

Biology 347 General Physiology Lab

Introduction to the iWorx System

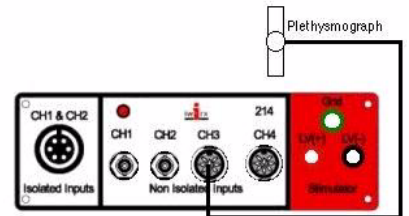
Objectives

- Students will become familiar with the iWorx hardware and software.
- Students will learn traditional techniques associated with taking a pulse.
- Students will learn how to interpret data from a plethysmograph using the iWorx system.

Introduction

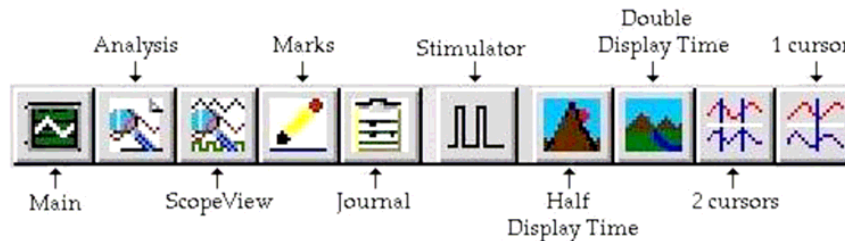
The iWorx Hardware

The device enclosure is constructed from extruded aluminum, with a minimum of student-accessible controls and adjustments. For most applications, setup is automatic and transparent to the user. With one mouse click, the unit can be configured for EEG, EMG (EOG) or ECG. The iWorx 214 includes a dual-channel biopotential amplifier designed for use on human subjects. Two additional channels accept practically any sensor you are likely to encounter, as well as voltage output of pH meters, spectrophotometers and other laboratory devices.



The LabScribe Software

The cornerstone of iWorx systems for teaching is LabScribe2 software, the easiest to use data recording and analysis solution available for both Windows and Macintosh computers. It strikes the ideal balance between flexibility and simplicity. Just push the Record button, then use the AutoScale feature to center and expand your data; and you're recording! The easy click-and-play approach also extends to a useful assortment of analyses, such as rate, integral, and conversion to real units. And, of course, built-in online help is always available.



The Main Display

Data recorded with LabScribe2 is presented as distance-per-unit of time, e.g., cm/sec, exactly as it would be on a traditional paper chart recorder. The x-axis display is compressed or expanded using point and click icons in the LabScribe2 toolbar. The LabScribe2 display can smoothly scroll data at any speed. The display scroll rate is not determined by sampling rate, so you have full control over resolution and display. This is particularly useful when students want to compress high-resolution data on the time axis to create a data overview.

AutoScale

A single button allows you to find the data on a channel, wherever it is, center it and expand it to fill the available channel space. AutoScale used with iWorx high-resolution recorders ensures that your students will never again lose data because they are out of range.

Cursors

Most measurements students make on recorded data involve a distance in time or a difference in amplitude. For this reason, LabScribe2 places two easy-to-move cursors in each display of data. LabScribe2 displays the difference in time and the difference in voltage (or calibrated units) between the cursors. Cursors can be moved with the mouse, or for precise placement, with the arrow keys on the keyboard.

Real-Time Marks

Students can insert "Text Marks" from the keyboard into their data to indicate events like drug delivery or stimulus points. It is easy to search and Go To Mark anywhere in the data. For reporting, students can position the text in a given mark over the data it applies to, just like writing on chart paper.

Analysis

The LabScribe2 Main Window currently supports functions that can show you the real-time rate, integral or any of 28 online analyses. Each of these is set up from a single click in the Main Window. LabScribe2 also has an "Analysis Window" where students can make more in-depth measurements and build lab reports. There are 31 different kinds of measurements supported in this window.

Procedure: Pulse in the Resting Subject

The term pulse refers to the alternating surges of pressure (expansion and recoil) in an artery that occurs with each contraction and relaxation of the left ventricle. This difference between systolic and diastolic pressure is called pulse pressure. Normally the pulse rate (pressure surges per minute) equals the heart rate (beats per minute) and the pulse averages 70 to 76 beats per minute in a resting state.

The pulse may be felt easily on any superficial artery when the artery is compressed over a bone or firm tissue. The following table shows the location of the most common superficial arteries.

Table 1: Common Superficial Arteries and their Location

Artery	Location
Common Carotid	At the side of the neck.
Temporal Artery	Anterior to the ear, in the temple region.
Facial Artery	Clench the teeth, and palpate the pulse just anterior to the masseter muscle on the mandible (in line with the corner of the mouth).
Brachial Artery	In the antecubital fossa, at the point where it bifurcates into the radial and ulnar arteries.
Radial Artery	At the lateral aspect of the wrist, above the thumb.
Femoral Artery	In the groin.
Popliteal Artery	At the back of the knee.
Posterior Tibial Artery	Just above the medial malleolus (by the ankle).
Dorsalis Pedis Artery	On the dorsum of the foot.

1. Using the above table, try finding your partner's pulse in various locations. Please do not violate your partner. Make sure that both of you are comfortable before proceeding to take a pulse.
2. Use your first two fingertips and apply some pressure to the location. I usually find it easier to take a pulse by first applying ample pressure to the region and then slightly pulling back.
3. Count the number of pulse surges in your partner for thirty seconds. You can multiply the number by two to get the number of surges in one minute. Fill in the table and answer the questions.

Artery	Surges/ Minute

Which pulse point had the greatest amplitude (strongest feeling)? Can you offer an explanation for this?

Now take three pulse measurements in your partner's radial artery. Average these measurements.

Count 1: _____

Count 2: _____

Count 3: _____

Average: _____

Due to the elasticity of the arteries, blood pressure decreases and will smooth out as the blood moves farther from the heart. The pulse however, can still be felt in the fingers. A device called a plethysmograph can measure the pulse in your finger tips. We will connect a plethysmograph to the iWorx unit and take a pulse. Use the same subject as the above experiment.

1. Verify that your iWorx unit is connected to your computer via a USB cable from the back of the iWorx unit to the computer.
2. Open **LabScribe**.
3. Go to the **Settings** menu at the top of the window. Select **Tutorial** lab.
4. Connect your plethysmograph into channel 3 on the iWorx unit. Wrap the plethysmograph around your volar surface (where the fingerprints are) of your middle finger. Wrap the Velcro strap around your finger to secure the plethysmograph in place. Have the subject sit still and relax.
5. Click the **Record** button in the upper right corner.
6. Take your reading for precisely thirty seconds (you will see the time next to the **Record – Stop** “button.”) Click **Stop** when you are finished.
7. If the peaks in your chart go down, a drop down to the left of “pulse” will allow you to invert. You want the peaks to go upward.
8. Now click on the **Analysis** icon in the icon tray.
9. Make sure that Pulse is highlighted in the Display Channel Box.
10. Drag the blue cursors to the tops of two peaks in adjacent finger pulses.
11. Select T2-T1 in the drop down “add function” Menu. This will determine the time (in seconds) of each pressure surge.
12. Record your T2-T1 value: _____
13. Calculate the pulse by taking 60 (as in seconds/minutes) divided by your T2-T1 value: _____

How does this value compare with the average value that you got using the traditional method?

Is one method more reliable than another?

What are the sources of error for this experiment? How might you combat these errors?

Things to notice and try (after going back to the main window from the analysis window):
Scroll back and forth along the time axis with the blue scroll at the bottom

Select one cursor and “add a mark to the preset” by typing a comment and hitting return. You will find that you can then drag the blue cursor leaving the comment on a black line.

Notice that you can “auto scale.” Also, you can manually change the scale with the minus and plus signs that flank the auto scale button.

Notice that you can half the time display. Also you can double the time display. If you compress the entire 30 seconds onto the screen, the bottom scroll bar will disappear.

If you did record exactly 30 seconds, then you can then count the pulses and multiply by two to get your pulse.

The bottom recording is the moment to moment heart rate, and it will show up if you hit the bottom auto scale.

Trouble shooting

If Lab Scribe does not finish opening, holding down option and apple simultaneously and hitting escape will allow you to force a quit. Don't bother reporting a bug when you re-launch it. Also, cancel when it asks if you want to recover the data.

New Experiment: What is the effect of apnea on pulse rate and peripheral pulse magnitude?

Background: There is a dramatic change in the size of the plethysmograph reading and perhaps a subtle change in in the pulse rate when a subject holds his or her breath (see week 8, supplement link), and this is also related to the diving lab (week 14).

Method: Our pilot work suggests that this works better with the plethysmograph strapped to the thumb. Have the subject sit quietly. The hand should rest on the desk and should not move. Record one full screen without any noise before auto-scaling. It will help if there is a high signal to noise ratio, if not, adjust the tightness and/or location of the strap or even find a better subject. Tell the subject to get ready to hold his or her breath. The person running the computer should type “start” in the mark box on top and hit enter at the same time the subject takes a deep breath and holds it. There is time to type “end” when the subject starts breathing again (try to go for at least 20 seconds).

Analysis: We will be entering the data for both classes (1 from each of 6 desks, morning and afternoon, 12 subjects total) and we will link the group data to the syllabus. In the analysis window, use the cursors from peak-to-peak to get pulse from T2-T1. Do this for 3 separate heart beats before breath holding and get the average. Do this again in the middle of the period of apnea. Similarly, get and average 3 control and 3 apnea magnitudes (baseline to peak, V2-V1).

Discussion: Did the peripheral pulse get smaller during apnea? Did it get slower?