Instructor Manual

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

Contents

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 very well. 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 interacting with their peers.

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*.

There are also *Discovery Practicals*, which are investigations of an area of experimental science which is not necessarily tied to material being discussed in class.

Students will be working together in Teams of three or four students, with four the generic number. There will be up to nine Teams per Group with two Learning Assistants for each Group.

In the course of the term, 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.

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. Also keep an eye out for Teams in which, say, three members are doing most of the work and one student is sort of hanging back and not participating.

Going through the modules will take almost all of the 2 hours of the session. You should plan on allocating a about 20 minutes or so 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. More information about effective ways to do this is in the **How to Conduct a Session** section below.

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.

The First Meeting

There is an old saying that you never get a second chance to make a first impression. Therefore the first session of the Physics Practical at the beginning of the term 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 term.

Preparation

Before the first Practical you should divide the students into *Teams* of four students each. If you have prior test results or other similar information on the students, try to make each Team diverse in terms of their abilities. Also try to avoid a Team which consists of three males and only one female student.

You will be re-arranging the Teams about half way through the term.

Conducting the First Meeting

When the students come in, tell them which Team they are in and which Pod the Team will be using.

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? (The next section of this document discusses this is some detail.)
- 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.

At this point you should tell the students that each Team will have two designated people, who will be a different individual every week:

- **Facilitator**. This person takes primary responsibility for the Team. He/she should keep the Team on track, and when discussion with the entire Group occurs he/she is the primary spokesperson for the Team.
- **Record Keeper**. This is the person who does most of the writing in the lab book.

Have each Team choose the Facilitator and Record Keeper for this first session.

For the first session, the records should be written on loose paper. Each Team should designate one of their members to purchase a lab book and bring it to the next meeting. The loose paper can then be stapled into the lab book.

Next is the "name game." In this you and the other Instructor briefly introduce yourselves to the entire group. Information should include:

1. Your name.
2. Your research.
3. Where you live.
4. A personal fact about yourselves.

Then have each member of the Team introduce themselves to each other providing the same information. Finally, have each Facilitator introduce the Team to the rest of the Group.

Evaluation

All student work will be marked on a four point scale, with **no** fractional marks.[1] The marks are:

0. This is only for missing or totally unacceptable work.

1. This is for work that is seriously deficient and unacceptable.

2. This is for work that requires improvement. Considerable feedback on what improvement would be needed will be required.

3. This is the "standard" mark and indicates good work.

4. This is for exceptional work. No more than 10 – 15% of the students will receive this mark on any assignment. For team assignments, this translates into one mark of 4/4 for an "average" Practical group of 8 – 9 teams. You may wish to show the other students the work that received this mark, without identifying the student(s) of course.

Thus h-bar ($\hbar$) is 25%.

Then each component of the mark will be weighted, so that the total Practical mark is the sum of the marks times their weights. The final Practical mark is out of 100.

Some mark components are given to individual students, others are assigned to the whole team.

You will mark the lab books three times in the course of the term.

1. After the first session. These marks do not count towards the final mark in the Practical, but are intended to give the students some feedback on our expectations. It will also be an important part of you getting to know your students.

2. About half way through the term. You will mark a randomly selected set of six Activities that have been done since the first week of the term, chosen by the Practical Coordinator.

3. At the end of the term. You will again mark a randomly selected set of Activities that have been done since half way through the term, again selected by the Practical Coordinator.

Each week we will assign a set of Activities for the students to do. Some Teams work faster than others, so typically one of the Activities will be marked **If You Have Time** (IYHT). Please stress to your students that quality is better than quantity, and their learning will be helped more by doing the required Activities well rather than rushing to complete all the required ones plus the IYHT one. When the books are marked at the middle of the term and again at the end of the term, the coordinator will choose *one* of the IYHT Activities. If a Team has done the chosen Activity and the quantity looks

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[1] There is two exceptions to this rule, One discussed in the **Marking Formal Reports** sub-section. The other is the Error Analysis Assignment, which is marked out of 100 and then divided by 25.

appropriate, award a ½ point bonus. We do not intend for you to mark this Activity in detail.

The final Practical mark will have the *cube* of the number of unexcused absences subtracted from it. Being physically present in the room but, say, studying Chemistry is an absence. Being late by more than a few minutes is also an absence. So is leaving more than a few minutes early. Excused absences are usually only due to a medical reason and supporting documentation will be required.

Marking Formal Reports

Most marks are essentially a *ranking exercise*. This realisation leads to a good procedure to mark things like Formal Reports. Here is the process:

Read a report. Make notes about it on a large PostIt note and place it on the first page of the report. The students will never see these notes, which you will remove before turning the paper back.

Read a second report, making notes on it. Then you ask yourself whether the paper is better or worse than the first report: if it is better place it on top of the first one, and if it is worse black it under the first one.

Read a third report, making notes on it. Place it appropriately in the pile.
After you have read and ranked all the reports, then your only task is to decide where the divisions between the marks lie in the pile.

Experience has shown that the four-point marking scale with no part marks, 4, 3, 2, …, works well for all marking *except* for the Formal Report. For the Formal Report you will probably find that awarding half marks, 4, 3.5, 3, 2.5, …, is more appropriate.

How to Conduct a Session

Most of this section discusses the question and answer segment that should occur during each session.

For the sessions involving *Conceptual Practicals*, it is a good idea to stop work on the Activities about half way through the session for a question and answer segment involving the entire Group. This typically takes about 20 minutes, but may be somewhat longer for the session just before a Test.

The question and answer segment is most effective if you have problems, questions, etc. prepared for the students. Have each Team work on the material, and then have them report to the entire Group their answers and conclusions. We suggest that only one of you needs to actually do this preparation, and you should alternate whose responsibility it is.

We have found that often question and answer session is most effective if the problem or question is prepared in multiple-choice format and delivered to the students via the **Quiz** facility of the *Synchronise* software. Then the students work on the question as a Team and collectively decide on the right answer. Here are some tips on using the Quiz facility:

- The **Quiz** button is located on the left sidebar of the *Synchronise* window. You may select an existing quiz or devise a new one.
- At the top of the window are two buttons, labeled **Start Quiz** and **End Quiz**.
- When you start a quiz a dialog box will give you three options:
    o **Nothing**. When the student answers the quiz, they are not told whether or not they got the right answer. There appears to be a bug in the software, and **this is the option you should use**. The other options will occasionally trigger some sort of problem involving Excel.
    o **Grades Only**. The software will tell the students whether or not they got the right answer.
    o **Grades and Marked Quizzes**. I'm not sure what this does. It seems to be identical to the **Nothing** option.
- While the quiz is in progress, the student computers are locked until they answer the question.
- The software will display which Teams have answered the question and whether or not they got the right answer on your monitor. You probably do not want the students to see this while the quiz is going on. The **Picture Mute** button on the Crestron panel of the lectern will turn off the display by the projector.

I think the **Grades Only** option is appropriate.

Here are some options depending on how the students do on a quiz:

Almost all Teams got it right. You will probably want to individually go over the quiz and its solution with the few Teams that got it wrong.

No Teams got it right. You should go through the solution. Broadcast what you are writing on the Sympodium so all students can see: the projector screen is pretty far away from the Pods at the back of the room.

Only some Teams got it right. Have one or more of the Teams explain to the rest of the group. The hand-held microphone can be useful. Consider having them write the solution on the whiteboard and using the web cam to broadcast it to all monitors.

For other types of question and answer sessions, such as a *MasteringPhysics* problems, just displaying it on the screen means that it will be largely unreadable except by students at the very front of the room. Using the *Broadcast* capability of *Synchroneyes* to put the material being worked on each student monitor will allow all students to read it even in the case of small fonts.

When a student has a question or comment, it is important that the entire Group knows what that question or comment is. Sometimes this means that you should repeat it for the entire Group. Giving the student the handheld wireless microphone can be a nice alternative.

If a Team has done some good work on their whiteboard, if they use their webcam to view the whiteboard you can Broadcast that to all monitors so everybody can see it.

Class Presentations

Class presentations are a tremendous learning experience for the presenters. This section discusses some tips on conducting these.

Have the hand-held microphone and laser pointer available.

The presentations are 10 minutes each. Especially if you have 9 Teams presenting in a single session it is vital that you keep the timing of these on track. Give the students a 2 minute warning as they are presenting. If they are still presenting when time expires give them two more sentences to wrap it up. Although questions and discussion at the end are good, do not let these take too much time.

Most students will use PowerPoint presentations, although this is not required. A good way to project these is to have each Team save the presentation in the Team area on Feynman. You may access these from the Instructor PC on the lectern.

Immediately after the Presentations the two Instructors should meet to assign marks. There are two stages to this:

1. Rank the Presentations from best to worst. Writing these on a blackboard or whiteboard is a good idea.
2. Decide which of the Presentations are good enough to receive a mark of 4, and which are so poor that they receive a mark of 2. The remaining ones in the middle of the ranking receive a mark of 3.

Using the Pilot Room

Light Controls

There are two toggle switches which control the "rope lights" which illuminate the ceiling. One is located beside the main door into the room, and the other is located on the wall just behind the lectern.

There are two *Lutron* controls that control most of the other lights in the room. They are located right beside the toggle switches for the rope lights. They have five buttons. The bottom button turns off all the lights under its control, and the top button turns all lights

on. The other three switches turn subsets of lights on and off. These "scenes" will probably require some adjustment as we learn what our lighting requirements are.

There are two switches available to the students to control the lighting at their Pod. One is a toggle switch located under the whiteboard. It controls the two pot lights over the Pod, so students can turn them off for their Pod. These pot lights are controlled by the Lutron unit, but students can turn them off for their Pod. There is also a light mounted under the cupboard over each whiteboard. These lights are not under control of the Lutron panel. There is a switch on each light for turning it on and off.

Touch Screen

On the side of the lectern is a touch screen. It has menus for controlling the screen and projector, the blinds, and which computer will be used at the lectern.

From each menu, touching the upper-right corner, which has a little curved arrow logo, return to the main menu.

From the main menu, touching the *Local PC* button will:

- Lower the screen
- Start the projector

Once the projector is warmed up, touching *Local PC* will give access to a *Picture Mute* button. This can be useful when you wish to set up the PC for something which you do not wish to students to see. Touching the button again activates the projector.

From the main menu, touching the upper-right corner, which as an **X** logo, exits the system. You will be asked to confirm this choice. Choosing *Yes* will raise the screen and turn off the projector. Note that projectors should never be just powered off: instead they should cool down to preserve the bulb. This happens automatically when you exit the system, and the projector can not be turned on again until after the cool down period has finished.

On the whiteboard behind the lectern are three switches, which are backups for the blind and screen controls on the touch screen. In general you should not use these. All three should all left in the middle "neutral" position.

The Large Whiteboard

There is a large whiteboard behind the lectern. In general, using the Tablet (described below), projector, and screen is a better alternative since it is more readable for the entire group than writing on the whiteboard.

Pod and Computer Numbers

The Pods and their computers are numbered from 1 to 10. Number 1 is the one closest to the main door. Number 2 is the Pod just to its East. The numbering continues around the room, ending with the computer in the lectern, which is number 10.

Student Logins

The login window has a field on the bottom: `Log on to:` Students should choose `UGLABS`. This will log the students into the PC and also enable the network connection to the server.

One member of the Team should log in using their UTORid and password.

Student Network Connections

After logging in, students will have access to three network drives which can be seen, for example, from `Start / My Computer`. The two drives are:

1. `public`. This is an area containing materials which everybody has read access. It includes Modules, datasets, and more.
2. `home`. This is the area for the individual student.
3. `team`. This is the area for which each member of the Team has read and write access.

   Note: students should never save work on the local PC. These discs will be ruthlessly purged on a regular basis. They save their work on the server.

Printing

We charge for printing. Students pay using their TCard. The Practical staff have TCards if you wish to print something.

The current rates are 10 cents per page for black and white and 15 cents per page for color. The students choose which type of printing they wish by choosing the appropriate printer in the print dialog box.

Instructor Login and Network Connections

There is a special login for instructors. The login is: `ta`. See me for the password.

You will have access to three network drives:

1. `public`. This is the same read-only area that the students may access.
2. `Classes`. This directory contains a sub-directory for each of the 18 student Teams. These are the ones where students save their work.
3. `TAs`. This is a directory where you may save anything that you wish.

Using the *Sympodium* Tablet

The instructor's computer is equipped with a touchscreen monitor. The stylus can be used both as a mouse and to "write" on the screen. A set of buttons is located on the top and bottom center of the tablet. These are shown on the next page.

Here is a simple way to use the monitor as a tablet PC:

1. Press the button at the top center of the group at the bottom of the monitor. The button has a logo of a piece of paper and a pen.
2. The three "Pen Tools" button on the top of the monitor allow you to choose a black pen, blue pen, or red pen. The erase button turns the stylus into an eraser.
3. To erase everything on the screen, right click on the writing area with the mouse and choose Clear Screen.
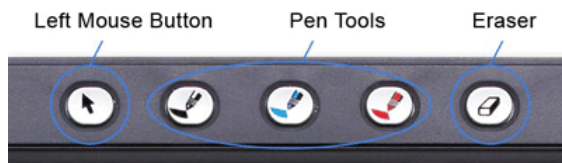

Top Buttons

Bottom Buttons

Left-Clicking and Dragging the mouse pointer are performed by touching the stylus to the screen. To right-click, first press one of the "Right Mouse" buttons under the display. The next stylus tap will be taken by the computer to be a right-click. Another way to perform a right-click is to tap and hold the stylus on the screen for three seconds. At any time, it is possible to use the pen tool to "write" anywhere on the current display. To do so, simply press one of the three pen tool buttons located at the top of the monitor – the mouse pointer will turn into a pen and a floating toolbar will appear:
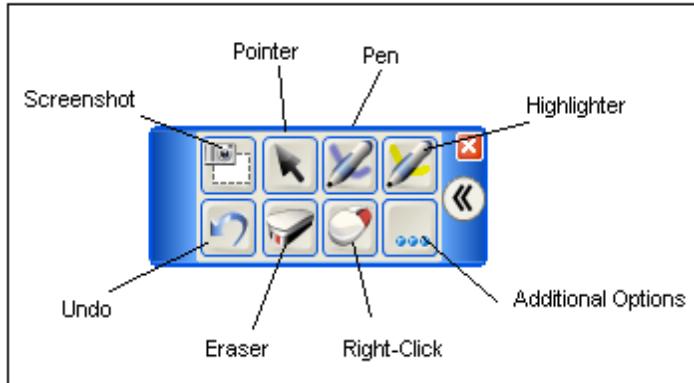
To remove all markings from the current screen, right-click anywhere on the screen and select "Clear Screen". To revert to normal mouse functionality, right-click anywhere on the screen and select "Close Writing Layer". Alternatively, press the "Left Mouse Button" on the top of the monitor. To retrieve your markings, click on the "Undo" button in the floating toolbar. The "Keyboard" and "Tools" buttons on the bottom of the tablet are used to bring up an on-screen keyboard and the floating toolbar respectively.

Note: The software used to control the student computers also has some functionality built-in to work with the stylus. Unfortunately these features don't interact well with the buttons on the monitor and can lead to unexpected behavior if both are used at the same time. We recommend only using the monitor controls at all times.

SynchronEyes Software

Within the Practical room the instructor has the ability to monitor, control, and manage the pod computers remotely using the *SynchronEyes* software. The application is divided into a number of "Views" which can be accessed from the left-hand side of the main window. In this section we discuss the most common functionality, which all appear as part of the **Thumbnail View**. Further functions and views are discussed in Appendix 1.

You will see a thumbnail image of each pod's computer display updated at regular intervals. The length of the intervals can be changed from the "Options" > "Preferences..." > "Advanced" tab.

Locking the Student Displays
To temporarily disable the student computers, click the "Lock" button in the toolbar. The students' monitors will go blank, display a custom message, and ignore input from the mouse and keyboard. The message may be changed from the "Options" > "Preferences..." > "Lock Screen" tab. To unlock the computers, simply click the "Lock" button once again.

Observing a Pod Display
To view the contents of a student display, select its thumbnail and click on "Observe" in the toolbar (Alternatively, you can double-click on the thumbnail).

Controlling a Pod Computer

To take full control of a student computer, select its thumbnail and click on "Control" in the toolbar. The student computer's display will appear onto the tablet screen and you can control it as though you were sitting at that computer.

Broadcasting Displays
To display a copy of the tablet screen onto all the pod computers click on the "Broadcast" button on the toolbar. This mode is especially useful for Teams who may have difficulty seeing the projector screen. In addition, it is possible to display the screen contents of any student computer simultaneously onto all of the other student computers. To do so, select a computer's thumbnail image and click on "Broadcast". When you are broadcasting, the students can not use their computers, so turn broadcasting off when you are done.

About turnitin.com

Students will turn in their Formal Reports to http://turnitin.com. Turnitin.com is an electronic resource that assists in the detection and deterrence of plagiarism. It is widely used by universities in the United States and by a growing number of universities in Canada, and has over 2,000 registered institutions and over 200,000 registered users from 51 countries. The Turnitin.com database searches over 4.5 billion pages on the Internet, millions of published works (including ABI/Inform, Periodical Abstracts, Business Dateline, and tens of thousands of electronic books), and currently holds over a million previously submitted papers (including paper mill essays).

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About the Modules

> **"I learned first year Physics by tutoring**
> **this course."** – a former instructor

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 this material over both before each Practical, so you are at least a little bit ahead of your students.

All student Modules, plus more, are available at:

http://www.upscale.utoronto.ca/Practicals/

Appendix 3 – More Synchroneyes Functions

Here we complete the list of functions available in the **Thumbnail View** and then describe the other views that are available via the left side of the window.

Thumbnail View

Voting
To have the pod computers vote on a single yes/no question, make sure no thumbnail is selected and click on the "Vote" button on the toolbar. The results of the vote will appear in the status bar below the thumbnails and each pod's answer will be displayed as an icon in the top left corner of the thumbnail. To stop voting, click "Vote" again.

Saving a Screenshot
To save an image of a pod's computer screen, select its thumbnail and click the "Capture" button on the toolbar. This can also be done while in observe or control mode.

Displaying Content
To have a video file play on all the pod computers click on the "Display Media" button on the toolbar. Similarly, to have a webpage open in the browsers of all the pod computers, click on the "Send Web" button on the toolbar.

Turning Off the Computers
To shutdown, restart, or log off all of the pod computers, click on the "Shutdown" button in the toolbar, and select the appropriate action.

Quiz View

You will see a list of available quizzes in the top portion of the window, and a preview or results of the selected quiz in the bottom portion.

Giving a Quiz
To distribute an electronic quiz to the pod computers, select the quiz from the "Quiz Files" list and click the "Start Quiz" button in the toolbar. The quiz will stop once everyone has submitted their answers or when the "End Quiz" button in the toolbar is clicked.

Managing the "Quiz Files" List
To add a Quiz file to the list, click the "Add Existing" button in the toolbar. To create and add a new Quiz file, click the "Add New" button. Double-click on any Quiz file in the list to edit it in the Quiz Wizard editing program. To remove a Quiz file from the list, select it and click "Remove".

File Transfer View

You will see a list of Files sent in the top portion of the window and a list of Files Received in the bottom.

Sending and Receiving Files
To send a file from the teacher computer to the pod computers, click on the "Send File" button and select the file. The file will open in the default viewer for that file type on the pod computers as soon as the transfer is complete. To change this behavior, go to the "Options" > "Preferences..." > "File Transfer" tab.
If the student SynchronEyes interface is enabled, the pod computers have the ability to transfer files to the teacher computer. These are displayed in the "Files Received" list.

Chat View
You will see a history of classroom-wide chat.

Enable Chat
To allow pod computers to chat between them click the "Enable" button in the toolbar. If chat is enabled the button will be highlighted – make sure it is not to prevent pod computers from communicating with each other.

Message
To send a private message to a pod computer, select its name from the list and click the "Message" button in the toolbar. Alternatively, this can be done by selecting the pod's thumbnail from "Thumbnail" view and then clicking on "Message". Even if global chat is disabled, sending and receiving messages to individual pods is possible.

Applications View
You will see a list of "Rules" concerning application use on pod computers.

Restricting Pod Computers
To block pod computer access to particular applications, check the application name from the "Rules" list.

Launching and Closing Applications
To start an application remotely on the pod computers, click on the "Launch" button in the toolbar. To stop an application, click on the "Close" button.

Inserting Additional Rules
The program comes with some a default list of rules. To add more rules, click the "Add New" button in the toolbar.

Controlling Internet Access
To prevent pod computers from accessing the Internet, click the "Internet" button in the toolbar. To allow access to certain websites, click the arrow within the "Internet" button and click on "Internet Block Exceptions..."
Note: Internet Block only blocks Internet Explorer. However, it is possible to restrict all Internet browsing via the Application Rules list.

This Manual was written by David M. Harrison, Dept. of Physics, Univ. of Toronto, March 2007. The **How to Use the Room** section is largely based on materials written by Andrew Zasowski and Chris Joephides in the summer of 2007.

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