written work. Don't lose it. Correct papers promptly and hand them back promptly. Remember to record all grades in your grade book.
- Keep copies of all handouts, e.g. tests, quizzes, problem solutions, and lecture supplements. Students may lose theirs, or you may need to give a copy to the coordinator, or you may want to use materials in future semesters.

Record keeping

- Keep your grades in a secure place. Record all scores which will count towards students' grades. You do not need to keep a record of students' attendance unless you choose to, however, you may want to note any extended absences.
- If you want to keep your grade records in computer form, you will get an e-mail description of how to get your class lists.

Absences

If you have to be absent, tell the coordinator well in advance and work with him or her to find a replacement. If you are sick, contact the course coordinator as soon as possible and arrange for your class to be covered. In no instances should you be gone without the course coordinator knowing about it and knowing who is responsible for your class while you are gone.

Scheduling extra class sessions

- Extra class sessions (makeup classes or review, etc.) can be scheduled by filling out a room request in 2084 EH. It is often difficult to find a time which is convenient for all your students, but late afternoon times may work.
- Students may miss classes for a variety of reasons, but you should stress the importance of attendance. You can request documentation of a health-related excuse; however, you should use your own judgment about absences.

Office Hours

Be conscientious about keeping office hours. They provide time for you to give students extra help, answer questions which couldn't be answered during class time, and go over quizzes and tests individually. Encourage your students to make use of your office hours because the one-on-one help can make a considerable difference. You can often check on the effectiveness of your in-class explanations by talking with students during office

hours.

Before classes begin

- Attend any preliminary staff meetings for your course.
- Photocopy enough copies of the course Syllabus and the Student Data Form to distribute to your students.
- Tentatively schedule office hours (3). They should be arranged at scattered times so as to be available to the largest number of your students. One of your office hours will be held in the Math Lab (Room B860 EH). Your Math Lab time will be assigned during the second week of classes, after which you can finalize your office hour times.
- Decide about course mechanics; homework, quizzes, in-class grading, attendance, etc.
- Develop a handout for the students in your section with all the pertinent information.
- Locate your classroom and the Math Lab.

First Day of Class

- Pick up your class list from your mailbox before you go to class. Class lists will also be available electronically.
- Get to your class early so you can be there when the students come in, put any announcements on the board, and start on time. The University hour starts at 10 minutes after the hour and ends on the hour.
- Take attendance the first two days by calling roll **or** passing around a sign-up sheet. A student must attend one of those days to hold a place in class. You will get a form in your mailbox to list the names of any students who do not show up on either of the first two days. The office will drop their names from your class list and make the spaces available to other students.
- Class enrollment and section changes (drops/adds) are controlled by the Math Office in 2084 EH, **DO NOT** tell anyone that they can get into your section. **DO NOT** even tell them that it's "all right with you." Tell them that class size is handled in 2084 EH and send them there.

First Few Days

- Students will continue to rearrange their class schedules, so you should take attendance until your class list stabilizes.
- Major religious holidays (Jewish, Rosh Hashanah) coincide with the start of classes in some academic years. This may create attendance problems for some students and faculty. Be as considerate as possible if the situation arises.
- Finalize your office hour times with your class.
- Remind students to make no travel plans which conflict with uniform exams.

First Few Weeks

• During the first three weeks of classes students can shift sections or even change courses. For instance, students may decide to shift from calculus to precalculus, or drop math altogether. Any such change after the drop/add deadline will appear on the student's transcript. The gateway test, your quizzes and corrected homework will give the students a way to evaluate his/her standing in the class during these first few weeks. Some students will ask for your advice about remaining in your class, and you might want to ask the course coordinator about specific cases. It is reasonable to be accommodating to someone who changes to your section late, but they are responsible for catching up with the class. Updated class lists are distributed 4 weeks into the term.

Homework Teams

Mathematics 105, 115, and 116 assigns team homework as well as individual homework. Homework teams are created on the second day of class. Each week the teams are required to work together to analyze and solve the team homework problems and write up the solutions. Students are encouraged to meet twice a week: once to discuss the problems and find solutions and once to go over the final write-up. A preliminary reporter's page is due after their first meeting and the second is due with the final product.

Each team turns in a single set of solutions. The instructor grades the homework and hands it back at the earliest possible date. (Feedback is more useful to students if they receive it soon after they have done the work.) Everyone on a particular team gets the same grade.

It is the instructor's responsibility to assign teams. Instructors in previous years have found that teams of four worked best. Groups consisting of only two students working together failed to generate enough ideas, and teams larger than four often have trouble functioning. With four on a team, an occasional student's absence won't matter.

A reasonable strategy for assigning the first teams when you know little about the students, is to group students who live near each other — preferably in the same dorm. (A list of dorms follows.) This minimizes logistic problems concerning where the group will meet. Until you know students better (and know when someone can hold their own), do not put one woman with three men. Some women put in this situation tend to participate less and often feel their contributions are not valued.

We suggest that you change the makeup of homework teams two times during the semester (after each uniform exam.) This allows each student to get used to working with a range of other students. Mixing groups helps in dealing with problem students or with groups where one or two students tend to dominate.

When you change the makeup of the teams, you may want to use a mixture of criteria for groups. There is evidence that having a mixture of levels in a group helps it function better. In this case, if everyone is working, both strong students and weak students grow stronger. It is also useful to have a mix of gender and race. When students have a good experience working together it leads them to respect the opinions of others.

Objectives for using cooperative homework teams:

- Give students a chance to talk about mathematics.
- Give students the opportunity to teach each other.
- Help students learn how to communicate with each other about mathematics.
- Give students support in their anxiety about not being told what to do.
- Help students to learn how to work together cooperatively.

Advantages of homework teams:

- Students can be given more difficult problems.
- Students become more willing and confident in doing math.
- Students learn to think more creatively.
- Instructors grade 7 homework papers instead of 28.

Assigning the First Teams

During the first day of class you will form groups of four. Try to form your teams with students who live close to each other (North Campus, South Quad, etc.) in order to make it as easy as possible for them to meet together. Make the teams as heterogeneous as possible (gender, race, etc.). There is evidence that when a heterogeneous group learns to work successfully together the members of the group become more tolerant and accepting of different ideas.

Dorm locations (roughly three groupings of dorms)

North Campus

Bursley Hall (This is where many of the engineering students will be housed.)
Baits Houses

“The Hill”

Couzens Hall
Alice Lloyd Hall
Mosher-Jordan Hall
Stockwell Hall
Mary Markley Hall

Central Campus

South Quad
West Quad
East Quad
Betsy Barbour House
Helen Newberry House
Martha Cook Building

Individual Roles in Homework Teams

Giving students individual roles in homework teams helps students take individual responsibility for making their homework team function successfully. It is important to make sure that students change roles every week so everyone will get a chance to function in a particular role. Here is the description of the roles which is contained in the Student’s Guide.

Scribe: The scribe is responsible for writing up the single final version of the homework to be handed in. This is the only set of solutions which will be accepted or graded. Each member of the group will receive the same grade. Whenever possible, your solutions should include symbolic, graphical and verbal explanations or interpretations. Diagrams and pictures should also be provided if possible.

Clarifier: During the team meeting the clarifier assists the group by paraphrasing the ideas presented by other group members, e.g. “Let me make sure I understand, the graph goes up...”. The clarifier is responsible for making sure that everyone in the group understands the solutions to the problems and is prepared to present the problems to the class if the team is called on.

Reporter: The reporter writes a record of how the homework sessions went, how long the team met, what difficulties or successes the team may have had (with math or otherwise). If there is disagreement about the solution of a problem, the reporter should present sketches of alternate solutions and explain the difference of opinion. The report should list the members of the team who attended the session and their roles. The report should be on a separate sheet of paper and be the first page of the teams homework solutions.

Manager: The manager is responsible for arranging and running the meetings. If the team has only three members, or if one of the four members cannot attend, the manager should also take one of the other roles. When the homework is returned, the manager sees that it is photocopied and distributed so that each team member’s portfolio contains a copy of the corrected problems.

Helping Homework Teams Function Effectively

Students will be more likely to work at making their homework teams work if they perceive that what gets done within their group is an important part of the class. Some of the ways you can make this part of the class important are:

- Give team homework a fairly large part of the grade. Counting team homework as 25% of the course grade will ensure that students take it seriously.
- Have some method for letting students see what other teams do. For example, calling on individuals (or pairs) to put solutions to particular problems up on the board and explain to the class why they did what they did. Don't always ask for volunteers. Students are going to be more likely to make sure they understand a particular problem if they think they might be called upon to explain it to the class.
- Photocopy good solutions and distribute them to other teams. In fact, you should resist the temptation to write up your own solutions. Their peers' good work is more impressive.

Some instructors have found it helpful to students if at the beginning of the semester the groups start some of the difficult homework problems in class. If a group is getting stuck at a particular point the instructor can ask other groups to help out. For example, the instructor can ask two or three groups how they have decided to approach a particular problem. In this way the instructor can help guide the students in learning to solve problems. It also will help students quickly find out that there is more than one way to approach problems.

How to deal with "sick" teams

In most classes there will generally be at least one sick team -- a team that is not working together effectively. Some of the signs of a sick team might be:

- Students appear to be working individually and not as a group.
- The homework is not up to par.
- Student(s) complain that someone isn't pulling his or her weight (doesn't show up, hasn't tried to work with the material before the meeting, doesn't contribute to the group, etc.)
- Student(s) complain that one or two other students dominate the group and don't listen to him/her.

Problems can often be minimized by giving students clear guidelines and instructions on what is expected, the goals of the group work, and the procedures for making the team work. Some strategies that instructors have used to help make a dysfunctional team function successfully:

- Meet with the students in the team and discuss with them their perceptions of what is going on, perhaps using the team evaluation forms from their Student Guide as a starting point.
- Give the students themselves the responsibility for making the team work.
- Change the teams around.
- Have the team meet in your office and practice working together.

Using team evaluation forms

Included in each Student's Guide is a team evaluation form. These may be used in a number of ways including: (1) each member of the group fills out a form for every other member and then they share and discuss the results, (2) everyone fills out one for each member of the group and hands it in to you. Whether or not you make use of the evaluation forms, it is helpful for students to use them when they are reflecting on how their group is working.

Team Evaluation Form

Your name _____ Date _____

Please enter the names of your team members, and enter your evaluation as follows

not a strength = 0 ok = 1 a real strength = 2

Name of Team Member	A	B	C
Attendance at group meetings	_____	_____	_____
Has read the material and tried to work the homework problems	_____	_____	_____
Comes on time	_____	_____	_____
Helps keep the group going	_____	_____	_____
Willing to listen to others	_____	_____	_____
Puts effort into the process	_____	_____	_____
Helps clarify problems	_____	_____	_____
Is willing to disagree	_____	_____	_____
Is tuned in to whether other members of the group understand the problem	_____	_____	_____
Helps ensure that everyone understands the solution.	_____	_____	_____

Being part of this group helped me better understand the material. (circle what's appropriate)

Strongly Agree Agree Neutral Disagree Strongly Disagree

Meeting with this group was better than working the problems on my own. (circle what's appropriate)

Strongly Agree Agree Neutral Disagree Strongly Disagree

Meeting with this group was a good experience. (circle what's appropriate)

Strongly Agree Agree Neutral Disagree Strongly Disagree

What suggestions would you make to improve your group or group experience?

Cooperative Learning in the Classroom

The importance of the first day

There are several things you can do on the first day of class that will make it easier to use cooperative learning throughout the semester. First, start getting students acquainted with each other and with you. Students are more likely to feel comfortable in participating if they know something about their classmates. Learning names as quickly as possible is imperative to making it all work and you can get a good start on the first day. Previous instructors used a variety of methods for learning names. Mort Brown took pictures of the students:

“I really worked on memorizing their names. On the first day I took a picture of each student, they were either sitting or coming in the door--usually in bunches. By the time I'd written all the names out at the bottom of the pictures, I knew most of them already because those candid pictures really brought the person across. It really made a big difference.”

Other instructors use a variety of ways to start learning names including using name tags and having the students introduce themselves to each other and/or the class.

It is also important to get students working in small groups in a cooperative assignment on the first day. Phil Hanlon, a faculty member in the Department who uses collaborative groups says:

“I find it important to start building a good learning environment on the first day. I learn names and I start out on the first day using groups. On the first day I split them into groups of four and give them a problem they are to grapple with as a group. I do this toward the end of class so they must finish the problem on their own and report back later.”

Having students engage in a cooperative task on the first day gives them a chance to get to know some fellow students right away. It also helps build expectations that this class will be different in the sense that students will be required to actively think and participate.

Getting students acquainted with each other quickly

For the first few weeks remind students to introduce themselves to each other whenever you put them in a different group. This helps students become acquainted and comfortable with each other. Using names when you call on students in class also helps everyone become acquainted.

Choosing appropriate group problems

The type of problems that you choose for in-class work can make or break an activity. The type of problem you use will of course be different depending on how much time you have. Problems that work best are interesting and challenging and have a clear purpose as a group assignment. In other words, the students' understanding of the material will be enhanced by working in a group on the assignment. If the problems are too easy students don't take them seriously--they tend to feel as if it is “busy” work.

Some instructors, have found it helpful to sometimes have homework teams start working on one of the more difficult homework problems and finish the problem outside of class. This is especially useful at the beginning of the semester. Students like it and it gives the instructor a chance to see how the different teams are working together. The instructor can go around to the groups and give hints and ask questions that help the groups get started and help model problem-solving strategies. Groups that are on the right track can be asked to share with the others how they decided what to do. Since most students are not used to working together and may not have a clue on how to approach these more difficult homework problems, making sure they are on the right track will make their first meetings more focused and productive.

Forming in-class groups

Instructors have found that in-class groups work better if students are required to get up and move to form the groups. Students are either asked to get into their homework teams or the instructor has them count off with the different numbered groups being spaced around the room. There are reasons for using different groups (than homework teams) for some of the in-class work. It gives students a chance to get acquainted and work with different students and it may help to break up patterns that tend to form when a group works together for an extended period of time.

Communicating the guidelines for an exercise

Being very clear about group assignments so that every student knows just what to do is crucial. Some instructors found it useful to have the problem(s) written on a piece of paper, giving each group only one piece of paper. This is a good technique to use to help students start thinking that you are on their side. The paper becomes associated with “them” outside of the class and the instructor becomes and ally against “them”---Mort found students even saying “They want us to do _____.” Also, with only one sheet of paper students can’t go off and work the problem individually. Variation is important. Other possibilities are writing the problem on the board, or if you are going to have each group do a different problem, writing each problem on a different board and having students fill in the solutions.

Other things that need to be communicated are any roles that are required (e.g., a scribe to write down the solution, etc.), how much time students have to finish the assignment and what is to happen with the product.

Using a variety of methods for getting students to work together keeps the class interesting.

- *Small problem solving groups* (groups of three or four students). With small groups fairly sophisticated problems can be used. This works best when you have enough time for the groups to reach a solution. Here again it is advisable to give the students a few minutes to individually read through the problem and think about it before they have to talk about it. For variety you could have some groups go up to the board and work the problem together as they are standing at the board.
- *Think-pair-share*. Individual students work a problem or write about a process, in pairs students compare answers and reach a consensus, and some pairs are asked to share their results with the class. In this process each student does individual work before comparing with another student. (Whenever students are given time to do individual thinking before they are required to work in a group it will help distribute participation in the group.)
- *Pairs*. Using pairs to address short assignments can be used intermittently with mini lectures without too much moving around. These can be planned, short assignments or if no one can answer a question posed to the whole class, you can break them into pairs and have them try to come up with an answer.
- *Group Quizzes*. Students tend to like group quizzes, and a tremendous amount of learning goes on when they are hammering out the answers. Most groups tend to get everything right. More difficult questions can be used on group quizzes than can be used on individual quizzes. (It is, of course, important to have individual quizzes too. But using group testing 2 or 3 times a semester seems like a real treat for most students.) One idea that has worked well is to give students a 10 minute quiz individually, collect it, and then immediately give them the same quiz again as a group quiz.

Getting groups “unstuck”

As important as it is to have students grapple with a problem together, it is equally important that they don’t spend a great deal of time frustrated. If no one in the group has any idea of how to get going, it is time for you to step in with a hint, or possibly a mini-lecture if several groups aren’t getting anywhere. The rule of thumb here is class time needs to be productive, not threatening.

Giving feedback to the groups, and using the results of group work

Instructors have tried a variety of methods for using the results from group work. This is an important part of the learning process because it not only gives feedback to the groups it gives students the opportunity to see other students' work and different ways of thinking about the problem. It also makes group work an important part of the in-class learning. If you give students practice in analyzing each others' work, it will help them become better problem solvers. Some of the methods that have been used:

- Ask one or two representatives from each group to put a problem on the board and explain it to the class. Some instructors have the whole group go up. Since students have been working in groups and have had time to think about the problem you might call on students instead of asking for volunteers. Groups will tend to make sure everyone understands the solution if any one of them might have to represent the group. Getting students in the class to analyze the solutions increases their learning. Some questions you might ask (whether the solution is right or wrong) are:
 - Do you agree or disagree with this solution and why?
 - Did anyone get a different solution or a different way of reaching the solution?
 - Which way is best and why?
 - Do you agree with what has been put up on the board?
 - Does anyone have any questions for the people who put this up?
 - Could anyone tell me to go about checking to see if this is a reasonable answer?
- Ask one group to put up its solution and then ask another group explain it to the class (if they agree with the solution) or tell the class how they might do it differently and why.
- Have the groups write their solution on an overhead transparency and have one or two students describe the results to the class. Or, you put up the transparencies and get students to comment on the results--that way the students who worked out the solution are distanced so others are more likely to be more open in analyzing it.
- Ask students to change papers with another group and critique and give feedback to the other group. If students know that other students will be seeing their papers they tend to be more careful and thoughtful. This process also helps students to learn how to critique their own papers, and allows them to see the thinking of another group.
- Have two groups get together and compare their answers, discuss the discrepancies, and come up with an agreed upon solution.
- Have students hand in the solutions for extra credit. (This takes little class time but takes more work for the instructor outside of class. It isn't always necessary to grade or make comments on these papers--just look them over and get an idea of where students might be having difficulties and then spend some class time addressing those areas. In this case students get the extra credit if they were engaged in the process.)
- Have students hand in their solutions as part of their homework assignment.
- Sometimes just discussing the problem as a whole group is enough.

Making sure the ideas are clear before students leave class

Students often have trouble understanding other students work. If the wrap-up of a group exercise isn't completely clear, many students will become frustrated and blame the group work itself. You need to be prepared to recap the session for them if necessary.

Further resources

There are several videotapes of instructors teaching Calculus classes, many of them facilitating cooperative learning in the classroom. You may check out these videos and watch them to get other ideas.

End of Term Procedures

Scheduling review sessions

If you plan to have review sessions for your class, please place a room request in 2084 EH. Room requests can take up to a week to fill, especially during the busy period of review sessions, so plan ahead.

The seriousness of assigning student's grades

Assigning final grades in a course deserves great care. The grades you give students are a part of their permanent records and may have far-reaching effects on their futures. So leave yourself time to think through this job.

Return of exams

Students can get their exams returned by mail. Please announce to your class that students requesting their final exams must provide the instructor with a stamped, self-addressed envelope of suitable size.

In general, papers and examinations should be returned to students so that they may study from them. Examinations that are not picked up or mailed should be retained and not be destroyed for at least one year to provide for those who wait to pick up their exams until later, and also to protect you in cases where charges of improper grading are filed.

Receipt of grades by students

Please announce to your class that mathematics grades will not be given out through the departmental offices. As soon as grades are posted by the registrar's office, they can be viewed via Wolverine Access. However, students who wish to know their grade by postcard should provide you with a stamped postcard. Federal privacy regulations prohibit posting grades in hallways, even if the students are identified only by ID numbers rather than names.

Non-Standard grades

The grades of I (incomplete), X (excused absence from both the final exam and the alternate), and NR (no report) should be given very rarely. These grades always remain on a student's transcript to indicate an irregularity. Unless you report a different grade within the appropriate deadline, these grades will lapse to an E.

You cannot give the grade of I to any student who has completed all the work, nor can you allow a student to do extra work to raise the grade. An incomplete should be used only in the case of a student who is passing the course, but is missing one portion of their grade (often a term paper or exam) and has arranged with their instructor to make it up. Please contact the course coordinator before giving a grade of I.

Students who miss the final exam and the alternate should get a grade X only if they have contacted you and presented an excuse satisfactory to you that their absence was unavoidable. All X's should be given in consultation with the coordinator.

NR (which means no report) should be used only when a student who has never attended your class (or attended only at the very beginning of the term) appears on your gradesheet. A student who has taken exams and has only recently dropped out of sight should be given a grade in consultation with the course coordinator.

Grade complaints

You can prevent many complaints by agreeing to meet with students and explaining their performances on the final exam. There are times when students will insist that they know the material, but for various reasons their records don't show it. They need to see that the grades you give are a record of their actual performance, not your opinion of their potential.

There is, however, an increasing tendency for students to make official complaints about their grades. If informal efforts do not resolve the problem, we have to set an elaborate and time-consuming appeals procedure.

And beyond that, it is not unheard of for students to sue the University for alleged unfair grading. Your best form of preventive medicine is a good set of records. If you can show that grades were arrived at by a rational system, uniformly applied, most complaints will disappear.

Returning your textbooks

Return your textbooks to 2084 EH. If you are teaching, advising, or tutoring, or for some other reason want to keep your book for the summer, you still need to sign it out.

Changing course grades

It is unlikely that you will ever have the occasion to change a grade. If you should need to submit a different grade to remedy a clerical error or to replace a grade of I or X, you fill out a Supplementary Grade Report (available in 2084 EH). You will need to know both the student's ID number and college affiliation, e.g. LSA, Engineering, etc.

Leaving Town

If you are going to be unavailable after the term, graduate students should leave their gradebooks and exams in the Graduate Office, and let them know an address where you can be contacted. Faculty should leave their gradebooks and exams with the Associate Chairman, and a forwarding address in 2074 EH.

Classroom Activities

Activities in the classroom generally fall into the following categories: lectures, class discussions, group activities, etc. (Sample lesson plans are available.) Often several modes are mixed into one class period. The proportions of the mix will depend on the ideas to be investigated, the size and maturity of the class, and the personality and style of the instructor.

Lectures

We are convinced that giving frequent extended lectures is, in general, not an effective use of classroom time. There will be many times when you should lecture, but there is no need to systematically present all the material step by step. The book is very readable and students can learn the content by reading the book. Our rule of thumb has been to lecture no more than fifteen minutes at a time. The guiding principle is to tell the students something they want to know at the exact time they want to know it.

Short “bursts” of lecture can be useful in the midst of a cooperative activity. If a large fraction of the students have run into difficulty, it may be time to intervene. You can spot this kind of moment by listening carefully to the conversations going on within groups and to the kinds of questions directed at you.

Lecturing also may be useful to clarify a particular concept when you know that the students will have a hard time understanding the concept without additional assistance.

Another good use of a short lecture is to give guidelines to the students on what to expect in the next readings and any pointers on how to learn the material. It is good to use short lectures (10-15 minutes) to preview new material or to review previous ideas.

Cooperative learning activities

Using cooperative learning in the classroom can be the most rewarding and, for some instructors, the most difficult to do. In Appendix D you will find tips and advice for using cooperative learning gleaned from the experiences of previous instructors. In Appendix E you will find a check list that you can use as you develop cooperative learning activities.

Quizzes

Students need quizzes to evaluate their individual performance and to practice their test-taking skills. Many instructors include a problem from the individual homework to encourage their students to do all the homework. You should not let quizzes take up too much valuable class time. Try to have them no longer than 20 minutes at the most.

Motivational talks

Students (and instructors!) need frequent encouragement in these courses. There is a substantial payoff if you take a few moments to talk to your class about the progress they have made, for example, “Your writing has come a long way”, or “Look how well you’ve learned to handle these long word problems.”

Getting Students to Read the Book

Bob Megginson

1. Don't lecture as if the students have never before seen the material!
2. Don't lecture as if the students have never before seen the material!
3. Don't lecture as if the students have never before seen the material!
4. You must *really* expect them to read the book, and always act as if you expect them to read the book.
5. You must set the tone the first day of class, *saying* that they must read the book and why.
6. *You* must read the book!
7. Make each day's assignment of reading an *event*, complete with coming attractions.
8. When you start the day's activities, do a brief activity that assumes the reading of the book.
9. As a rule, don't do examples directly from the book, unmodified -- it sends the wrong message. (But there are exceptions.)
10. When examples from the book are important and difficult, go over the difficult parts, only outlining the results of the easier parts, constantly tossing in phrases such as "as you saw in your reading,..." Better yet, get them involved in a group activity to work through the exercise themselves.
11. When they aren't doing the reading, try:
 - (a) Brief quizzes over the reading at the beginning of the day.
 - (b) Group activities based on the reading, as mentioned above.

Most Importantly ---

12. Don't lecture as if the students have never before seen the material!

Questioning Techniques

- An interactive teaching approach stimulates students to think rather than to listen passively, so show that you are open to questions by paying attention to your audience and asking questions frequently. Some of your questions will be addressed to the whole group and other questions to individuals.
- Don't hesitate to call on all of your students, not just the ones who raise their hands. You will find that the classroom atmosphere is improved when many students participate in the discussion and the whole class stays alert.
- Think about the types of questions you ask and try to vary them from easy and factual to more thought-provoking.
-
- Make sure that students can hear each others' questions and answers, and listen attentively yourself.
- A silent class is often an indication that the students have not understood the material easily. They may very well be completely confused and unable to phrase questions or simply intimidated.
- Teachers often sprinkle their lectures with the following questions: "Do you all understand?" or "Any questions?" or "Is this O.K.?" Students almost never answer these questions because they don't want to appear dumb. You will have better results asking more explicitly "Why did I multiply?" or "What other functions behave this way?" or "Am I going too fast?"
- After you ask a question, don't call on someone too quickly for an answer. Leave sufficient time for all of the students to think about how to answer. They will learn more. It's a good idea to wait at least 4 seconds (try counting).
- Don't answer your own questions. Questions phrased like "What shall we do now, graph it?" give the students the impression that you won't require them to think for themselves.
- If you are short of time, you can postpone a question to a later time or to a later class.
- If a question isn't of interest to the whole class, don't answer it during class. If you carry on a private conversation with one student, the rest will lose interest immediately, so answer very specialized questions after class or during office hours.

Establishing and Maintaining Control in the Classroom

Sometimes instructors teaching in the introductory courses have difficulty controlling their classes. It is uncomfortable when students have conversations during class, come in late, leave early, read the newspaper, or do homework from other classes. In classes that use group homework and in-class cooperative learning, students get to know each other much better than they do in ordinary classes, so they will have more to say to each other. Letting some students disrupt the class is not fair to the rest of the students who would like to listen. Here are some things that you might do to establish control of the class.

Set a tone of authority from the beginning.

- Don't be overly friendly, especially at first. Establish that you are in charge. It is always easier to let up a little later than to tighten up after things get out of hand.
- Dress professionally (especially for the first few weeks of class).
- Have them call you by your last name (Mr. _____, Dr. Jones).
- Have a firm attitude in front of the class, polite and pleasant.
- Start on time and end on time.

Hand out written, explicit ground rules of what you expect from the class. The ground rules might include:

- I expect mutual respect.
- I will be on time and start the class on time, and I expect you to be in your seats and ready to go at 10 minutes after the hour.
- When students are presenting their work everyone listens.
- When I am speaking, everyone stops what they are doing and listens.
- This class ends on the hour. I will do my best to finish at that time and I expect everyone to stay in their seats and to be attentive until that time.
- I will be at every class, and I expect you to be here also. Casual attendance is one of the major causes of poor performance.

Reinforce the punctuality rules.

- Start the class on time. If someone comes in late, stop what you are saying and wait until he/she is seated and then quietly say, "Please be on time tomorrow" then continue on with what you are saying. (They will be on time if the ground rules are set, the instructor starts on time, and important stuff is covered in the first few minutes of class.)
- Do not cater to students who arrive at class late. For example, don't stop talking and hand back a paper to a latecoming student.
- If students start to pack up early, stop what you are doing and say, "This class ends at 9:00, there are still five minutes before it is time to pack up to go."

If a student is frequently late, you may want to say (after class) that you are bothered by the disruption.

Reinforce the “no conversation” rules. *Talking and whispering, even when they concern the topic at hand, disturb both the class and the instructor.. As a general rule, the students are more likely to start to whisper when the discussion is not pitched at the right level. If it’s too easy, they feel that they don’t have to listen, and if it’s too incomprehensible, they try to explain it to each other*

- When you are talking to the class (lecturing, explaining something) do not allow others to talk too (those old ground rules). If someone starts to talk, stand still and look at them until they are quiet and then go on with your lecture.
- If someone talks to another student while you are trying to explain something to the class, quietly remind them of the rule and wait until there is order.
- If a student keeps talking even when you have called for attention, or have said that you are going to make a really important point, ask that student (by name) a question about the point that you have made.
- When a student starts to answer a question, and there are others talking, say, "Wait a minute, I want everyone to hear." Say to the class that <student's name> is about to speak and you want everyone to hear it. When the talking stops, ask the student to answer the question, and thank him or her.
- Have students build on each other's comments, "John, do you have anything to add to Mary's answer?" If this is done enough students will start to listen to each other's answers. • When you think that a student really understands a problem, ask him or her to explain the problem at the board. Tell the other students that <student's name> is going to explain the problem, and that they should all pay attention.

Control the in-class cooperative learning activities. *Don’t give the impression that you’re not watching the whole class even when you’re walking around attending to individuals.*

- When starting a group exercise, count the students off and have them move to their group for the exercise. Students tend to sit with people they know. Moving them will make it more likely that they will get right down to business. (Try to avoid having them work in their homework groups except on special occasions.)
- During a group exercise, watch out for groups that are talking about something other than the problem you have assigned. Following are some possible actions to take if they are not staying focused on the problem:
- Ask the students who are talking about something else to tell you where they are in the problem.
- If they are finished, ask them if they all understand it well enough to present it to the class. If not, have them explain it to each other.
- Have them go up to board and put up the solution.
- Have an extra group activity to give to groups who finish early.
- When you want to make a point or clarify something during a group activity, tell the class in a loud voice that you need their attention to make an important point. Wait for the talking to stop, and then make your point.
- When you are ending a group exercise, go to the front of the room and loudly ask for everyone's attention. Repeat yourself until the talking stops. One instructor who had a quiet voice used a bell to signify the end of a group exercise.

Don't let a few students dominate the class. Make sure everyone gets equal time.

- One “expert” student may monopolize the discussion by answering all your questions almost as quickly as you pose them. The way to distribute the discussion more evenly is by calling on all of your students individually.
- A persistent student may repeatedly interrupt you with low-level questions or questions which seem to lag behind the lecture. This situation is difficult to handle because you can't cooperate without getting behind schedule and boring some of the other students. Be polite but encourage the student to see you after class or during office hours. You might also suggest that the student's speed of comprehension will be increased by reading the upcoming lecture material before class.
- An aggressive student will sometimes try to engage you in a dispute. Just listen and calmly insist that you will discuss the problem individually after class. If the issue is one of how some problem was graded, take the paper back and say that you will review the grading and discuss it later. It is far easier to consider partial credit when students are not watching.

Classroom Interactions: The Instructor – Student Relationship

The classroom personalities of effective teachers range from quiet and scholarly to lively and entertaining, and your own teaching will change as you gain experience and try out new techniques. Regardless of your own individual style, the classroom atmosphere is best when the instructor is open, supportive and consistent in dealing with students.

Mutual Respect

- Be positive about the course and course material to your students. Students do better and learn more when they trust that the Department has done its best to develop a good course and choose a good book.
- Learn your students' names and use their names as early in the term as possible. You may want to get to your classroom early to talk informally with students before you begin the class. Encourage the students to get to know each other and work on their homework in groups.
- Always treat students with courtesy and listen to them carefully. Expect them to treat both you and their fellow classmates respectfully.
- Don't be afraid to let your students know something about you personally outside of your role as teacher.
- Don't waste the students' time. Begin and end the class promptly. Prepare thoroughly for each class, paying special attention to the homework problems even though they may seem trivial. Students get restless and angry when the instructor reads, rereads and stumbles through a homework solution. Hand back the students' tests and papers promptly.
- Meet your obligations. Keep all appointments you make with students. When you hold office hours, don't leave early assuming that no one is coming. It's often a useful strategy to make specific appointments with students during your office hours, particularly if they could benefit from the extra attention. Discussions during office hours create good relations with students who then get a chance to know you more personally.
- Don't make snap judgments about students' capabilities – the students will often prove you wrong.
- Don't discuss a student's performance or behavior with other students.
- Be careful not to categorize students on the basis of race or gender.
- As a teacher in charge of a class (or even as a tutor or grader) you must be very careful to avoid any non-professional relationship with your students. Close personal or romantic attachments are inappropriate, even when completely mutual. Because a student might feel that he/she could gain academic favors by agreeing to a closer personal relationship (or suffer by refusing), any situation with the potential for exploitation, realized or not, must be scrupulously avoided.

Dishonesty and Cheating

- An atmosphere of mutual trust and a sense of classroom community will relieve some of the competitive pressures on your students. However, there are certain specific steps which you can take to prevent cheating.
- Whenever you want problems done independently, state it clearly. Tell them that, in general, cooperative

studying will improve their learning (it will), but that in this particular instance you want them to work alone.

- Unfortunately, classrooms are often too crowded to allow alternate seating, so you can only spread them out as much as possible. Have them put away all books and papers.
- The most common form of cheating is copying from a neighbor's paper. Don't hesitate to preface a quiz with something like, "I know we're crowded here, but there are serious penalties for academic dishonesty (see the Student's Guide), so you must keep your eyes on your own paper.
- Proctor conspicuously and carefully.
- Detailed instructions for proctoring the uniform exams will be given to you before exam day.
- Occasionally a student will try to alter a test paper after you hand it back and then claim you made a grading error. You can discourage this as you correct by indicating errors in red pencil and drawing a line through any questions which are left blank. If you suspect a student of doing this, speak to the course coordinator before returning the paper.
- If you are concerned about a probable cheating incident, consult the coordinator. Don't try to handle it yourself. Don't accuse a student of cheating without very solid evidence. For your own protection it is better to go through channels.
- Keep your grades in a secure place.
- Many cases of dishonesty take the form of highly suspicious excuses. You can ask for documentation of any medical excuse but otherwise you will have to use your own judgment about whether or not to accept an excuse for late work, missed tests, etc. It's better not to challenge the validity of an excuse and certainly don't be sarcastic (sometimes an implausible story will turn out to be true). Remind students that they should alert you in advance if they encounter problems with keeping deadlines. Don't bother with excuses about missed quizzes; it's far easier to announce that you will drop one or more quiz scores. Whenever you find yourself negotiating with a student, be as charitable as possible without making extra work for yourself or being unfair to the other members of the class.

Unusual Situations Which Can Arise With Individual Students

- Accommodate students with disabilities as much as possible. It is common for them to need extra time during tests. You may receive documentation about a student in your class from the Office of Services for Students With Disabilities. If the situation is complicated, contact your course coordinator.
- Some students become abnormally dependent on you and want you to give them excessive time. Don't let their demands make you late for your own courses or keep you after office hours. You are already spending considerable time on your teaching, so suggest that they find a classmate to work with or try one of the tutoring facilities (see "Tutoring Facilities").
- It is very rare to have a student with severe test anxiety, however, many students worry about tests and don't perform as well on them as they do in their daily work. If you find yourself working with a student who is overly anxious, it helps to explain that the trouble often stems from an inability to choose an appropriate technique quickly when problems of several types are mixed together. Practicing old tests under simulated conditions is the best cure for this type of worry. Also, students are used to much easier test than the ones we give. It's useful to point out that our test questions are purposely never exactly like the homework but instead the questions may require them to apply their understanding in new situations.

Tutoring Facilities

Math Lab (936-0160) The Math Lab provides tutorial help for students in the introductory courses. It is staffed by instructors and advanced undergraduates. Any student in your class who needs extra help should be strongly encouraged to see you during your own office hours, but the Math Lab with its convenient hours is a good alternative. Announce this to your class.

Math Lab B860 East Engineering
M-Th 10am-4pm and 7pm-9pm
Friday 10am – 2pm
Sunday 2pm – 4pm

Tau Beta Pi The Tau Beta Pi engineering honors association has regular tutoring hours conducted in various libraries and dormitories during the term. You will receive an exact listing early in the term so you can announce it to your class.

Comprehensive Studies Program (764-6410) The Comprehensive Studies Program is located in G155 Angell Hall (see “University Support Offices”). It provides free tutoring in scheduled individual and group sessions for students who have had limited access to high-quality academic resources prior to entering college. The tutors are graduate or upper-class undergraduate students with teaching experience. The services are open to all students.

Minority Engineering Program (764-6497) The Minority Engineering Program operates the Engineering Learning Resource Center on North Campus in 2327 Electrical Engineering and Computer Science. Graduates and senior undergraduates tutor in all areas of math and engineering.

Disabled Students Special assistance for students who are physically disabled or have learning disabilities is available through the Office of Disabled Student Services (see “Instructional Support Services”).

Athletes The time commitment required by college athletics is substantial. Students participating in varsity athletics are eligible to receive academic support including tutoring, regularly scheduled study groups, skill development, academic advising and assistance with interpreting the regulations governing athletic participation.

Departmentally Designated Private Tutors Early in each term the Undergraduate Program office in 2084 EH compiles a list of volunteer math tutors. Tutors indicate which courses they are interested in teaching. The list is available to students who then make individual arrangements about time and place and hourly payment rate.