Experiment 7
Introduction to Computer-Based Laboratory Experiments: Using the Vernier LabPro® Interface

OUTCOMES

After completing this experiment, the student should be able to:
- use Vernier's *LabPro®* interface and *LoggerPro* software to carry out a simple time-based experiment.
- copy data from *LoggerPro* into *Excel*.
- determine the effect of a solute on the boiling point and freezing point of a solvent.

DISCUSSION

Computer-based data acquisition techniques are used in many laboratory settings, including both upper division science courses in schools and professional laboratories in medicine and industry. The primary advantage of computer-based methods in any laboratory setting is the speed with which data can be gathered. Computers also assist in data analysis and can improve the overall efficiency and accuracy of laboratory processes. To be prepared to work in any college or professional laboratory, you must be familiar with computer-based methods of data collection and analysis.

Data-gathering probes are simple electronic devices that respond to different types of stimuli by sending out electrical voltage signals. The signals by themselves are meaningless, but computer software can interpret and display them as meaningful data. In order for the software to correctly interpret the signals, however, it is necessary to calibrate the probe. *Calibration* consists of feeding the probe a signal of known value and teaching the software to recognize that value as a reference point. For example, the temperature of ice water is known to be 0 °C. If a temperature probe is placed in ice water, the software can be instructed to recognize that signal as 0 °C. Some probes will already have a calibration file built into the hardware and software. Other probes (like the pH probes) will require that the calibration be done manually.

The science labs at both campuses of Anoka-Ramsey Community College use Vernier technology along with computers running Microsoft *Windows* for their computer-based data acquisition. The Vernier technology utilizes a *signal interface* known as *LabPro®*. This signal interface looks like a blue-green rectangular box that is connected to the computer via a USB connection. Various types of data-gathering probes may be connected to the *LabPro®* interface which then serves as a switchboard for routing the signals into the computer. The signals are then interpreted into meaningful data by means of *LoggerPro* software which is on the

computers. In each experiment, you will use different probes depending on the type of data you are collecting. Some of the probes that are available to use include pH probes, temperature probes, light sensors, photogates, and sonic rangers.

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PROCEDURE

⚠ *Wear safety glasses or goggles at all times for this experiment.*

⚠ *Be very careful when using a hot plate. Do not touch the heating surface at any time while it is in operation. Route all wires to avoid contact with the heating surface.*

Procedure 1: A Time-Based Heating Experiment

1. Plug the temperature probe into Channel 1 of the Vernier *LabPro®* interface. Open the *LoggerPro* application from the Start menu or desktop. If the temperature probe is not automatically identified by the software and interface, open the file for the stainless steel temperature probe from the **Probes & Sensors** folder of the **Experiments** folder.

2. Adjust the experiment length to 30 minutes and the sampling rate to take 1 reading every 30 seconds.

3. Make sure that your columns are labeled with the proper units. Make changes, if necessary, by double-clicking on the column headings. Adjust the time column to read to two decimal places. The temperature measurements are accurate to approximately ± 0.1 °C, so adjust the temperature readings to the correct number of decimal places.
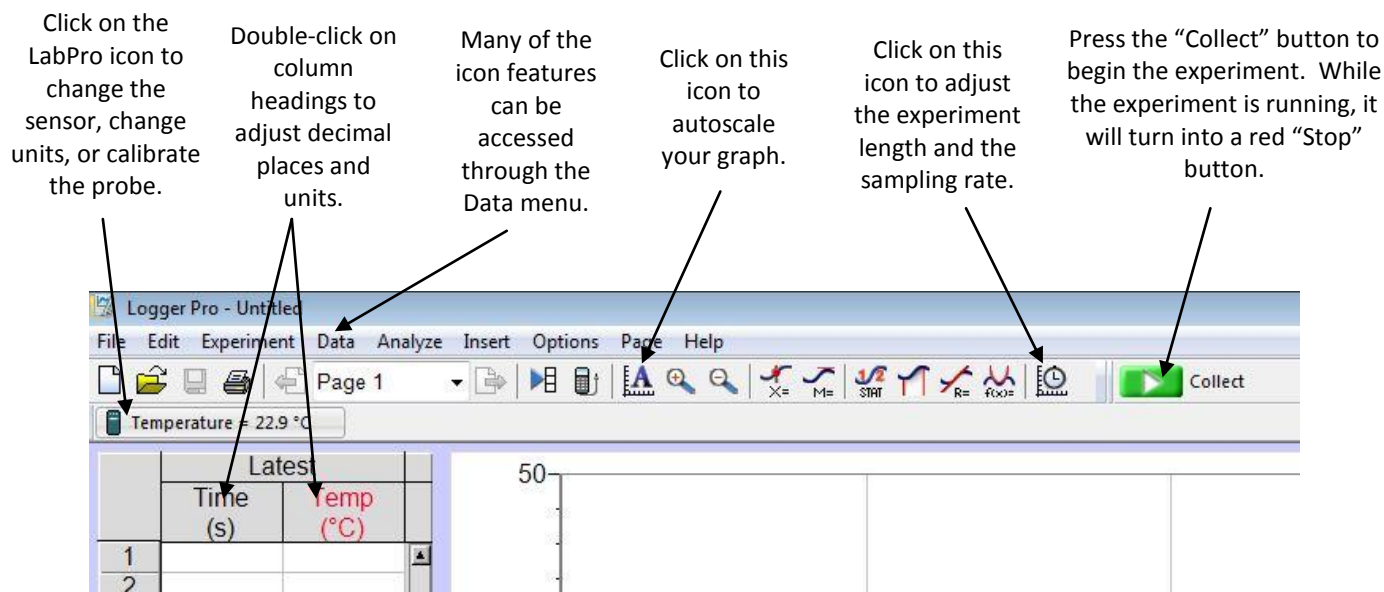
Click on the LabPro icon to change the sensor, change units, or calibrate the probe.

Double-click on column headings to adjust decimal places and units.

Many of the icon features can be accessed through the Data menu.

Click on this icon to autoscale your graph.

Click on this icon to adjust the experiment length and the sampling rate.

Press the "Collect" button to begin the experiment. While the experiment is running, it will turn into a red "Stop" button.

Figure 1. Sample LoggerPro interface

4. Clamp the temperature probe to a ring stand.

5. Add 150 mL of cold water (no ice!) to a 250 mL beaker and place the beaker onto the hot plate. Adjust the temperature probe so that it is in the middle of the water, not touching the sides or bottom of the beaker. Again, make sure that the probe wires do not touch the heating surface of the hot plate.

6. Set the hot plate to the highest setting and begin heating. Start the data collection by clicking the green **Collect** button on the *LoggerPro* tool bar. You will notice that the time and temperature readings will be displayed on the data table and the points will be plotted as the experiment runs.

7. The experiment will stop on its own after 30 minutes. However, if you should desire to stop the data collection early, you may click on the red **Stop** button on the tool bar. You may stop the data collection early if the temperature rises to a point where it changes very little in a period of about three to four minutes.

8. Save your file by clicking on the disk icon in the upper left portion of your screen. Select "Store Latest Run" from the *Experiment* menu so you can graph a new set of data. *When using the interface, get in the habit of saving your file and storing the latest run whenever you complete a trial. Failure to do so may result in all of your data being lost in an experiment. Remember – save early and often.*

9. Repeat steps 5 to 8, dissolving 20 g of salt into the cold water before heating.

Procedure 2: A Time-Based Cooling Experiment

1. Set the hot plate off to the side to cool while doing procedure 2. You will **not** be using the hot plate for this part of the experiment.

2. Adjust the timing for this experiment to run for 3 minutes and set the sampling rate to take a reading every 5 seconds.

3. Place a mixture of ice and water up to the 150 mL mark in a 250 mL beaker. *Make sure that the ice goes all the way to the bottom of the beaker*.

4. With the temperature probe at room temperature, click on the green **Collect** button and thrust the probe into the ice-water mixture and stir gently. Allow the experiment to run for the full three minutes.

5. Save the file, store the latest run and repeat steps 3 and 4, pouring 20 g of salt into the ice-water mixture.

DATA ANALYSIS

1. Copy the data from each trial onto separate pages (or separate sheets) of an *Excel* spreadsheet. Save your data in order to avoid the accidental loss of your work.

2. If necessary, readjust the number of decimal places on the time column to two decimal places and on the temperature column to one decimal place.

3. Graph each set of data, adjusting the size of the graphs and the scaling to make it easy to read and interpret. Remember that the more appealing you make your data and graphs, the better they may be received.

POSTLAB ACTIVITY

You will be turning in a worksheet for this experiment. It will be completed either individually or in pairs, according to your instructor's directions. If you are submitting the worksheet electronically, the tables and graphs that you generated in the data analysis will be pasted into the worksheet. The worksheet contains embedded Excel tables into which you may paste your tables. The graphs will have to be copied and pasted into the appropriate sections.

Follow your instructor's directions for submitting the worksheet. If you are submitting electronically, please use the following convention for naming your worksheet: *Lastname1 Lastname2 LabPro*. If you are emailing the worksheet, use a subject line of *Chem 1061: LabPro Lab*.