

"You can not teach a [person] anything; you can only help him [or her] discover it in [themselves]."

-- Galileo

This manual is for Instructors in the Physics Practicals. It should not be made available to students. In fact, it is a good idea to not even make the existence of this document, particular the notes on the Modules, known to your students. Contents are:

- [An overview of the philosophy and implementation of the Practicals.](#)
- [How to be most effective in your role as an Instructor in the Practicals.](#)
- [The First Meeting](#)
- [Notes on the Modules that your students will be performing.](#)

Philosophy and Implementation

Much of the traditional educational process uses the following model:

The instructor possesses the knowledge, and students can acquire that knowledge by listening to the instructor "lecture" about it.

However, as the quote from Galileo indicates, many have known for a long long time that this model doesn't really work. Beginning in the early 1990's, Physics Education Research has clearly proved that for most students Galileo was correct.

That research has also shown that:

- When first year students begin a University Physics course, most of them have incorrect ideas about the basic principles that govern the physical universe. For example, most of them have concepts about forces and motion that are largely Aristotelian, not Newtonian.
- For a traditional course based on mathematical formulae and problem solving, at the end of the academic year student wrong concepts have not significantly changed.

The research has also discovered some techniques that help students overcome their incorrect ideas.

Conceptually based activities using a Guided Discovery model is the single most effective strategy in helping students to understand the fundamental ideas of Physics.

Whenever possible, the activities should be based on real physical apparatus.

Most students learn most effectively in a social context.

These facts are the "heart" of the Physics Practicals.

Students will work together in *Learning Teams* of 3 or 4 students. In the usual case these Teams will work together for the entire academic year. There will be up to 8 Learning Teams in your Practical Group, and each Team will do most of their work at a *Pod* in the practical room. You will be working with another Instructor, and in the usual case the two of you will be working with your Group for the entire academic year. The Group meets once a week for 2 hours.

In the course of the year, some of your students will probably drop the course. The *minimum* number of students in each Learning Team is 3. If a Learning Team has less than 3 students, you will need to re-organise your students. The *maximum* number of students in each Learning Team is 4.

The Practicals are based on a series of *Modules*. Often the module will contain:

- Conceptually-based activities based on the material currently being discussed in the students' class.
- Introduction to various aspects of experimental science, which is needed to analyse the response of the apparatus being used to explore the concepts of the module.

Such a learning Module is called a *Conceptual Practical*.

In the second term, we will introduce *Discovery Practicals*, which are investigations of an area of experimental science which is not necessarily tied to material being discussed in class.

How To Be an Effective Instructor

During most of the session, you and the other Instructor will typically "float" around the room individually, monitoring the work that is going on and intervening when requested.

As we have just seen, the heart of the learning process in the Physics Practicals is a Learning Team of 3 or 4 students working together on a series of activities. Your role is to intervene when the Learning Team is stuck and not able to resolve an issue. However, effective intervention does **not** mean giving the answer: recall that students don't really learn when they just listen to an authority giving the information. Instead, you should attempt to lead the students to the answer to their own question by asking leading questions of your own.

When you ask a question, do not expect an immediate answer. Students sometimes need time to think and/or discuss it among themselves.

Of course, you do not want to frustrate your students by seeming to be unwilling to help. Thus in very rare

cases you may have to make a statement instead of asking a question.

You may find that at first this *Socratic* method of teaching, where you only ask questions, is very difficult to do. Persevere: it gets easier and really is the most effective type of teaching for these Practicals.

Since most modules will involve physical apparatus or a computer simulation, you should also resist the urge to actually manipulate the system under consideration yourself. If you "drive" instead of letting your students do it, you may benefit but they will not. Keeping your hands behind your back or in your pockets will help you resist the sometimes strong urge to just do it for them.

You should also try to insure that all members of the Learning Team "drive" the apparatus. Do not let a single student dominate any aspect of the activities.

Going through the modules will take almost all of the 2 hours of the session. You should plan on allocating a maximum of 15 minutes at the beginning of the meeting to answer questions that the students have about the classroom material. This part of the Practical should involve the entire group, not just an individual Learning Team, and both Instructors. Immediately before a test, you should plan on spending more time on these sorts of questions.

Evaluation of students in the Physics Practicals is easy. If the student attends for the full 2 hours and works on the material of the current module they get a Pass, otherwise they get a Fail. There are a couple of activities later in the year that you will mark in more detail. We will discuss these at the appropriate time.

There is one final matter that is sometimes difficult. When (not if) you get a question for which you do not know the answer, admit it. Tell the students that you will find out what the answer is, and then do so. If you do not have time to find out the answer during the Practical, find out for the next meeting. Do not try to fake it: this can be disastrous for your role as an Instructor.

In summary, then, the 2 most important teaching strategies are:

1. Make most of your interactions with your students involve you asking questions.
2. At least figuratively, keep your hands behind your back or in your pockets.

You may wish to muse about the fact that your learning how to be an effective Instructor should follow the same principles we are using with your students. You will need to discover much of the above material for yourself.

The First Meeting

The first session of the Physics Practical at the beginning of the academic year is by far the most important. This is when you will establish a relationship with your students and set the environment for the Practicals. Your success in this will persist for the entire year: it is very difficult to change the first impressions that you make with your students.

Here is a list of some things that you will want students to learn in the first meeting:

- How are the Practicals organised? (Learning Teams of 3 or 4 students working cooperative on a series of modules.)

- How will they be evaluated? (Virtually all of the Practical mark is Pass/Fail, where they receive a Pass for attending the Practical and participating in the activities.)
- What are the requirements to succeed? (Attending the Practicals and participating in the activities.)
- What benefit will they receive by attending the Practicals? (The topics of the Practicals will appear on their tests, and thus their performance on the tests will benefit from participation.)
- You will treat the students in a respectful and professional manner. You expect the students to treat you in the same fashion.
- You expect the students will treat each other in a respectful and professional manner.
- What should the students call you?

This last point deserves a bit more discussion. Most of these students are fresh out of high school, where they have learned that they should call their teachers "Mr." or "Ms." Don't make them uncomfortable by not making it clear to them what to call you. If you want to be addressed by your first name, say so. If you want to be addressed by your last name (*Mr. Blow*, *Ms. Blow*, or *Dr. Blow*) tell them. If you choose the latter, you should consider addressing them in a similar fashion. You should discuss this issue with the other Practical Instructor, and use the same protocol.

A good way to begin the first session is the "name game." In this you, the other Instructor, and each student will briefly introduce themselves to the entire group. Information should include:

1. Their name.
2. Their program of study.
3. Where they live.
4. A personal fact about themself.

As the students come in, have them take a seat in the room. After you have introduced the idea of Learning Teams have them arrange themselves into such Teams. No Learning Team should have less than 3 students or more than 4. If the Group has close to the maximum of 32 students, each Team will have to have 4 students.

About the Modules

"I learned first year Physics by tutoring this course."

-- a former PHY138 tutor

If this is your first time serving as an Instructor, you may be surprised at how little first year Physics you remember. As the above quote indicates, this does not make you unique. In addition to the Guides to the Modules for your students, we have prepared Notes for you to help you re-learn this material. It is important that you have looked over both before each Practical, so you are at least a little bit ahead of your students.

Here are links to both the Guides and Notes for the Modules:

Author

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