

## Nova5000 Multi-media Science Lab Tutorial

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### Nova5000 Probeware and MultiLab for Nova5000 Sales Script

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This brief tutorial demonstrates how easy it is to use probeware with the Nova5000, allowing students to focus on the science rather than on the technology which is just a tool. You'll experience in the tutorial how when you plug a sensor into the Nova5000, it is automatically identified. Sensor auto identification is another ease of use feature. You'll also see the many sophisticated mathematical data analysis tools within MultiLab that allow students to work like practitioner scientists and also see the relationship between math and science. Fourier makes over 65 scientific probes and also can accommodate Vernier probes. Hence the Nova5000 can accommodate more probes than any data logging system on the market.

#### Running a Temperature Experiment

Here we will show how to run a basic experiment, zoom in on the data and export the data to PlanMaker. You will simply plug in the sensor, launch MultiLab and click Run. No setup is required.

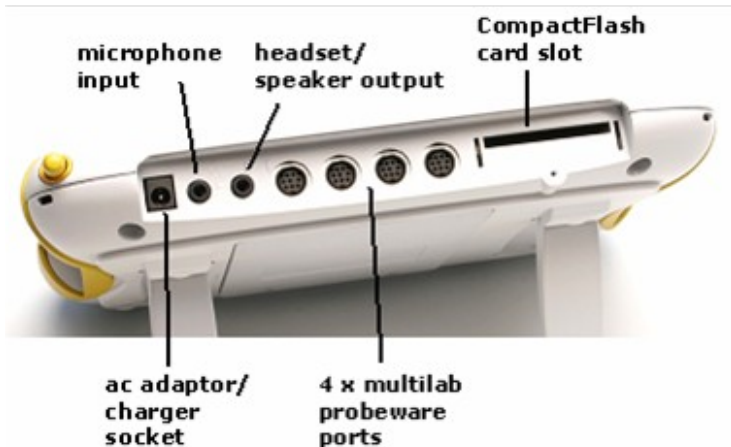
Have handy either cups of hot and cold water or you can use your hand and demonstrate friction heating of the sensor. The temperature sensor itself is at the tip of the stainless steel sheathe.


1. You should have a Temperature sensor that looks like this.

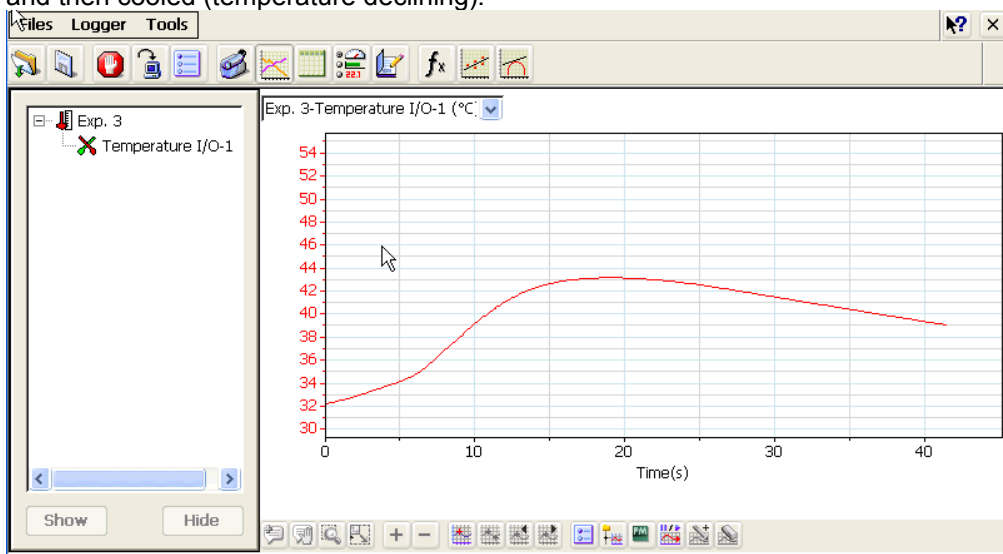


***Notice how quickly and easily you can start data collection with the automatic sensor detection.***

Plug this sensor into the port labeled I/O-1. The arrow on the plug of the Temperature probe should face down. *As you face the Nova*, it is the port on the right. If the probe is not plugged into port 1, the Nova will not recognize it.



- For demonstration purposes you should have a MultiLab shortcut on your desktop already. Otherwise, go to **Start > Programs > Science & Math > MultiLab** to launch the software.
- With the sensor connected and MultiLab launched, simply click or tap **Run**  on the main toolbar to begin collecting data. MultiLab uses default values for sample rate (10/s) and sample size (500).
- As soon as you click **Run**, you will see a graph of Temperature vs. Time. You should either heat and/or cool the Temperature sensor and watch the temperature change on the graph. In the graph below, the Temperature sensor is being heated (temperature rising) and then cooled (temperature declining).




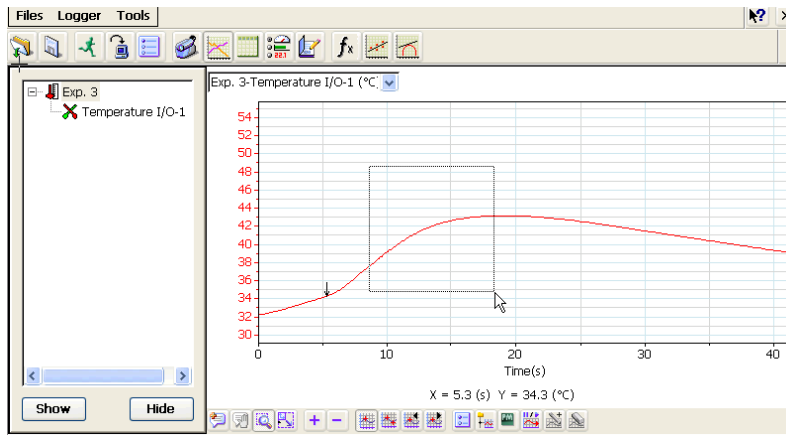
- Click **Stop** to stop the experiment.

### Analyzing the Data

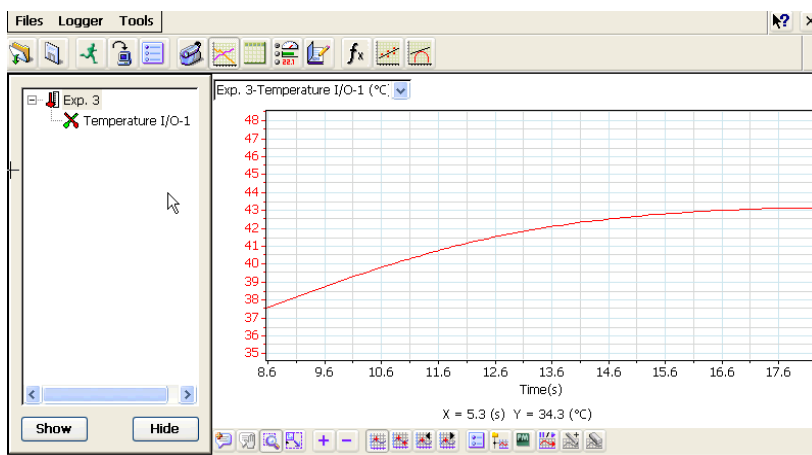
**You can perform some basic analysis on your plotted data to show off the Data Analysis functionality of MultiLab, a key area for science teachers.**

Show how you can zoom in on a section of the plotted data to explore the results more closely.

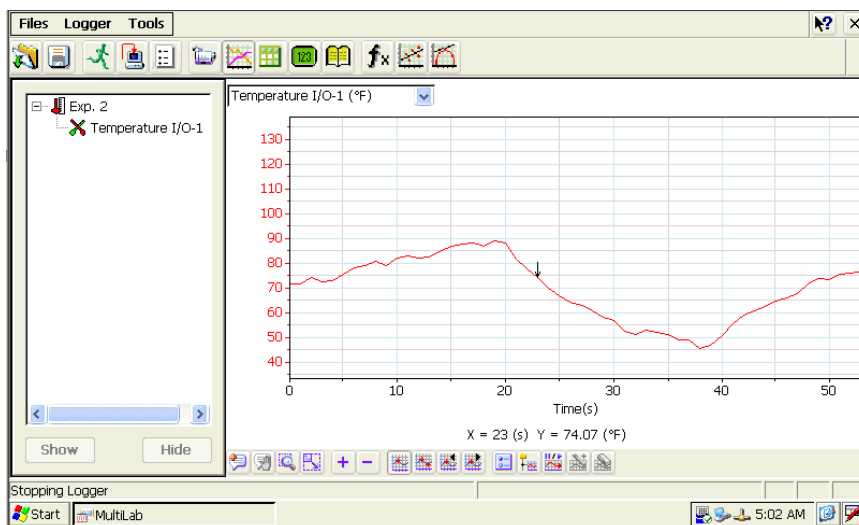
- Click **Zoom**  in the lower toolbar and use the cursor to drag over the area to be zoomed.



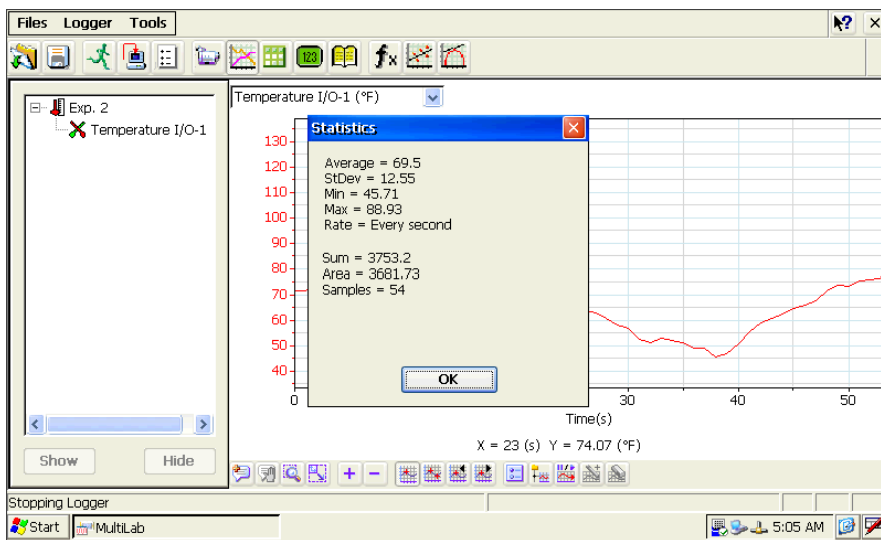
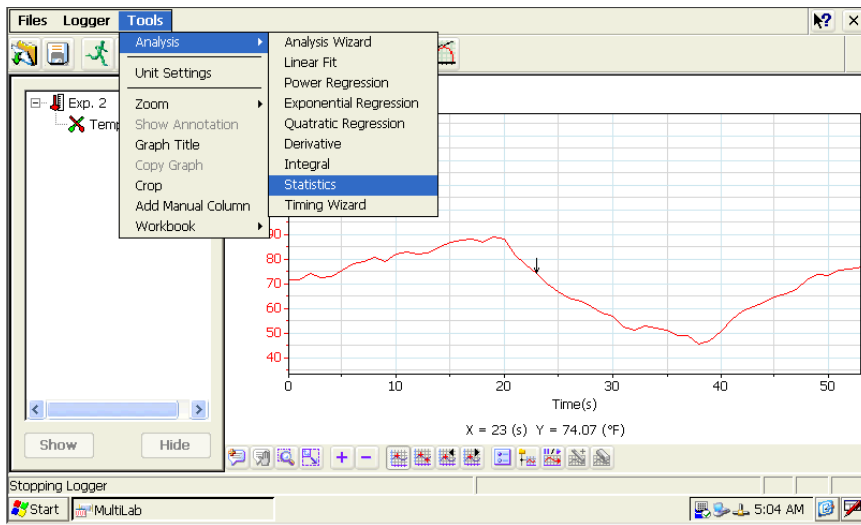
The graph will immediately zoom in and the y-axis scale will be smaller.



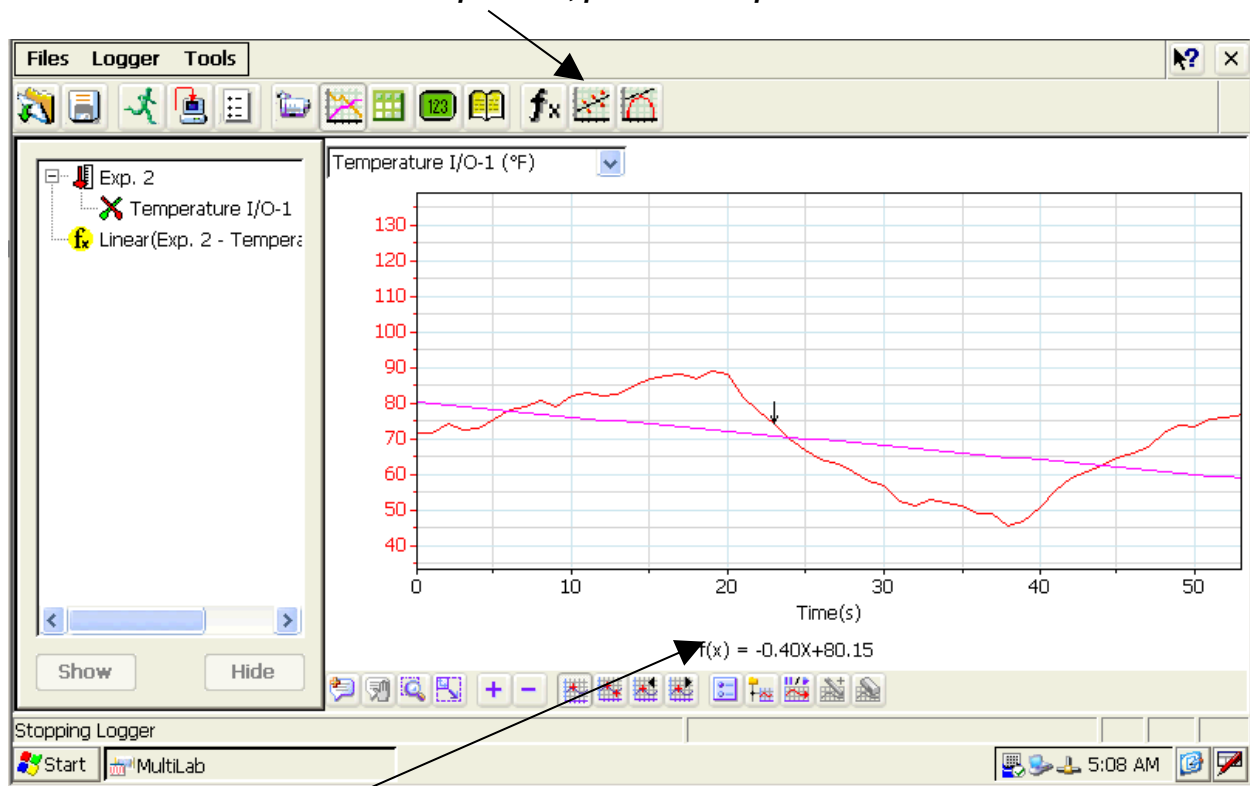
- To read points on the graph, click on the **First Cursor** icon at the bottom of the screen below the graph. An arrow will appear on the graph, and the temperature and time readings for the location of the arrow will appear at the bottom screen below the graph. You can drag the arrow along the graph to see how the readings change. This feature helps students with graphical interpretation which is a skill that is required on many standardized tests.



3. Go to the **Analysis** drop down menu at the top of the screen and select **STATISTICS**. You will see the statistics for this graph. After viewing the **STATISTICS**, click **OK**.




- Select the **LINEAR FIT** icon on the menu bar at the top of the screen, and you will see the best fit line to the temperature graph. The equation of this best fit line appears below the graph. One of the common data analysis techniques in science is the fitting of experimental data to equations. ***This is a feature of MultiLab. It's worth noting that MultiLab even allows students to do quadratic, power and exponential fits.***



The best fit linear equation is displayed in standard form below the graph.

### Exporting the Data to PlanMaker

It's very easy to export the data to PlanMaker, in order to further manipulate the data e.g. display the data in a different format.

Click the **Export** icon  in the lower toolbar. This will launch PlanMaker. When prompted how to separate the values in PM, select the Comma option.


The screenshot shows the PlanMaker spreadsheet application. The spreadsheet has two columns: 'Time(s)' and 'Temperature I/O-1 (°C)'. The data is as follows:

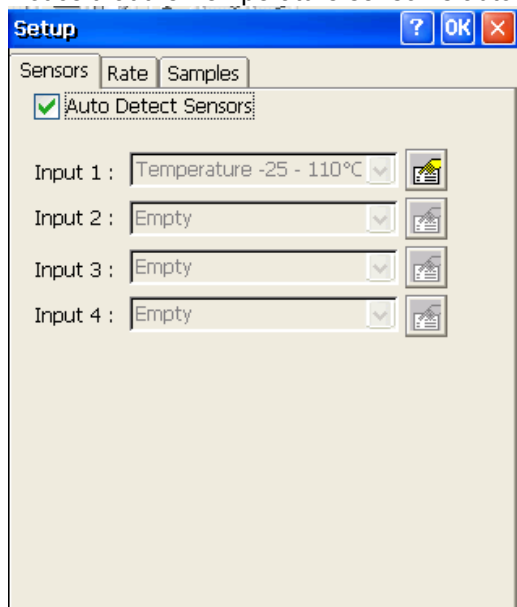
Time(s)	Temperature I/O-1 (°C)
0	32.23
0.1	32.26
0.2	32.26
0.3	32.28
0.4	32.31
0.5	32.33
0.6	32.36
0.7	32.4
0.8	32.43
0.9	32.48
1	32.5
1.1	32.53
1.2	32.57
1.3	32.6
1.4	32.65
1.5	32.67

The spreadsheet is titled 'Sheet1' and the status bar shows 'MultiLab 16.06.07 14.49.49.pmd - PlanMaker'.

## Using the Setup Dialog

You can perform another temperature experiment but on this occasion enter the Setup dialog to change the settings.

1. After you launch MultiLab, click the **Setup** icon . The following screen appears. Notice that the Temperature sensor is automatically identified.





2. Click the **Rate** tab and manually change the rate to 1/second. Click the **Samples** tab and select a larger or smaller sample. Click **OK** to accept these settings.

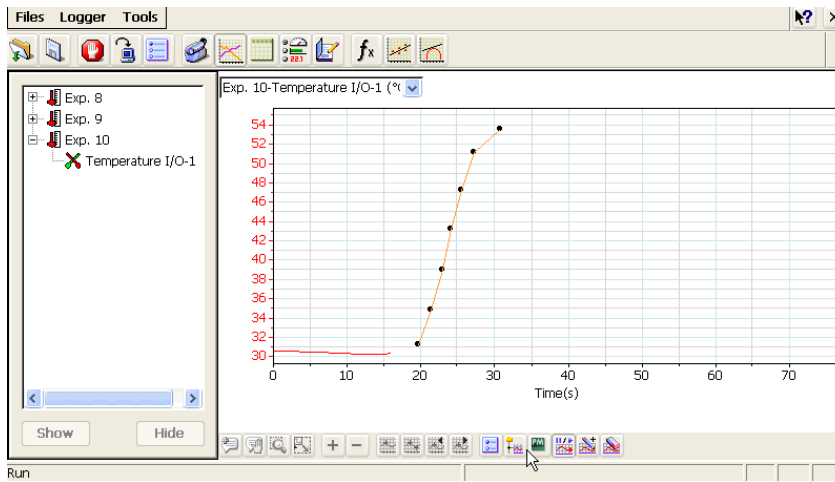
## Using the Prediction Tool


Using the Setup defined in the previous section, you will now experience one of the many educational benefits of MultiLab.

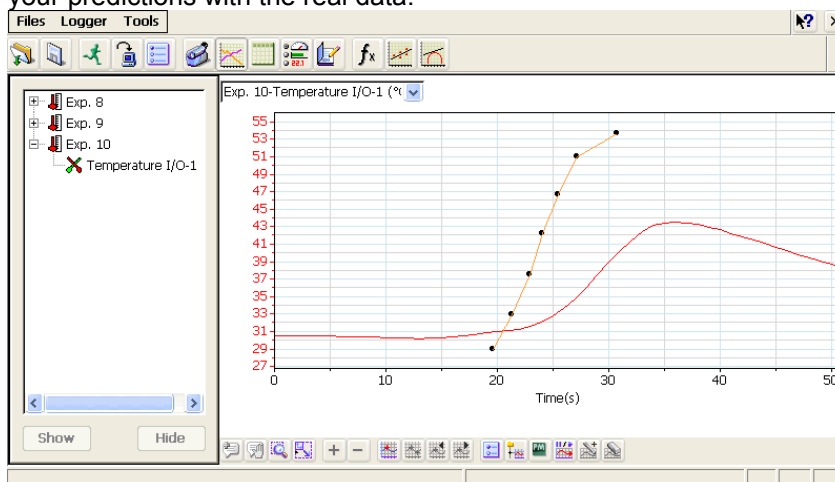
The Prediction tool enables you to draw predictions directly on the graph, prior to displaying the real data.


Students can try and predict the direction of the graph before you heat the temperature sensor, then after you cool the sensor down. You can experience this by following the steps below.

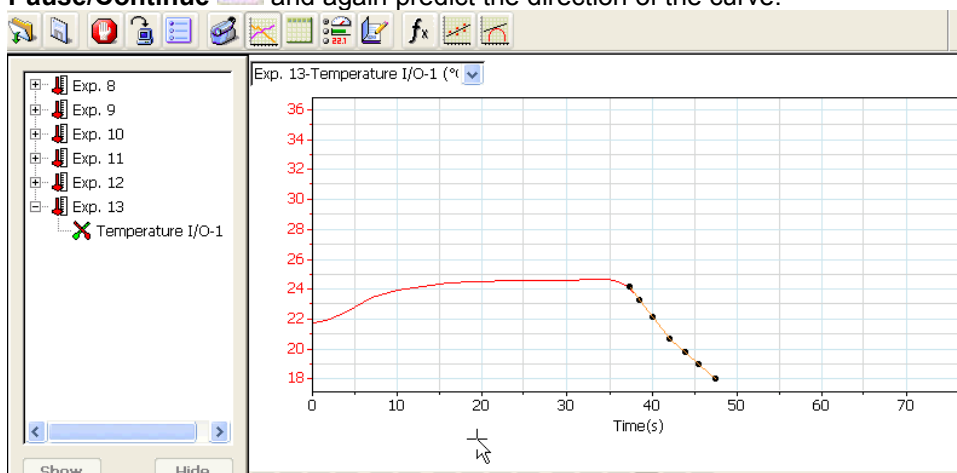
1. Make sure you are in **Graph** view and click **Run** on the main toolbar to start recording data. After a few samples are taken, heat the Temperature sensor either using hot water or a flame.
2. Click **Pause/Continue**  on the graph toolbar to freeze the graph. The data recording continues, but the plotting of data on the graph is paused.
3. Click **Add prediction**  on the graph toolbar to enable the Add prediction tool. Tap the points on the graph where you predict the plot will continue. Each point you add to the graph will be connected by a straight line. By clicking **Add prediction** again, you can add a second set of predictions, and so on.  
The student should expect the curve to dramatically move upwards, as the sensor gets hot quickly.



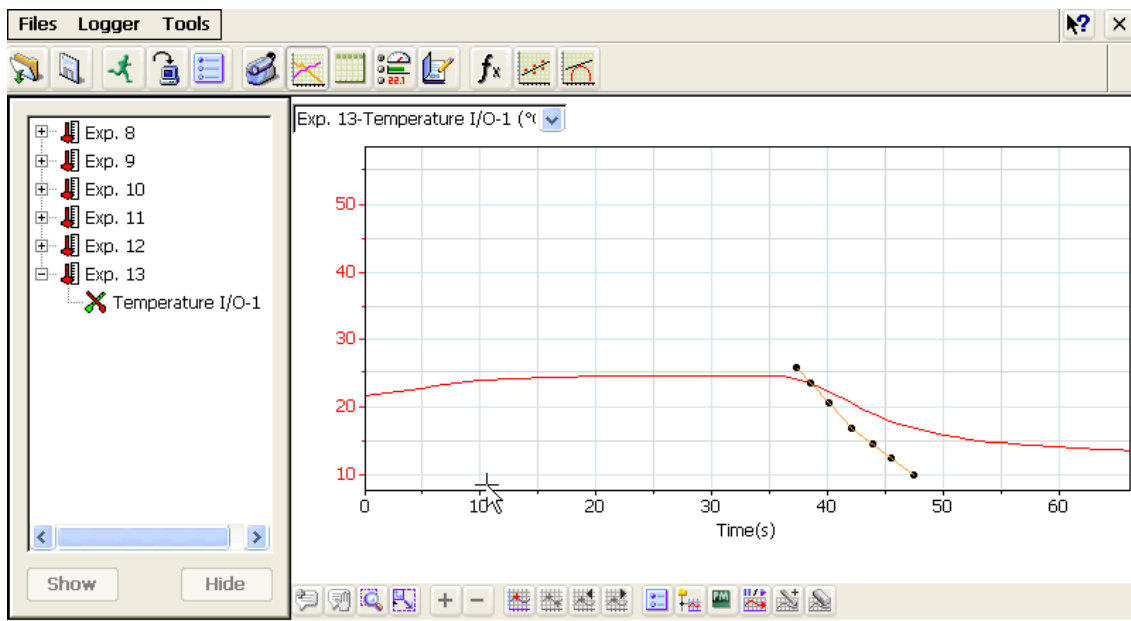
4. Click **Pause/Continue**  a second time to resume live data display and to compare your predictions with the real data.



5. Start a new experiment and place the Temperature in cold water to cool it down. Click **Pause/Continue**  and again predict the direction of the curve.



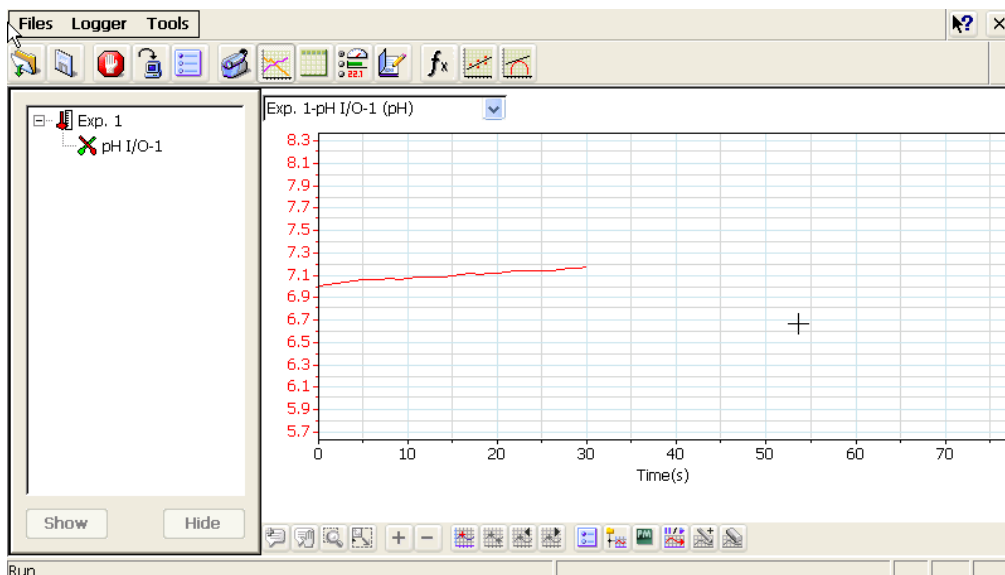
6. Unfreeze the graph to see if the predictions were correct. The student should expect the curve to move downwards as it cools and then even off as it reaches a stable temperature.



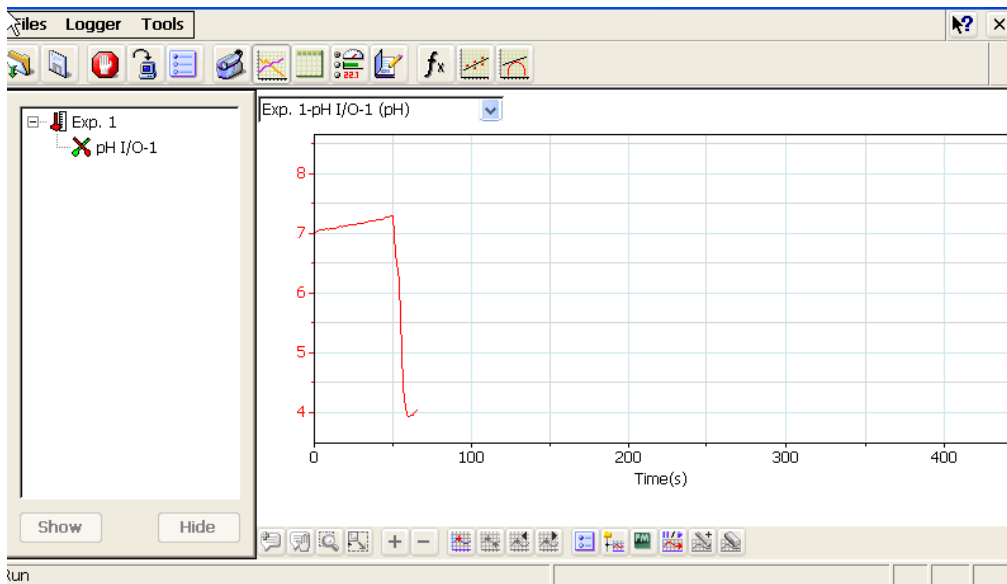
### Performing a pH experiment

Another straightforward experiment to try with a pH probe is to measure the affect on pH of tap water when you add a substance such as vinegar.

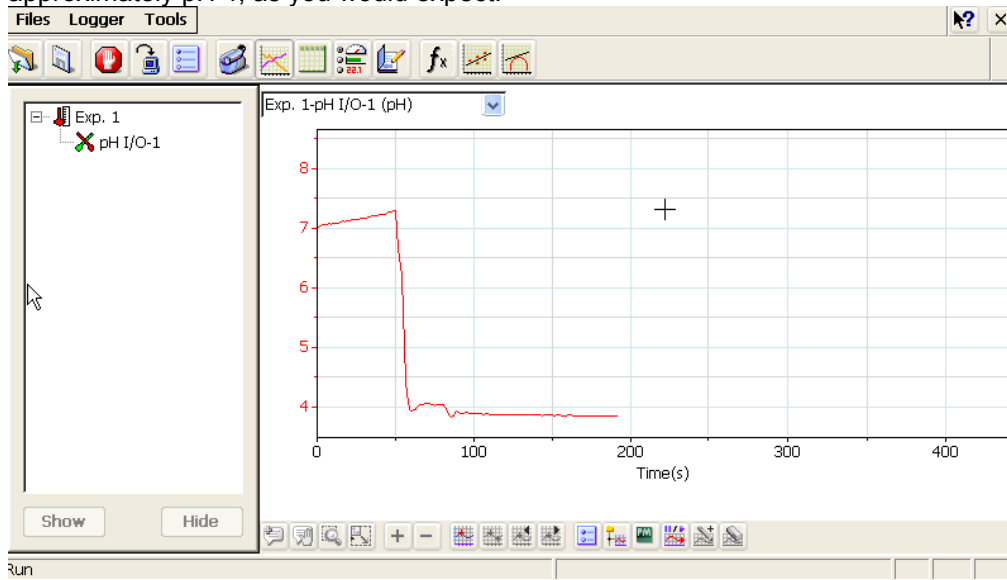
1. Connect a pH adapter to the Nova's Input 1, and ensure the pH electrode is connected to the adapter.
2. Place the electrode in a glass of tap water and launch MultiLab. Enter the **Setup** window. Change the **Rate** to 1/second. Close the Setup window and click **Run** to start the experiment.
3. Let the experiment run for a few seconds in order to get a stable pH reading on the tap water. In this example below, the tap water is a neutral pH 7.1, as you would expect.



4. Pour a tablespoon (or more, at your discretion) to the tap water, stir the liquid and watch how the graph shoots downwards as the acidic vinegar mixes with the water.



- Let the Nova5000 continue to log data and watch as the readings stabilize at approximately pH 4, as you would expect.



- Click **Stop** to end the experiment.