BASIC USERS GUIDE FOR THE SCIENCE WORKSHOP™ PROGRAM

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This is a very basic outline of how to use the Science Workshop Program on the Macintoshes in the Physics Lab. This will cover the basics of getting started and activating the sensors. It will also include some basic graphing and data analysis techniques available to the user. This is just a get started guide, so if you really want to understand the program you ought to refer to the manual and tutorial that came with this program. Basically, only use this if you have no interest in actually learning how to use the program, but just need to look like you do.

Getting Started

Obviously the first thing to do is open the program. The icon to start the program is located in the Science Workshop Folder, the location of which varies from computer to computer. The folder may be on the desktop (you're lucky) or it may be buried somewhere in the hard drive (tough luck). You do have some short cuts through. First you should go to the apple menu and scroll down to the item called recent applications. If Science Workshop was one of the last 5 or so applications opened then it will be right there. You can click to it and it will open. A second shortcut is to go under the File menu and use the Find File option. Finally, you can just double click the hard drive and look for the folder.

Okay, now before you open the program, look around the computer. There ought to be the interface box in the vicinity of the machine, and it should be connected to the computer somehow. If not then you need to stop here because without the interface you have nothing. Just try to run the program without it. You will suffer some embarrassing error messages and the humiliation of your peers

Assuming the interface is there, then you need to turn it on **before** you start the program. If you do not turn the interface on first, the machine cannot see it and assumes you don't have one. Refer to the above for this case. Now that you have turned it on, it's time to get busy.

Getting Busy

You now have several choices before you, the first being what you need to do with the interface. For the present day Physics 123 and 221 Labs there are only two types of sensors in use, the PHOTOGATE and the ROTATIONAL MOTION sensor. Do not attempt to use anything else in this interface without explicit permission from whoever is in charge. Connecting the sensors to the interface is possible the easiest step in this process. Just plug it in to whichever number suits you. If you are using the Rotational Motion sensor, you get two plugs. Be sure that the black plug is on the left and the yellow plug is on the right, otherwise everything will run backwards. Now that you have plugged in the sensor, it is time to let the computer know what you did.

The screen should have a small image of the interface box, as well as some menu selections. Somewhere on the left side of the window should be a little picture that looks suspiciously like the plug of the sensor you just connected. Be careful here! On the right side is another plug but it doesn't look anything like the plug you connected (This is for analog sensors. We are much more advanced than that; we've gone digital). Now click on the digital plug and drag it over to the number on the interface in which you plugged

the real sensor. For the rotational sensor drag it to the number on the left. Release the button and watch the magic happen.

NOTE: If you are using a photogate sensor, keep reading here. If you are using a rotational motion sensor, skip the immediate next section and proceed with caution to the section entitled "ROTATIONAL MOTION SENSOR".

Photogate Sensor

Now the photogate sensor is just the same old photogate we've always used with the Pasco timer. With the advent of computers in the lab, we no longer need those timers and can do the exact same thing on a much more expensive piece of equipment. Actually we can do one better by using the computer to directly calculate velocities, but I'm getting ahead of myself.

When you drag the plug icon to the interface port, a menu should have appeared with the names of a lot of sensors listed. You should scroll down this menu until you find the selection called "PHOTOGATE AND SOLID OBJECT". If you feel the temptation to select another sensor mode, then you're on your own buddy.

Once you select the proper mode, another window will pop up and ask for the length of you sold object. This, in case you didn't know, is the flag on the glider. The flag length should be measured exactly with a caliper and entered here in meters (10 cm = .1 m). Click DONE or hit return.

You should be returned back to the original window. Now you are ready to begin the adventure that is Science.

NOTE: If you are doing the collision experiment, then repeat the above procedure. Otherwise, skip the next section and proceed to the section entitled "ACTUALLY DOING SOMETHING USEFUL"

Rotational Motion Sensor

If you are using the rotational motion sensor then you really are doing some heavy duty Science, so be careful not to mess it up. When you drag the plug icon to the interface port, a menu should have appeared with the names of a lot of sensors listed. You should scroll down this menu until you find the selection called "ROTATIONAL MOTION SENSOR". If you feel the temptation to select another sensor, then you're on your own buddy.

When you select the Rotational motion sensor, you will see that two of the ports on the interface are shaded out. This is because you are (hopefully) using two ports of the actual interface. Neat, huh?

You should now be looking at a menu that as asking you a lot of questions you don't understand. I'll take it real slow.

The first thing on the leftmost side is the two numbers 1440 and 360. This is the number of data points per revolution of the sensor. The 1440 setting means that there is one data point per quarter degree, giving a much smoother and more continuous data, but unfortunately you can't go too fast or you will overload the computer. The 360 setting gives only one data point per degree. Less data, but you can take rotate the sensor faster. The basic rule here is that if you are only using one sensor, use 1440. If you are using two sensors simultaneously then use the 360 setting.

Next you will see on the right a little menu bar that you can select and scroll up and down. It should say RACK before you do anything. Now is the hard part. Look at your sensor and try to see which gear the little plastic band is around. There is a large gear, a medium gear, and a small gear. Whichever gear the plastic bind is around, select the choice on the menu labeled "(YOUR GEAR SIZE HERE) PULLEY GROOVE". (Note that in the parentheses it doesn't actually say "your gear size here", it says large, medium, and small.)

Once you have done that then select done or hit return. You should return to the original window. It is now time to begin the adventure that is Science.

NOTE: If you are doing the driven harmonic motion experiment, then repeat the above procedure for your second sensor. Otherwise, proceed to the next section.

Actually Doing Something Useful

Now it is time to actually take some data. Exactly what data you are taking depends on the experiment. Here is where you need to use your brain and stop depending on this walk through. Once you have your data tables and graphs set up properly, then all you need to do is hit "RECORD" and the sensors become active. When you are done you can hit "STOP" or "PAUSE" to deactivate the sensors and stop recording data. "PAUSE" will keep you in the same data set if you want to record more data, while "STOP" closes the data set to new data. If you do not want to actually record data, but just want to quick look, you may select "MONITOR". This is the exact same as "RECORD" except when you hit "STOP" there is nothing saved to memory.

Before we move on to analysis, here are some basic guidelines for the Photogate and the Rotational Motion Sensor data recording methods.

Photogate - If you are using the photogate, it is to measure the velocity of a moving glider. Therefore you are interested in discrete data points, not a continuous spectrum. You should use then a table to display your data. You have two ways of doing this. You can click on the table icon and drag it over to the image of the sensor, or you can go to the "Display" menu and select "Open New Table". If you drag the table icon over you will be presented with a new window, which asks what quantity you want to measure. With the "PHOTOGATE & SOLID OBJECT" mode, there are only two quantities you can choose from: "TIME", and "VELOCITY". You should select the "VELOCITY" quantity.

If you used the "New Table" option the computer will select for you a quantity to measure. You can change this by clicking on the image of the sensor on the top of the table and scrolling down the menu it gives.
If you are doing the collisions experiment you will want to display the velocities from both photogates on the same table, so you will need to push the "Add Column" Icon. This is just a little picture of a new column being added. If you are confused as to which button this is you can refer to the quick reference guide or go to help and turn on the "BUBBLE HELP". This way the computer will tell you which buttons are which. When you add a column it will ask which quantity you want to measure. This is the same as before but you need to make sure that you select the right digital port. For example the first photogate might be in port 1 and the second photogate could be in port 2 or 3 or 4. You need to tell the computer which one you want to measure. Remember you are smarter than the computer, regardless of what that little voice in the back of your head is telling you.

Rotational - The rotational motion sensor is a bit more complicated. With this sensor you are recording data over an extended period of time, so you will have a continuous data set. This calls for a graph or plot of the data over time. Click on the Graph Icon and drag it over to the Rotational Motion Sensor Icon or select "New Graph" from the "Display" Menu. If you drag the Graph icon over you will be presented with a new window, which asks what quantity you want to measure. The rotational motion sensor has many quantities it can measure, but you will always select angular position, velocity, or acceleration. Once you have selected this, the graph window will appear. If you selected "New Graph" the computer will assume which quantity to measure. You can change this by clicking on the image of the sensor on the left side of the window, and then selecting which port and which quantity to measure.
If you need to display two variables at once from the same sensor or if you want to display quantities from two different sensors, you need to click on the Add-A-Plot icon, which looks like a little x-y graph with an arrow pointing down. You can then select a new quantity to display.
If you are doing the Driven Harmonic Motion lab, you will not be directly measuring quantities from the sensor, but rather using the computer to "smooth" these values out. The computer uses smoothing functions to accomplish this. When you open the graph, instead of selecting the quantity next to the appropriate port number, look under the "CALCULATIONS" Heading. You should see a list of the quantities called for in the Lab Manual. (Note: This will only be true if you load the experiment ahead of time like it says in the Lab Manual)

Now What Do I Do?

Now that you've recorded some data, you may be asking what can I do with this data. The data analysis tools available to the Science Workshop program are adequate for the experiments in the Lab Manuals. To activate the data analysis package, click on the Sigma icon. This icon should appear on both the Graph and Table window. If you are in the Table window, the analysis program will give you the Min, Max, Mean, and Standard Deviation of the data set. If you are in the Graph window, the window will split in half and there will be an Analysis frame opened on the right half. The sigma button will appear on this side as well. Click here and a menu will appear with lots of different options, such as mean, standard deviation, curve fitting, and numerical integration and differentiation. These are pretty self-explanatory, so I won't bother.

You can also do some neat things with the graph display, like show more than one data set on the graph, use the cross hairs to measure the distance between two data points, magnify the window, and zoom out. Refer to the quick reference card for the specifics of the Graph window.

Final Approach

Now that you've set up your experiment, recorded your data, and analyzed it to the best of your abilities, you may feel some sort of attachment to your work. You have two options - saving and printing. If you want to save the program, you may do so on the hard drive or on a floppy disk. Be warned that lots of mean people use these computers so there is no guarantee your file will be there tomorrow. You will probably want to save it on the floppy disk, or FTP the file to an account on another machine. You can save the entire experiment or just the data. You can also print any of the graphs or tables, or export them to other programs such as Word or Excel. If you print anything, the printer is in Ed Petit's office. You can get into the office from the key that is in the case. The combo to the case is … I'm not telling. Find out yourself from Mr. Petit.

Double Secret Bonus Round

Do you wonder if there is anything more to this story? Do you have a burning desire to do more, to be better, to go higher? If so, then crack open the manual for Science Workshop and school yourself proper. There is only one way to lean the ins and outs of this program and that is by getting your hands (and knees) dirty. There's a lot more that I haven't covered that could still be considered "essential" knowledge. If nothing else, study the 4-page quick reference guide and at least learn what all the buttons do.