Teaching Assistant Preparatory Course Guide[1]
FALL 2001

Introduction

Welcome to the University of Arkansas' Physics department Teaching Assistant (TA) Preparation course. This course takes place prior to the start of classes in the fall and counts as a one-credit hour course. Our graduate student body is made up of a widely diverse group of excellent students from many different institutions both in the U.S. and abroad. Many of our graduate students will earn a M.S. or Ph.D. and move on to take jobs in industry. Others will fill positions in academia. Whether a graduate student is headed for industry or a teaching position, they will be required to interact with undergraduate students at some point during the pursuit of their degree. This interaction may range from instructing a lab section to grading exams for a course. No matter what future occupation a graduate student plans, **communication skills**, important to being a good teacher, will be vital.

Our TAs brings with them many different educational experiences, skills and abilities. No matter the amount of experience a TA may have, they tend to be unsure of what will be asked of them while performing their duties and responsibilities. The goals of this course address these concerns and list in detail the different duties and responsibilities they will perform. This course is designed to introduce TAs to the types of classes they will instruct and introduce them to the type of students with whom they will interact.

This course does not cover how to teach students with disabilities. For more information concerning this topic please call Human Resources, 575-5351

Course Rationale

The purpose of this course is to prepare graduate students to be the very best teaching assistant he or she can be, to develop his or her teaching skills, and to develop them professionally through responsibilities and duties. A responsible job teaching makes graduate students more attractive to research advisors and often makes a difference in getting a job after graduating. Many professors, who are asked to write letters of recommendation, will often comment on a graduate student's teaching abilities and communication skills.

[1]Funded in part by the National Science Foundation, Shaping the preparation of Future Science and Mathematics Faculty, DUE - 9813876

Course Goals

- To help develop the teaching skills of TAs and to help them have an enjoyable teaching experience.
- To introduce TAs to the types of courses that this department offers to undergraduate students.
- To familiarize TAs with the expectations of the department concerning their performance.
- To introduce TAs to the demographics of the students enrolled in undergraduate physics classes.
- To introduce TAs to several problem-solving methods and instructional grading techniques.
- To familiarize TAs with a cooperative teaching technique used in undergraduate labs.

Schedule

Monday, August 13th

- Check in with Shari Witherspoon in the main office, PHYS 226. You will receive your office assignment, key card(s), and a welcome to Fayetteville packet.

- Advising with Prof. Raj Gupta on either August 13 or the afternoon of August 14.

- Check in with the Laboratory Curator, Stephen R. Skinner, in PHYS 246. You will receive your TA Preparatory Program packet and have your picture taken

NOTE You must have checked in with the physics department by Wednesday, August 15th; and you must register for the mandatory TA Preparatory Program. This program is a one-credit hour graduate level course required of all graduate students enrolling in the University of Arkansas' Graduate Physics program as of 2000.

Thursday, August 16th

8:30 - 10:00:	• Welcome and introductory comments by the Vice Chair of Physics, Dr. Lin Oliver. • Introduction to the program, review of the schedule and the course goals	PHYS 133
10:00 – 10:15	Coffee break	LOBBY
10:15 – 12:00	• Duties and Responsibilities of a Teaching Assistant	PHYS 133
12:00 – 1:15	Lunch provided by the program. All graduate students are required to attend. **LUNCH TOPIC: "Preparing A Course Syllabus"**	PHYS 132
1:15 – 1:30	Break	
1:30 – 4:30	Science Workshop Seminar	PHYS 244
4:30 – 5:00	Wrap-up and discuss homework assignment for Friday	PHYS 244

Friday, August 17th

8:30 – 10:00	• How to teach an undergraduate introductory lab • Lab Guidelines	PHYS 133
10:00 – 10:15	Coffee break	LOBBY
10:15 – 11:30	• Grading	PHYS 133
11:30 – 1:15	Lunch, we will walk to a local restaurant. Bring money. All graduate students are required to attend. **LUNCH TOPIC: "Utilizing the First Day of Class"**	PHYS 132
1:15 – 1:30	Break	
1:30 – 4:30	Problem Solving	PHYS 245
4:30 – 5:00	Wrap-up and discuss homework for Wednesday	PHYS 245

Monday, August 20th

- Physics Summer Workshop with Ed Sobey, Peabody Hall 04 (8:00 a.m. – 5:00 p.m.)

Tuesday, August 21st

- Physics Summer Workshop with Ed Sobey, Peabody Hall 04 (8:00 a.m. – 5:00 p.m.)

Wednesday, August 22nd

8:30 – 10:00	Integrating the world wide web and computers into your class.	PHYS 244
10:00 – 10:15	Coffee Break	LOBBY
10:15 – 12:00	Integrating the world wide web and computers into your class. (Continued)	PHYS 244
12:00 – 1:15	Lunch provided by the program. All graduate students are required to attend. **LUNCH TOPIC: To be Chosen by the Graduate Students**	PHYS 132
1:15 – 1:30	Break	
1:30 – 3:30	"Professional conduct in the work place" Presented by Dr. Barbara Taylor	PHYS 133
3:30 – 4:30	To Be Announced	
4:30 –5:00	Wrap-up and homework discussion	PHYS 244

Thursday, August 23rd

8:30 – 12:00	Meet with teaching assignment supervisors	
12:00 – 2:00	Departmental Pizza Party – Get to know the faculty	LOBBY
2:00 – 4:00	Meet with teaching assignment supervisors and/or work through the first several labs/assignments as related to your teaching assignment	
4:00 – 4:30	Wrap-up and discuss the TA Orientation Program hosted by the Graduate School	PHYS 133

Friday, August 24th

- Graduate Student Orientation (ALL DAY)

Section I: Courses

The physics department offers a wide array of courses from undergraduate through graduate level. TAs should familiarize themselves with the exact description of the course(s) they are to instruct. A complete listing of these courses can be found in appendix A. This listing of courses and descriptions are based on the 1999-2000 academic year.

Types of Introductory Physics Course

Lecture Classes – Two to four hours each week, sometimes with informal cooperative group learning.

Drill Sections/Practicum – One to two hours a week. Instructor reviews assigned homework and answers questions pertaining to the course material. A ten-minute quiz, 10 – 20 points, is given each week. Drill instructors are also encouraged to use demos related to the material. A list of available demos can be obtained from the lab curator.

Laboratory – Two, three, or four hours a week. (Four-hour sections meet twice a week for two hours each time.) Cooperative group learning with the TA acting, as the facilitator, is the instructional method used by most of the labs offered. The lab is performed after the instructor covers the necessary safety instructions and presents necessary information. Lab experiments are usually completed during one lab session. For most lab sections the students are required to write a formal lab report for credit. Several lab sections are now using an inquiry based activity guide that does not require a written lab report for every activity.

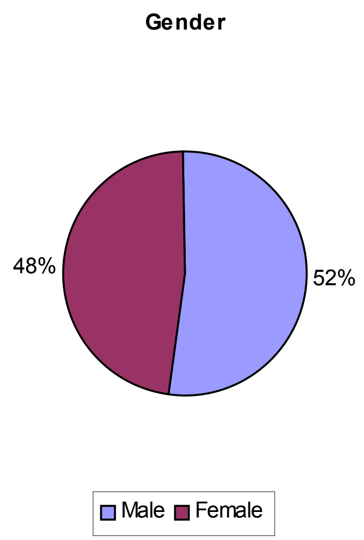
Tests/Exams – Tests are arranged by professors and usually take place during the scheduled lecture class time. However, instructors reserves the right to give tests at other designated times and places within university guidelines.

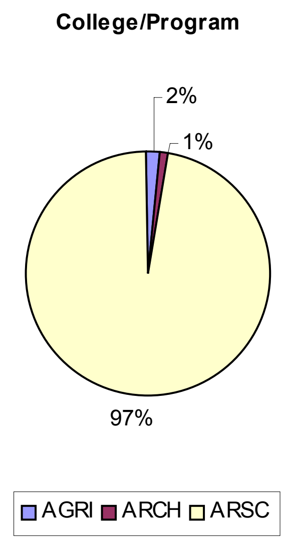
Student Demographics

It is important for instructors to know the demographics of the students being taught. The undergraduate population that comprises the students taking physics courses represent most of the colleges, schools, and programs on campus. The enrollment population for the undergraduate physics courses taught at the University of Arkansas is given in the following pie graphs. The percentage of Arts and Science (ARSC) students who are declared physics majors is also included. All percentages are based on the enrollment figures for the 1999 Fall Semester after the drop date. For a further break down of students for the courses listed in the graphs, see appendix B.

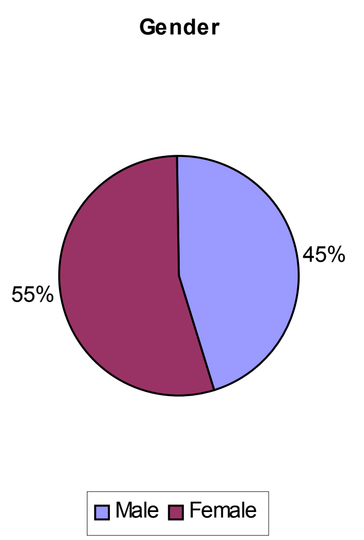
Course Enrolment by College and Gender

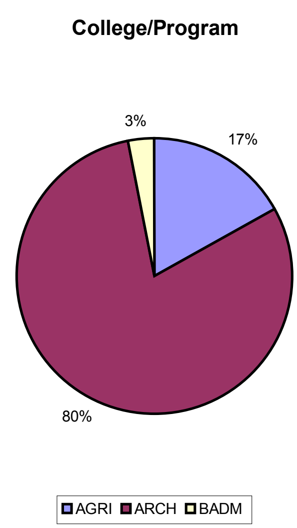
Physics in Human Affairs (PHYS 1023)



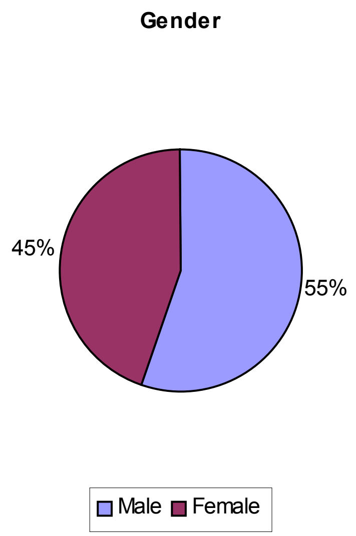


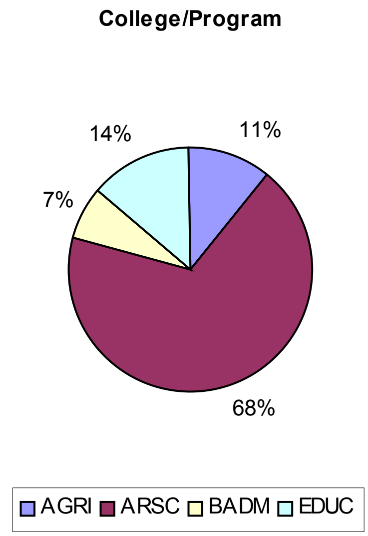
Physics for Architects (PHYS1044)



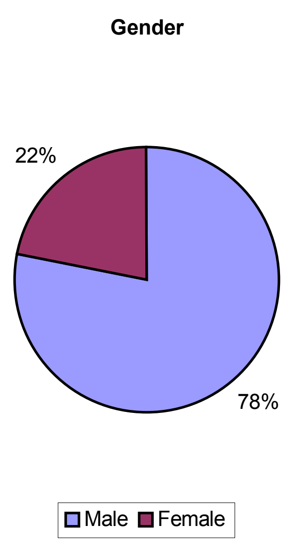


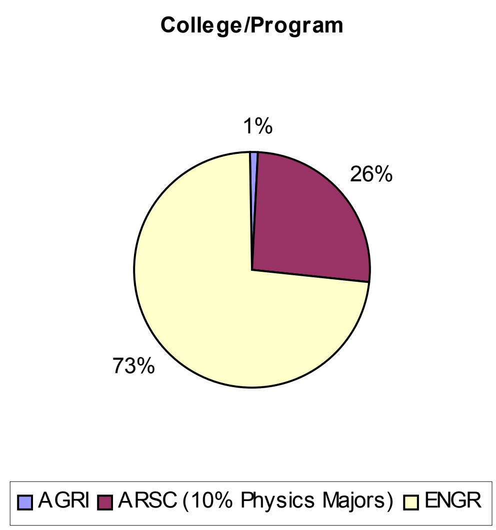
College Physics I (PHYS 2013)



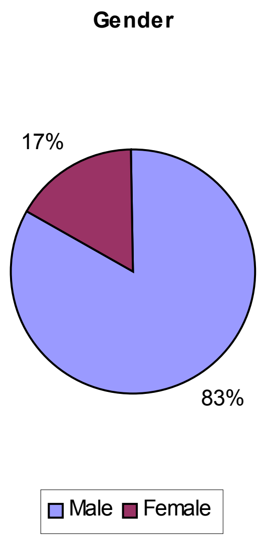


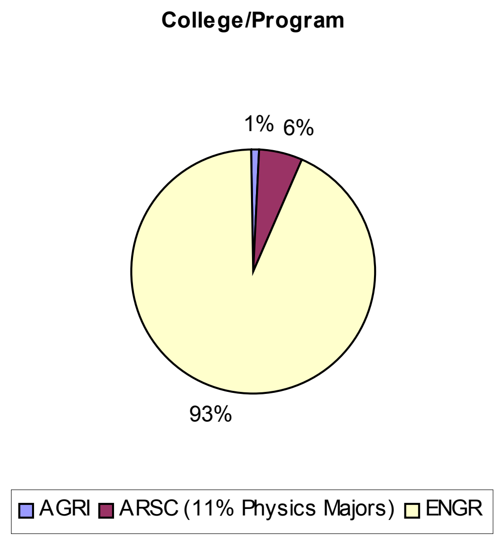
University Physics I (PHYS 2053)



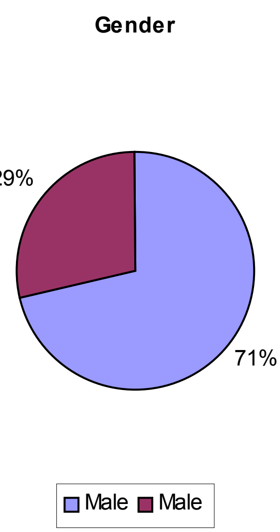


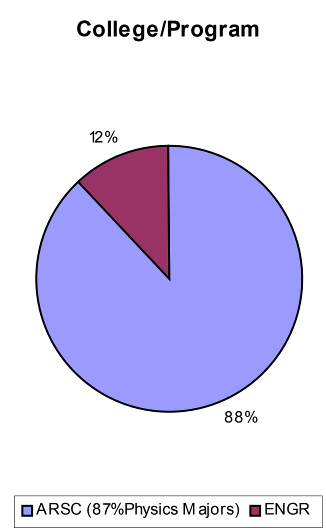
University Physics II (PHYS 2073)



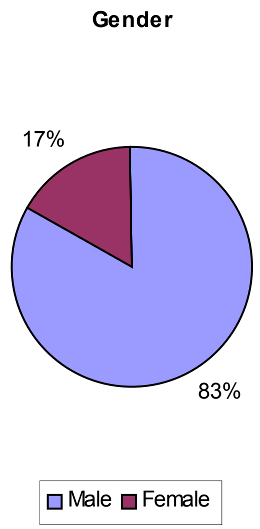


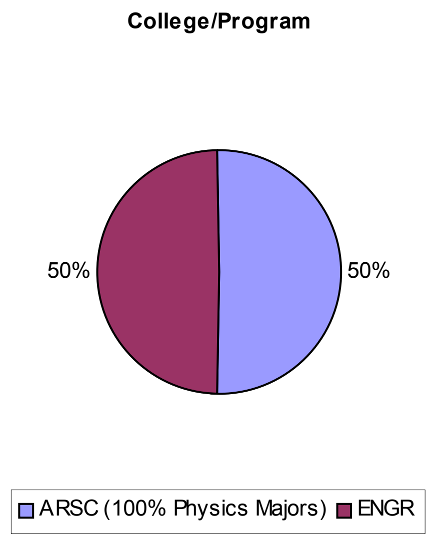
University Physics III (PHYS 2093)





Optics (PHYS 3544)





These percentages are listed in order to give the TAs an idea about the kind of students taking physics course and labs. Most physics courses require the students to have already taken or to be currently taking a certain level of math. The chart below shows the level of math that students should be familiar with based on the physics course in which they are enrolled. This should help TAs in preparing notes for class.

Math Levels Required for Undergraduate Physics Courses

PHYSICS COURSE NUMBER	PHYSICS COURSE NAME	MATH COURSE NUMBER	MATH COURSE NAME	PRE OR CO REQUISITE
PHYS 1023	Physics in Human Affairs	NONE	NONE	NONE
PHYS 1044	Physics for Architects I	NONE	NONE	NONE
PHYS 2013	College Physics I	MATH1203	College Algebra	Pre
		MATH1213	Plane Trigonometry	Pre
PHYS 2053	University Physics I	MATH2554	Calculus I	Co
PHYS 2073	University Physics II	MATH2564	Calculus II	Co
PHYS 2093	University Physics III	MATH2574	Calculus III	Co
PHYS 3544	Optics	MATH2564	Calculus II	Pre

Section II: TA Responsibilities and Expectations

Description of Specific Duties

A Teaching Assistant's assignment will include a wide range of responsibilities. Some of these are: instructing undergraduate lab(s), grading assignments and exams, instructing drill sessions, writing a syllabi for teaching assignments, and holding office hours. TAs are assigned to a professor who is in charge of instructing an undergraduate physics course. The TA(s) for this course are responsible for instructing either several lab sections, several drill sections, or a combination of both and for any grading required by the professor. The TA may also be required by the course instructor to develop a syllabus for the lab and/or drill sessions they are instructing.

Graduate Students are 50% appointed and are expected to work 20 hours a week. When assigned a Teaching Assistantship position you are required by the department to have eight contact hours a week with the students. This means that a TA will teach four two-hour labs a week or an equivalent combination of labs and drill sessions. These eight hours do not include office hours, of which three are required. Grading paper and exams, or preparing for class is not considered as part of your contact hours. However, all of these hours can be counted toward your 20 work week.

The following is a break down of the responsibilities and duties required of a TA when instructing a specific type of course or class.

Teaching Drill Sessions – Drill sessions are no longer part of the physics department curriculum.

Teaching Laboratory Sections – The duties will involve: answering student's questions, working homework problems, giving quizzes, grading exams, and possibly covering some course topics in more detail. Arrive at the lab at least five minutes earlier than the students. Check to see that each lab station has the proper equipment and that it is in proper working order. At this time the TA may wish to write notes on the chalkboard for the students. Although some students enter the room early, try to keep the lab empty until the start of lab. Early arrivals will only distract from the TA's preparations but students wondering about the lab may injure themselves if they are not familiar with the safety rules pertaining to the equipment. Make it a habit to start lab on time. This will give the students plenty of time to complete the lab and gives the TA time to clean up before the next lab starts.

Office Hours – Office hours are important to the students. This is a chance for the students to interact one-on-one with their instructor. Office hours are usually held in the TA's assigned office. TAs are required to have at least 3 office hours a week. TAs are assigned to offices located on the second floor of the physics building near the labs. Please keep office doors open during office hours. This not only makes it easy for the students to find their TA but also allows the TAs to keep meetings professional. If several students needing are in need of help at the same time, be considerate of office mates and relocate to an empty classroom.

Developing a Lab or Drill Syllabus - There many aspects of the course that the TA needs to be aware of when writing a syllabus. It is important that the students are completely aware of how the lab or drill session is going to be taught and graded; when class will meet and what is expected of them when they walk in the door. Read the syllabus written by the instructor of the course. The instructor may have already set guidelines for the related lab and drill sessions. If the instructor has set guidelines for the related lab or drill, include them in the syllabus. The following is a set of items that all TAs should consider including in a syllabus. (See Appendix C for an example syllabus.)

- **Course name and Section number(s)**
- **Course description** - See appendix A
- **Instructor's Name, Office number, Phone number, and Office hours.** (TAs may choose to set office hours after meeting with students. Set office hours so that all students are able to attend at least one of the hours.)
- **Percent of the course grade the drill or lab is worth** - Be sure to read the course guide, the instructor may have included in the course guide how much of the overall course grade the lab or drill is worth. For some classes the lab is a separate grade; research this information.
- **Grading scale** - Decide how many points each lab is going to be assigned and if students are going to be allowed to drop one of the labs. When teaching a drill section, decide how many quizzes are going to be giving and how many points each quiz is worth. Please put lots of thought and time into developing the grading scale. It is important to the students that a complete grading policy is presented on the first day of class.
- **Make-up policy** – When teaching a lab section, decide if or when students will be allowed to make up missed labs. (Please check with the Laboratory Curator when setting this policy.)
- **Weather policy** - Refer to the weather policy set by the university.
- **Course/Section guidelines** - When instructing a lab, include a written description of how lab reports should be written and an example of a respectable lab report.

Most importantly, arrange a meeting with the course instructor in order for him/her to review the syllabus in advance to classes starting. Schedule a way to distribute the syllabus to the students. Many professors pass their syllabus out on the first day of class; however, a lab or drill instructor may not see the students until the first day of lab or drill. The TA may want the professor to pass out a copy of the syllabus prior to the first time lab or drill meets. Another alternative is posting the syllabus on the class web page. All undergraduates at the university are given electronic mail accounts and have access to the Internet through campus computer labs.

Another important issue concerning the syllabus for lab and drill sections is whether or not the students completely understand the guidelines set. One such way to check the student's understanding of the guidelines is to give a quiz over the guidelines for the drill or lab.

Teaching Preparation

Preparation is one of the most important aspects of teaching. If a TA is well-prepared and present himself/herself professionally, the students will respect the TA. If a TA is not prepared the students will feel that the TA does not know the material and the students will distrust you and not respect the leadership of the TA. Once trust is lost it is hard to regain. In order to help the TA prepare for instructing assigned labs and/or drills, a list of suggested preparation activities has been complied.

Preparing to Teach Lab – A TA will be required to instruct at lease one new lab every week with the possible exception of weeks that include holidays and exams. TAs should be prepared to spend a few hours each week preparing for lab. Each TA will have a weekly meeting with the professor in charge of the course. At this meeting the purpose of the lab and the procedure will be discussed. The lab curator will attend these meetings in order to give the TAs instructions pertaining to safety, procedures, and operation of equipment. The following suggestions should help TAs to be prepared to teach lab. For further information, see Appendix D, Guidelines for Lab Instructors.

- Be very familiar with the lab, homework exercises, and the lab equipment. This means that the TA will need to schedule time in advance to perform the lab experiment, **including the data analysis**. The TA will need to read the lab manual and be familiar with all aspects of the equipment involved. (Check with the Lab Curator for times to practice the labs.)
- Ask TAs who have taught the lab before for advice about instructing the lab.
- Arrive a few minutes prior to the students.
- Check each lab station for proper equipment and check the equipment for proper function.
- Make sure that the safety equipment provided for the students is in proper working order and is ready for use.
- The TA may wish to write a few notes on the chalkboard prior to starting lab.
- Be sure to check the AV equipment to see if it is functioning properly. If not, contact the lab curator.
- Check to see if the lab curator requires equipment to be checked out by the students using a photo ID.
- **Always straighten up the lab room for the next TA.**

Preparing to Teach a Drill Session – Drill sessions are a good time for students to ask questions about concepts that are confusing to them and to discuss the homework assignments with their TA. As a TA there are several things that can be done to make sure that the drill session runs smoothly.

- Arrive at the classroom several minutes earlier than the students.
- Be familiar with the textbook and use the same notation as the book when solving problems.
- The TA should work the entire homework problem set in advance in order to be familiar with the problems and the subject matter. **The students are there for help and reinforcement, not to watch the TA attempt the homework for the first time.**
- Be prepared to discuss the physical concepts behind the homework problems.
- Have the quiz prepared in advance and make it relevant to the current topics in lecture.
- Plan on giving the quiz the last part of the class to give the students time to ask questions that relate to the quiz material. This will also keep students from leaving right after the quiz.

Preparing for Office Hours – Office hours are important to the students. We have listed several tips that will help office hours go smoothly.

- **Keep the door open at all times.**
- During office hours do not involve your self in a project that cannot be interrupted when a student stops by with a question.
- Have a copy of the course guide and textbook handy. Many of the questions asked during office hours pertain to the course structure.
- All TAs share an office with other TAs so space is very limited. When meeting with more than two students at the same time, move to an empty classroom. Do not forget to place a note on your door so that other students can locate you.

Preparing to Grade Lab Reports and Homework - This topic is covered in more detail in section V of this manual. The following suggestions will help TAs save time when grading assignments.

- Set the value of assignments prior to assigning them to the students. This should follow the grading scale set in the syllabus for the course.
- Developing a grading format, see section V.
- Stick to the format. If a TA does not grade consistently, the students will want to know why.
- Post a formal solution after papers are returned to the students so that the students can check their work.

Preparing to Grade Tests – How and where tests are graded are left up to the instructor in charge of the course.

Proctoring Tests – TAs are required to help the instructor in charge of the course proctor all exams. As a proctor, the TA will answer students' questions pertaining to the exam, and act as an extra set of eyes in the room, which will help deter students from academic dishonesty. The instructor for each course sets the time and place for the exams.

Section III: Instructing an Undergraduate Physics Lab

Instructional Method

Undergraduate physics labs are based on an active learning technique called "cooperative learning." Cooperative learning is a technique that involves group interaction among the students and interaction with the instructor. The instructor, the TA, acts as the discussion facilitator. The following elements are associated with this method of active learning.

- Students are involved in more than passive learning, such as a typical lecture section.
- Students are engaged in activities such as reading, discussing, writing, etc.
- There is less emphasis placed on information transference and greater emphasis placed on developing a student's skills.
- Students receive immediate feedback from their TA.
- Students are involved in higher cognitive levels. (Analysis, synthesis, evaluation, etc.)

Besides just learning the material represented in the course, these elements will help the students develop good communication skills and good interpersonal skills.

Students do not learn much by just sitting in class listening to an instructor, memorizing assignments, and spitting out answers. They must talk about what they are hearing, write about it, and relate it to past experience. They must make learning part of themselves. (Chickering and Gamson, 1987).

This method of active learning works very well for the way the labs are designed. Most of the labs are designed so that the students are performing an experiment that will help them take a physical concept introduced in class and prove its validity. For example, showing that momentum is conserved but that energy is not always conserved during a collision.

When participating in a lab activity, students work in groups of three or four. The size of the group depends on the activity and the size of the lab-room. The number of lab set-ups is usually consistent during the semester; however, the lab curator may change the number of set-ups depending on the lab and the equipment involved.

There are at least three roles played by the members of the group, the leader, the timekeeper, and the recorder. The leader is usually the most outgoing student, one who likes to take charge, and most likely the one who is willing to ask the TA questions. The timekeeper's duty is to keep the group on task. The recorder's duty is to record all of the necessary information needed for the analysis of the experiment; however, all the students in the group are encouraged to perform this duty.

The TA is the lab and discussion facilitator. The TA monitors the progress of each group and gives help when and where it is needed. The following is a list of the duties performed by the TA as the role of the facilitator.

- Assign students to groups.
- Explain the concepts covered in the lab and the goal of the lab so that the students are clear about the assignment.
- Explain the criteria for success - The criteria could be anything from the acceptable percentage of error to how the results are to be presented in the written lab report.
- Structure positive interdependence - This means that the TA has the responsibility of making sure that each member of the group achieves a prescribed level of mastery of the concepts covered and that all members participate in the lab activity.
- Evaluate students' achievements and evaluate how well the group functioned. (You may need to change the groups depending on how well the students worked together.)
- Interact with each group even if the group seems to be functioning well and is on task.

The facilitator has a responsibility to the students to be prepared for the lab and to be knowledgeable of the material. If you are not prepared to instruct the lab then you will not be able to perform properly in the role of the facilitator.

Uniformity of Lab Instruction

This is a major concern of the students each semester. The students will complain about their lab instructor if they find out that another lab instructor does not grade the lab reports as hard. This has caused many problems in the past. The following is a set of suggestions that will help TAs instructing labs for the same course to be consistent as a group when teaching and grading. See appendix D; guidelines provided by the lab curator.

- Practice the labs as a group. This will give the TAs a chance to discuss what material to present prior to the students performing the lab.
- Decide on how many students will be assigned to each lab group. This may very depending on the number of students in each lab.
- When you meet to practice the lab, decide on the point distribution for the lab reports and develop a grading format together.
- Grade together. This might be hard to do because of class schedules, but grading together will help you to grade consistently.
- Try grading lab reports written by students from other lab section(s).

Following these suggestions will make the TA's teaching assignment go more smoothly and create consistency amount the lab sections.

Section IV: Problem Solving and Grading

Problem solving and homework grading is an important aspects of being a Teaching Assistant. The TA is no longer just working homework problems for himself/herself and his/her instructor, but the TA is now working problems for approximately 30 students per teaching section. This should completely change how the TA looks at his or her problem-solving skills and problem-solving process. The TA will also want to consider how he or she is going to grade 30 or more copies of the same homework assignment.

Problem Solving

Before we can discuss how to grade homework assignments, we need to address the question: "What is problem solving"? Problem solving is the process of using a set of learned skills and facts to transform a statement or situation into a final goal defined by the problem statement. This process is usually subject to a set of constraints.

The first step in the problem solving process is to recognize a problem statement. A good problem statement has three distinct characteristics, the given constants, a goal, and a list of obstacles, (Woods, 1987). The given is any information needed to fully describe the situation so that the reader can draw a physical and/or mental picture plus any constant needed to solve the problem. The goal is the desired or terminal state for the problem. In other words, it is the desired answer in a numeric, algebraic, or sentence form. The obstacles are steps that might be required to reach the goal, such as assumptions, derivations, solving for missing information, etc.

There are three components to the problem solving process: the thinking component, the strategy, and the attitudinal component, (Mayer, 1983). The thinking component encompasses thought processes such as identification, clarification, evaluation, analysis, etc. The strategy is a well-developed and well-organized set of steps that will help you achieve the goal when implemented. The attitudinal components are the feelings or behaviors that arise while solving the problem such as frustration, success, failure, elation, confusion, etc.

When solving problems it is easy to mix up general skills with strategies, (Woods, PRS Program Unit 2). A strategy often involves a skill but is not strictly limited to just skills. Skills are generally defined as the laws, concepts, and truths that you are introduced to during a lecture or in a lab setting. An example of a skill is long division. A strategy is a list of instructions and behaviors, in a certain order, that must be followed in order to arrive at the goal. If the strategy is not followed precisely then the incorrect goal is often achieved. An example of a strategy is the steps necessary to start a car. Most people do not need to understand the laws of physics involved in how an internal combustion engine works, they only need to be able to follow a strategy, the set of instructions that will cause the internal combustion engine to start.

When solving a problem a student will often go through a couple of different thought processes. Two such thought processes are inductive reasoning and deductive reasoning. Inductive reasoning is a situation in which the problem solver must leap to a general rule given a series of examples or facts. Deductive reasoning is when the problem solver follows a series of logical thoughts to arrive at an answer. Deductive reasoning is usually the most-used reasoning process when working homework assignments, and inductive reasoning is most likely to be found in the lab.

Knowing how the students feel about all aspects of the course is important to helping you develop the learning environment. However, most course instructors are often not aware of the attitudes of their students. This is because we do not ask the students for attitudinal feedback except at the end of the semester in the form of an instructor evaluation. If the TA was aware that over 60% of his or her students were not grasping a new skill introduced in lecture because they could not read the instructor's handwriting, the TA might better understand why the students scored poorly on a recent homework assignment.

The TA can easily gather the necessary information on the attitudes of the students through a simple mid-semester survey. An example survey is provided.

Student Survey

Please answer the following questions concerning the teaching method and style of your TA. Your TA will be reading your responses. Please be honest so that your TA can make changes to his or her teaching method and style.

1. Can you understand your instructor's spoken English?
2. Does your instructor write so that you can easily read what has been written? If not why?
3. Does your instructor have any habits that interfere with your learning?
4. Does the instructor cover the material fully?
5. Does the instructor leave adequate time for the students to ask questions?
6. Is the instructor in his office during office hours?

This is just an example of the types of questions the TA could include in the survey. There are many resources available to TAs to help them improve as an instructor. Two such organizations on campus are The Teaching and Faculty Support Center and The Graduate School.

It is important to get the approval of the course instructor before giving a survey. The TA will also want to limit the survey to only the things that he or she can change. Such as, the time quizzes are given during the lab period, the length of lab reports, the way you present problem solutions on the chalkboard in the class, your office hours, etc.
It is important that the TA realizes that he or she is now expected to be an expert problem solver by the students. The TA will be expected to solve problems correctly on a chalkboard while thirty students sit and stare at him or her. This is not always an easy task, no matter the amount of experience the TA has gained as an undergraduate. In order to help the TA in this task, we must look at what the TA has become, an expert problem solver.

An expert problem solver is fully aware of the problem solving process, (The Complete Problem Solver). A person who carefully considers his or her strategy, stage by stage, and is aware of his or her attitudes toward the process, all of the things a novice problem solver does not do.

The following chart compares some of the characteristics of a novice problem solver and of an expert problem solver, (MacMaster, 1984).

NOVICE	EXPERT
▪ Emphasis on speed ▪ Unaware of mental process ▪ Mixes stages of the problem solving process ▪ Jumps into the problem ▪ Bases decisions on past experience without considering new facts ▪ Limits self to one solution ▪ Makes decision without measurable criterion	▪ Takes time ▪ Aware of process ▪ Considers the problem stage by stage ▪ Identify the problem and identifies all needed information ▪ Identifies the goal ▪ Identifies and selects the best method possible ▪ Establishes measurable criterion

The expert problem solver and novice problem solver are completely different in their processes. The list of actions carried out the by the expert problem solver are the actions and attitudes that we desire for the students to exhibit. However, since TAs are teaching introductory physics classes and/or labs, you cannot expect the students to show all of these behaviors and actions. It takes time, reinforcement, and encouragement to help the students make these changes.

Most TAs will not get a chance to require the students to solve their homework problems following a set format. So it is important that TAs set a good example of an expert problem solver by solving all problems that they present in class by following a format. The following is a suggested format.

- Draw a "good" diagram
- Define all variables used in the problem
- Show all steps to your solution listing the physical laws and concepts used, such as Newton's Second Law
- Box the answer so that the students can find it on the board.
- Be organized, do not jump around on the board.

Problem solving skills are an important tool in today's workplace. Many of the students are engineering majors who will someday be asked by their employer to solve complex problems on a daily basis. Some of the students may seldom use physics so the problem-solving skills taught by the TA will be the most beneficial thing they take with them. It is the TA's responsibility so see to it that as educators we help students develop strong problem-solving skills in the lab, skills that can also be applied to other situations.

The format presented in this handbook is only one of many formats for solving problems. For other formats see appendix F.

Making Mistakes and Using Them as a Learning Tool

TAs are not perfect and they make mistakes working problems at the chalkboard or when verbally answering a student's question. Acknowledge that you made a mistake and fix it right away; do not put it off. The TA may even be able to use the mistake as a teaching tool. For example if the TA improperly applied a physical law, explain how a students could easily have made the same mistake and why the mistake was made. The students will appreciate the fact that even TAs make mistakes sometimes.

Grading Problems

TAs are not only required to teach but also to GRADE. Grading is often the most dreaded part of teaching and is often the part of the course that the students complain about the most. But it is possible to make grading less painful if the TA develops a fair and consistent method for grading both homework assignments and lab reports.

To be consistent and fair all the time takes lots of practice. When grading homework it is important that the TA is familiar with the problem beforehand. This means that the TA will want to work the solutions to the homework assignments in advance. The TA will then be able to use his or her solutions as a key for grading.

When sitting down to grade the TA needs to have a plan. A plan will cut down on the amount of time that is spent grading. The plan should address the following questions: How many points are assigned for each problem? Is there more than one part to each problem? Are you grading for math or physics concepts? How you are going to handle the one person who solves the problem differently?

All of these questions should be kept in mind when the TA is making up the grading "key." A key should be a clearly written copy of the solution. Next to each problem to be graded write the point values assigned. Then circle the piece(s) of the solution to which points have been assigned and write next to it the amount that it is worth. For example, if a problem is worth 5 points and requires the student to show a diagram with axes labeled properly, make the diagram worth 2 of the 5 points possible.

Stick to the key but be prepared to deal with the one student who solves the problem differently from the others. It is possible that there is only one-way to solve it or that the problem statement required the student to use a certain method. If this is not the case, The TA will need to take some time to decide how to distribute the points. This information should also be recorded on the key, in case the TA runs into a similar solution, so he or she can justify the score.

When grading homework problems that ask for a quantitative answer the TA will find that students tend to make several different types of common mistakes. Some of these common mistakes are conceptual, mathematical, and/or a misunderstanding of the problem statement.

Many of these problems arise because the students have not developed a good set of problem solving skills. One of the most common errors the students make in their problem solving process is not drawing a "good" diagram. A "good" diagram is one in which all of the forces present are drawn and labeled, all of the givens in the problem statement are labeled, and all vectors are drawn to proper scale. It is important to model this behavior for your students in your own solutions.

Using the Chalkboard:

One thing that the TA will need to be aware of when using the chalkboard is that space is limited. The TA will need to practice presenting problems on the board so that he or she develops a method that will allow them to fully use the board. If a TA presents a problem solution in a clear and precise manner with well thought out reasoning, then the students will start to emulate the TA's methods. See appendix G for an example-grading key.

Grading Lab Reports

Writing lab reports is probably the most hated assignment you can give a student because of the time required. The TA should be prepared to spend a fair amount of time grading lab reports.

Many students do not realize how important it is to develop good written communication skills. Writing lab reports is a good way to build these skills. Many of the students will spend a good deal of their professional careers writing reports as part of their job.

There are many common mistakes and difficulties that students encounter when writing a lab report. The TA needs to keep track of these types of problems that occur frequently so that he or she can deal with them. The following list contains only some of the common mistakes and difficulties that students face.

- Misunderstanding the purpose of the laboratory experiment.
- Incomplete theory section
- Not fully understanding the procedure used to obtain the results
- Confusion about data analysis
- Misunderstanding about the results they are trying to obtain
- Not including reasons for error in data
- Lack of graphing skills and simple math skills
- Lacking full understanding about the physical concepts involved in the experiment

To help prepare students to write good lab reports it is important that the students fully understand what is expected of them. It is important that the TA is familiar with the guidelines set for the students when they are writing their lab reports. The TA will need these guidelines when he or she starts to grade. If the course instructor does not provide a set of guidelines, then the TA will need to develop a set of guidelines for the students. Be sure to include the guidelines in the course syllabus. It is important that the TA and the students are 100% aware of what is expected of them when writing lab reports.

Grading thirty or more lab reports takes time; there is no way around it. The TA will need to develop a “key” for grading, similar to the key developed for grading homework problems. A key will not only cut down on the amount of time the TA spends grading but will help the TA grade consistently.

In order to develop a key, the TA will need to be familiar with each of the labs. Most TAs are only asked to grade lab reports if they instruct a lab section. If a TA is a grader for a lab section and he or she is not instructing the lab then the TA will want to ask the lab instructor to either provide a grading key or ask them to help develop a key.

Using the outline provided for the students in the course syllabus, start filling in the missing items on the outline. An example of this would be:

> **Purpose:** The purpose of this lab is to show that momentum is conserved even when energy is lost in a collision.

Do this for every part of the outline being sure to include every chart, graph, or plot required. Next assign point values to each section of the outline. [Similar to developing the key for grading homework problems, circle the parts, that you have filled in on the outline, that you are going to be grading and assign them point values.] The TA may not wish to assign the procedure part of the experiment too many points because the procedure is often written out in detail in the undergraduate lab manual. See appendix F for an example of a lab report-grading key.

The grading key is something that the TAs might want to develop as a group. Developing the key with other TAs in the course will help all of the TAs to grade fairly and consistently.

TA Activities for Section IV

TA Activity V – Writing "Good" Problems – The purpose of this assignment is to give you a chance to practice writing "good" problems. You will write three problems related to the course that you are assigned to instruct. Once you have written your problems you will gather in-groups of three and evaluate your problems using the characteristics of a good problem. You will then choose one problem to present to the other groups.

Section V: How to Handle Being a TA and a Graduate Student

It is difficult to balance the duties and responsibilities of a TA along with the responsibilities of a graduate student. The TA will have to learn how to manage his or her time in order to balance teaching preparation with completing homework assignments for classes and studying for exams. This will not be an easy task. An article has been provided for the TAs to read that covers this topic. The TAs will be expected to attend, and participate in, an informal discussion session covering this topic and listen to several veteran TAs speak aboout how they managed to cope. Good luck on your teaching assignment.

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Appendix A

PHYSICS (PHYS) COURSES:

PHYS100V Projects (1-2) (FA, SP, SU) Independent study in experimental or theoretical physics for lower division undergraduate students. May be repeated for 2 hours.

PHYS1023 Physics and Human Affairs (FA, SP, SU) The great ideas of physics, together with their philosophical and social impact. Scientific topics include cosmology, relativity, and quantum mechanics. Philosophical and social topics include methods and values of science, problems related to energy sources, and implications of modern weapons. Non-mathematical. Designed for non-science majors. Along with PHYS 1021L, can be used to satisfy a 4-year physical science requirement for a B.A. degree. Students who have received credit in PHYS 2013 and 2033, or 2053 and 2073 cannot also receive degree credit in this course. UNIVERSITY CORE COURSE
PHYS1021L Physics and Human Affairs Laboratory (FA, SP, SU) Laboratory 2 hours per week. Pre- or Corequisite: PHYS 1023. UNIVERSITY CORE COURSE

PHYS1044 Physics for Architects I (FA) The relation between the principles of physics and the practice of building and operating structures. Topics include: The behavior of structures under various loads, the statics and dynamics of fluids, thermal storage, thermal expansion, the greenhouse effect, heat transfer, refrigeration, the energy problem, efficiency in the operation of buildings. One underlying theme is that the self-sufficiency of a building is an important part of architecture. Lecture 3 hours, laboratory 2 hours per week. Corequisite: PHYS 1040L. UNIVERSITY CORE COURSE

PHYS1040L Physics for Architects I Laboratory (FA) Corequisite: PHYS 1044.

PHYS1054 Physics for Architects II (SP) Acoustics, electricity and magnetism, light, and environmental physics. Topics include resonance, acoustical isolation, interference, reverberation time, electrical circuitry with emphasis on power and efficiency, electrical storage, light sources, reflection, refraction, absorption, transmission, color, astronomy (to give perspective to the use of sunlight in architecture), heat, noise, and radioactivity pollution. Lecture 3 hours, laboratory 2 hours per week. Corequisite: PHYS 1050L. Prerequisite: PHYS 1044. UNIVERSITY CORE COURSE

PHYS1050L Physics for Architect II Laboratory (SP) Corequisite: PHYS 1054.

PHYS2013 College Physics I (FA, SU) A non-calculus survey of the principles of physics including mechanics, heat and sound. Lecture 3 hours per week and drill (PHYS 2010D) 1 hour per week. Corequisite: PHYS 2010D and PHYS 2011L. Prerequisite: (MATH 1203 and MATH 1213) or equivalent. UNIVERSITY CORE COURSE

PHYS2010D College Physics I Drill (FA, SU) Corequisite: PHYS 2011L and PHYS 2013.

PHYS2011L College Physics I Laboratory (FA, SU) Laboratory 2 hours per week. Corequisite: PHYS 2010D and PHYS 2013. UNIVERSITY CORE COURSE

PHYS2033 College Physics II (SP, SU) Continuation of PHYS 2013. Topics include electricity and magnetism, light, relativity, quantum mechanics, atomic and nuclear

structure. Lecture 3 hours, drill (PHYS 2030D) 1 hour per week. Corequisite: PHYS 2030D and PHYS 2031L. Prerequisite: PHYS 2013. UNIVERSITY CORE COURSE
PHYS2030D College Physics II Drill (SP, SU) Corequisite: PHYS 2031L and PHYS 2033.

PHYS2031L College Physics II Laboratory (FA, SP) Laboratory 2 hours per week. Corequisite: PHYS 2030D and PHYS 2033. UNIVERSITY CORE COURSE

PHYS2053 University Physics I (FA, SP, SU) Introduction to the principles of mechanics, wave motion, temperature and heat, with calculus. Lecture three hours per week and practicum two hours a week (included in PHYS 2051L). Pre- or Corequisite: MATH 2554. Corequisite: PHYS 2051L. UNIVERSITY CORE COURSE

PHYS2053H Honors University Physics I (FA) Introduction to the principles of mechanics wave motion, temperature and heat, with calculus. Lecture three hours per week and practicum two hours a week (included in PHYS 2051M). Pre- or Corequisite: MATH 2554. Corequisite: PHYS 2051M. UNIVERSITY CORE COURSE

PHYS2051L University Physics I Laboratory (FA, SP, SU) The laboratory includes a practicum component integrating it with the lecture (PHYS 2053) and meets twice a week for two hours at each meeting. Corequisite: PHYS 2053. UNIVERSITY CORE COURSE

PHYS2051M Honors University Physics I Laboratory (FA) The laboratory includes a practicum component integrating it with the lecture (PHYS 2053H) and meets twice a week for two hours at each meeting. Corequisite: PHYS 2053H. UNIVERSITY CORE COURSE

PHYS2073 University Physics II (FA, SP, SU) Continuation of PHYS 2053. Topics covered include electricity, magnetism, light and geometric optics. Lecture three hours per week and practicum two hours per week (included in PHYS 2071L). Pre- or Corequisite: MATH 2564. Corequisite: PHYS 2071L. Prerequisite: PHYS 2053. UNIVERSITY CORE COURSE

PHYS2073H Honors University Physics II (SP) Continuation of PHYS 2053H. Topics covered include electricity, magnetism, light and geometric optics. Lecture three hours per week and practicum two hours per week (included in PHYS 2071M). Pre- or Corequisite: MATH 2564. Corequisite: PHYS 2071M. Prerequisite: PHYS 2053 or PHYS 2053H. UNIVERSITY CORE COURSE

PHYS2071L University Physics II Laboratory (FA, SP, SU) The laboratory includes a practicum component integrating it with the lecture (PHYS 2073) and meets twice a week for two hours at each meeting. Corequisite: PHYS 2073. UNIVERSITY CORE COURSE

PHYS2071M Honors University Physics II Laboratory (SP) The laboratory including practicum meets twice a week for two hours at each meeting. Corequisite: PHYS 2073H. UNIVERSITY CORE COURSE

PHYS2093 University Physics III (FA) A continuation of PHYS 2053 and PHYS 2073. Topics include waves, physical optics, thermodynamics, kinetic theory, and an introduction to quantum mechanics. Lecture 3 hours per week and practicum 2 hours per week (included in PHYS 2091L). Corequisite: PHYS 2091L and MATH 2574. Prerequisite: PHYS 2073.

PHYS2091L University Physics III Laboratory/Practicum (FA) The laboratory includes a practicum component integrating it with the lecture (PHYS 2093) meets twice a week for two hours at each meeting. Corequisite: PHYS 2093.

PHYS220V Introduction to Electronics I (1-18) (FA, SP, SU) Individualized, self-paced laboratory instruction in electronics requiring no previous electronic experience. Topics include basic DC and AC electronics fundamentals. May be repeated for 2 hours. Pre- or Corequisite: MATH 1203 or MATH 1285.

PHYS306V Projects (1-3) (IR) Individual experimental or theoretical research problems for advanced undergraduates.

PHYS3113 Analytical Mechanics (SP) Newton's laws of motion applied to particles, systems of particles, and rigid bodies. Introduction to Lagrange's equations and expansions. Prerequisite: PHYS 2073 and MATH 2574.

PHYS320V Introduction to Electronics II (1-4) (FA, SP, SU) Individualized, self-paced laboratory instruction in electronics, covers topics including semiconductor devices, electronic circuits, and digital techniques. May be repeated for 4 hours. Prerequisite: PHYS 220.

PHYS3414 Electromagnetic Theory (SP) Electrostatics including dielectric, magnetostatics and magnetic materials. Maxwell's equations, radiation theory, and wave propagation. Prerequisite: PHYS 2073 and MATH 2574.

PHYS3544 Optics (FA) Elements of geometrical, physical, and quantum optics. Lecture 3 hours, laboratory 2 hours. Corequisite: PHYS 3540L. Prerequisite: PHYS 2073 or MATH 2564.

PHYS3540L Optics Laboratory (FA) Corequisite: PHYS 3544.

PHYS3603 Introduction to Modern Physics (FA, SP, SU) An introduction to the basic ideas of 20th century physics, with an emphasis on those that form the foundations of modern technology: quantum theory and its application to atomic, nuclear, optical and condensed matter physics. No credit is given toward a B.S. degree in physics. Prerequisite: PHYS 2033 and (MATH 2043 or MATH 2554).

PHYS3601L Modern Physics Laboratory (FA, SP, SU) Experiments illustrating the development and concepts of modern physics. No credit given toward a B.S. major in physics. Prerequisite: PHYS 3603.

PHYS3614 Modern Physics (FA, SP, SU) Introduction to special relativity, statistical physics, quantum physics, and a survey of nuclear and particle physics. Review of thermal radiation, photon, and wave mechanics.

PHYS3923H Honors Colloquium (IR) Covers a special topic or issue, offered as part of the honors program. No more than 3 hours may be offered toward fulfillment of the requirements for the B.S. or B.A. degree in Physics. May be repeated. Prerequisite: honors candidacy (not restricted to candidacy in physics).

PHYS399VH Honors (1-6) (FA, SP, SU) Independent study for physics students enrolled in the honors program. Prerequisite: junior standing.

PHYS400V Laboratory and Classroom Practices in Physics (1-3) (FA, SP, SU) The pedagogy of curricular materials. Laboratory and demonstration techniques illustrating fundamental concepts acquired through participation in the classroom as an apprentice teacher. Prerequisite: PHYS 3114 and PHYS 3414.

PHYS4073 Introduction to Quantum Mechanics (FA) A survey of quantum mechanics from the wave mechanical point of view. Required course for B.S. Physics majors. Prerequisite: PHYS 3614 and MATH 3404.

PHYS4103 Physics in Perspective (SP, Odd years) Human implications of physics, including life's place in the universe, the methods of science, human sense perceptions, energy utilization, societal impacts of technology, and the effect of physics on modern world views. No credit given toward a B.S. major in physics. Prerequisite: PHYS 3603 or PHYS 3614.

PHYS4113 Physics in Perspective (SP, Odd years) Human implications of physics, including life's place in the universe, the methods of science, human sense perceptions, energy utilization, societal impacts of technology, and the effect of physics on modern world views. Credit allowed for only one of PHYS 4113 or PHYS 4103. Prerequisite: PHYS 3614.

PHYS4203 Physics of Devices (SP, Even years) Principles of physics applied in a selection of technologically important devices in areas including computing, communications, medical imaging, lasers, and energy utilization. Students will utilize technical journals. No credit given toward a B.S. major in physics. Prerequisite: PHYS 3603 or PHYS 3614.

PHYS4213 Physics of Devices (SP, Even years) Principles of physics applied in a selection of technologically important devices in areas including computing, communications, medical imaging, lasers, and energy utilization. Students will utilitize technical journals. Credit allowed for only one of PHYS 4203 or PHYS 4213. Prerequisite: PHYS 3614.

PHYS4333 Thermal Physics (SP, Even years) Equilibrium thermodynamics, statistical physics, and kinetic energy. Prerequisite: PHYS 3614.

PHYS462VL Modern Physics Laboratory (1-3) (FA) Advanced experiments, projects, and techniques in atomic, nuclear, and solid state physics.

PHYS4713 Solid State Physics (SP) Crystal structure, diffraction and symmetry. Lattice vibrations, elasticity and optical properties. Electronic structure, band theory, transport and magnetism. Course emphasizes applications and current topics in semiconductors, optics and magnetism. Corequisite: PHYS 3414 and PHYS 4333. Prerequisite: PHYS 3614.

PHYS4734 Introduction to Laser Physics (SP) A combined lecture/laboratory course covering the theory of laser operation, laser resonators, propagation of laser beams, specific lasers such as gas, solid state, semiconductor and chemical lasers, and laser applications. Prerequisite: PHYS 3414 and PHYS 3544.

PHYS4754 Introduction to Applied Nonlinear Optics (FA) A combined lecture/laboratory course. Topics include: practical optical processes, such as electro-optic effects, acousto-optic effects, narrow band optical filters, second harmonic generation parametric amplification and oscillation, and other types of nonlinear optical spectroscopy techniques which are finding current practical applications in industry. Prerequisite: PHYS 3414 and PHYS 3544.

PHYS4774 Introduction to Optical Properties of Materials (SP) A combined lecture/laboratory course covering crystal symmetry optical transmission and absorption, light scattering (Raman and Brillouin) optical constants, carrier mobility, and polarization effects in semi-conductors, quantum wells, insulators, and other optically important materials. Prerequisite: PHYS 3414 and PHYS 3544.

PHYS4794 Lightwave Communication (SP, Odd years) A laboratory based course on light propagatioin in planar and fiber waveguides, optical coupling, operation principles of semiconductor lasers, detectors, and LEDs, hands-on experience with applications in communication systems. Prerequisite: PHYS 3414 or ELEG 3703.

PHYS4803 Mathematical Physics (IR) Development of mathematics used in advanced physics, including tensors, matrices, group theory, special functions and operators. Prerequisite: MATH 2574.
PHYS498V Senior Thesis (1-6) (FA, SP, SU)

PHYS4991 Physics Senior Seminar (FA, SP, SU) Student mastery of the principles of physics are assessed by means of research paper writing and an examination chosen by the faculty. The research paper may be used to satisfy the Fulbright College writing requirement. (Required of all B.S. and B.A. physics majors in their last year.)

Appendix B

Student demographics of undergraduate physics classes at the University of Arkansas based on Fall 1999 enrollment after official drop date.

CLASS NUMBER	COLLEGE OR SCHOOL	DEGREE	MALE	FEMALE	TOTAL	% SCHOOL	%MALE	% FEMALE
PHYS1023	Agriculture		4	3	7	2%		
Physics in Human Affairs	Architect		1	0	1	0%		
	Arts and Sciences	Art	1	2				
		Criminal Justice	5	6				
		Communication	6	8				
		Computer Science	16	8				
		English	8	20				
		Math	1	2				
		Music	5	1				
		Law	0	1				
		Other	76	72				
		TOTAL	118	120	298	81%		
	Business		37	23	60	16%		
TOTAL			160	146	366		44%	40%
PHYS1044	Agriculture	Interior Design	0	16	16	16%		
Physics for Architects	Architect		41	37	78	80%		
	Business		3	0	3	3%		
TOTAL			44	53	97		45%	55%
PHYS2013	Agriculture		11	9	20	11%		
College Physics I	Arts and Sciences	Biology	35	24				
		Computer Science	3	0				
		English	4	1				
		Math	0	1				
		Other	14	16				
		Pre-Med.	13	11				
		TOTAL	69	53	122	68%		
	Business		9	3	12	7%		
	Education		9	16	25	14%		
TOTAL			98	81	179		55%	45%
PHYS2053	Agriculture		1	1	2	1%		
University Physics I	Arts and Sciences	Biology	3	3				
		Chemistry	5	5				
		Other	9	7				
		Computer Science	4	0				
		English	2	2				
		Math	3	3				
		Physics	5	0				

		TOTAL	31	20	51	26%		
	Engineer		121	23	144	73%		
TOTAL			153	44	197		78%	22%
PHYS2073	Agriculture		0	1	1	1%		
University Physics II	Arts and Sciences	Other	5	3				
		Physics	1	0				
		TOTAL	6	3	9	6%		
	Engineering		121	22	143	93%		
TOTAL			127	26	153		83%	17%
PHYS2093	Arts and Sciences	Other	2	0	2	12%		
University Physics III		Physics	8	5	13	76%		
		TOTAL	10	5	15			
	Engineer		2	0	2	12%		
TOTAL			12	5	17		71%	29%
PHYS3544	Arts and Sciences	Physics	2	1	3	50%		
Optics	Engineer		3	0	3	50%		
TOTAL			5	1	6		83%	17%
* Other - represents all degrees with less than 1% of the total college or school population.								

Appendix C

Sample Lab Syllabus

Course Name: College Physics I Lab
Course Number: PHYS 2013L
Course description: College Physics I Laboratory (FA, SU) Laboratory 2 hours per week.
Corequisite: PHYS 2010D and PHYS 2013.

Lab Instructor: Stephen R. Skinner
Office: PHYS 246
Phone: (501) 575-6059
E-mail: sskinne@comp.uark.edu
Office Hours: To be announced after the first day of class.

Welcome to College Physics Lab. This lab is worth one credit hour and carries a separate grade from College Physics, PHYS 2013. This lab is designed to help reinforce the physical concepts and laws discussed in the lecture part of this course. Attending lab does not take the place of attending class. Passing the lab does not mean that you will pass the class and vice-versa.

This lab is designed so that the students work together in groups of three or four, depending on the lab and space available. You will be able to complete the lab in the time allotted. Even though you work in groups the lab reports are not to be done as group projects. Please write reports individually.

Grading Scale: Your grade will be based on the completion of 10 labs, five quizzes, and a lab final. Each lab is worth 10 points. The 10 points will be distributed differently for each of the 10 labs and the distribution will be discussed prior to lab. You will have five pop quizzes during the semester worth 3 points each. The quizzes will be given at the beginning of the class. The purpose of these quizzes is to make sure that you are prepared for lab. If you are not prepared for the lab then your understanding of the physical concepts covered in the lab may not improve. The lab final will be given on the last day of labs and is worth 35 points. You may only use your graded lab reports on the lab final.

LAB REPORTS (10 POINTS)	= 100 POINTS	67 % OF GRADE
Lab quizzes (3 points)	= 15 points	10 % of grade
Lab Final (35 points)	= 35 points	23 % of grade
TOTAL points	= 150	

150 – 135 points = A
134 – 120 points = B
119 – 105 points = C
104 – 90 points = D
89 – 0 points = F

Make-up Policy: You will only be able to make up one missed lab during the semester. There will be a make-up day at the end of the semester, the week before the lab final. You are required to submit a lab report for the make-up lab. If you know that you are going to be missing a lab, please try to attend another section during the week if circumstances allow.

Weather Policy: Lab will meet unless the University of Arkansas officially closes.

Lab Report Format:
All lab reports should include the following:

- **Purpose –** This is a statement, no longer than three sentences, that describe the reason this experiment is to be performed. **Ex:** *This experiment will show that the capacitance of a parallel plate capacitor increases with the area of the plates and when you insert a dielectric with a dielectric constant greater than that of air.*
- **Theory –** This presents in detail the physical concepts that covered by this experiment. This part of the lab must be well written. Include physical laws, diagrams, graphs, and equations when referenced
- **Apparatus –** This section is a list of the materials used in the experiment.
- **Procedure -** Like the instructions for baking a cake, the procedure is an important part of any experiment. The procedure is important because, for your results and conclusions to be factual and believable, someone else must be able to follow your procedures and arrive at the same results.
- **Data –** This section contains all of the recorded measurements that you need in order to compute your results. The data should be contained in well-organized and labeled charts. You must also define all variables used in the experiment. This is similar to the homework and includes all constants.
- **Data-analysis –** This section requires that you show all of your work. This means that you will need to neatly copy all of your scratch work. Show all steps that are necessary. You will also include a well-labeled chart showing all of your results.
- **Conclusion -** In this section you will discuss all of your results. If you had to calculate a number to make a conclusion then you need to discuss the limits of precision and accuracy.
- **References –** A list of resources that you used to complete the lab report. Please use the referencing techniques of the APA format.

Questions pertaining to the course or lab: Please contact me at any time if you have questions pertaining to the course or the lab. You can contact me at the above phone number or by e-mail: sskinne@comp.uark.edu.

Appendix D

Guidelines for Lab Instructors

1. **Practicing the Lab** – Practice the complete lab prior to instructing the lab. Check with the Laboratory Curator concerning lab schedules.

2. **Pre-lab Check** - Always do a pre-lab check. This means that the TA will need to arrive a few minutes earlier than the students. Check each lab station for proper equipment and check the equipment to see if it is functioning properly. If a piece of equipment is not working properly, notify the lab curator so that it can be taken care of before lab starts.

3. **Equipment Function** - Be familiar with the proper function of each piece of equipment. If the TA is not sure how a piece of equipment functions, contact the lab curator for proper operating instructions. The proper function of equipment should have been discussed at the lab meeting.

4. **Hazardous Material and Safety Equipment** - Always be alert to the presence of hazardous material and lab equipment that requires safety precautions and equipment such as chemicals, mercury thermometers, radioactive samples, lasers, shock or burn hazards, etc. If the TA has any questions about the handling of hazardous material contact the lab curator. Each lab is provided with a simple first aid kit. The kit is located in the cabinet under the sink in each lab room.

5. **Checking Out Equipment -** Several labs will require students to present a picture ID when checking out equipment. For security reasons, keep the IDs on you at all times. When the students return equipment in proper working order, they get their IDs back. Please follow this guideline.

6. **Broken Glass** - If a piece of glassware breaks during the lab, clean it up immediately. A broom and dustpan are available in the lab curator's office. Notify the lab curator so that the broken piece can be replaced.

7. **Equipment Breakage Forms** - "Equipment Breakage Forms" are located in each of the lab rooms in red notebooks. Should a piece of equipment break:
    - Fill out the top part of 2 forms.
    - Give the first copy to the student who broke the equipment.
    - Give the second copy to the Lab Curator.

Appendix E

Appendix F

Problem Solving Strategies[2]

[2] Strategies are borrowed from *Workshop #20 Preparing TAs to Teach Undergraduate Courses* by Patricia and Kenneith Heller.