BASIC TUTORIAL

Jocelyn Mariah Kremer
Documentation
BIOPAC Systems, Inc.

William McMullen
Vice President
BIOPAC Systems, Inc.

BIOPAC® Systems, Inc.

Manual Revision 3.7.7.17
11.17.2010
© BIOPAC Systems, Inc.
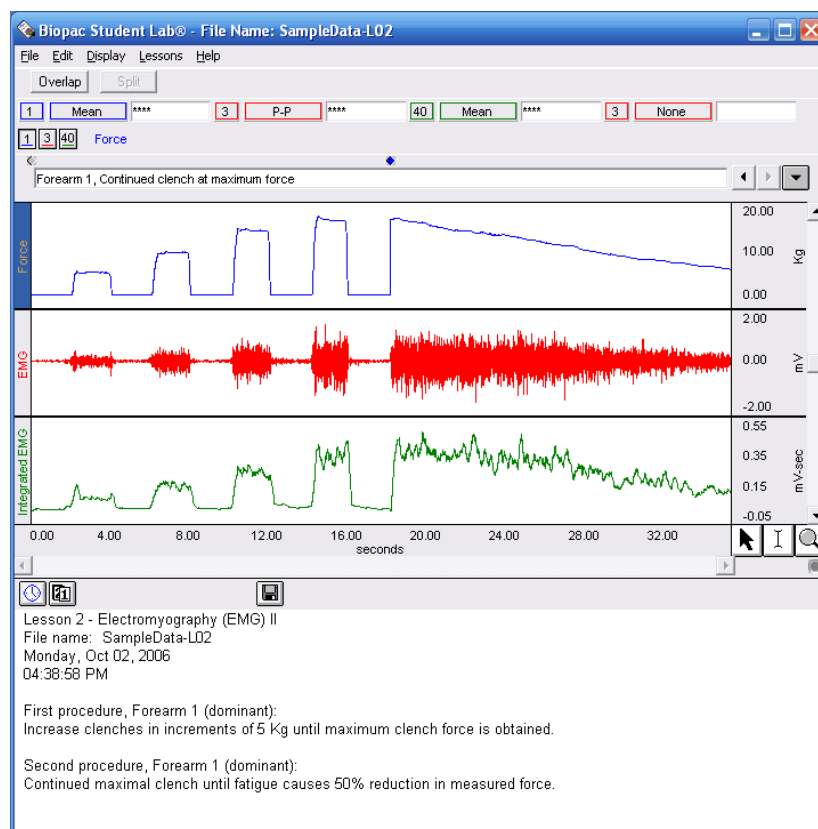
Welcome to the Biopac Student Lab!

This short Tutorial covers basic concepts that make the Biopac Student Lab System unique and powerful, and provides detailed instructions on how to use important features of the program for data recording and analysis. You are encouraged to open the Sample Data File and follow along as you complete the Tutorial. Have fun experimenting with the display and analysis functions of the Biopac Student Lab—interacting with the software as the Tutorial explains functionality will ease the learning curve. For more information, see your instructor or review the Software Guide.

Biopac Student Lab System

The **Biopac Student Lab System** is an integrated set of software and hardware for life science data acquisition and analysis.

Biopac Student Lab Software

MP45 is
CH 1 and CH 2 only.

Biopac Student Lab Hardware

MP3X Acquisition Unit

Transducers

The inputs on the MP unit are referred to as **Channels**. The channel input ports are on the front of the MP unit and are labeled CH 1, CH 2, CH 3, and CH 4.

The **Analog Out port** on the back of MP3X Units allows signals to be amplified and sent out to devices such as headphones; on the MP36, Analog Out is a built-in low voltage stimulator.

Software   The Biopac Student Lab software includes guided Lessons and BSL *PRO* options for advanced analysis. The software will guide you through each Lesson with buttons and text and will also help you manage data saving and data review.

Hardware Includes the MP Data Acquisition Unit (MP36, MP35, MP30, or MP45), electrodes, electrode lead cables, transducers, headphones, connection cables, wall transformer, and other accessories.

HOW THE BIOPAC STUDENT LAB WORKS

One way to think about how the Biopac Student Lab works is to think about it as being like a video camera connected through a VCR into a television set. In a general sense, a video camera records information about the outside world and then converts the images it collects into an electronic format that can be passed to the VCR and television. The images the VCR captures are stored on videotape to be archived or viewed at a later date.

Like a video camera, the Biopac Student Lab records information about the outside world, although the types of information it collects are different. Whereas cameras record visual information, the Biopac Student Lab records information ("signals") about your physiological state, whether in the form of your skin temperature, the signal from your beating heart or the flexing of an arm muscle.

This physiological information is transferred via a cable from you (or whomever the information is being recorded from) to the Biopac Student Lab. The type of physiological signals you are measuring will determine the type of device on the end of the cable.

When the signal reaches the Biopac Student Lab, it is converted into a format that allows the data to be read by a computer. Once that is done, the signal can be displayed on the computer screen, much like the video images from the camera are displayed on the television set.

It takes about 1/1,000 of a second from the time a signal is picked-up by a sensor until it appears on the computer screen. The computer's internal memory can save these signals much like the VCR can save the video images. Like a videotaped record, you can use the Biopac Student Lab to recall data that was collected some time ago. And like a video, you can edit and manipulate the information stored in a Biopac Student Lab computer file.

The Biopac Student Lab software takes the signal from the MP unit and plots it as a waveform on the computer screen. The waveform of the signal may be a direct reflection of the electrical signal from the MP channel (amplitude is in Volts) or a different waveform that is based on the signal coming into the MP unit.

- For example, the electrical signal into the MP unit may be an ECG signal, but the software may convert this to display a Beats Per Minute (BPM) waveform.
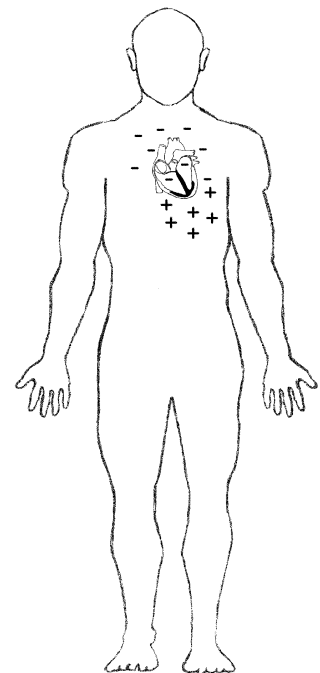
The Body Electric

When most people think of electricity flowing through bodies, they think of rather unique animals, such as electric eels, or of rare events such as being struck by lightning. What most people don't realize is that electricity is part of everything our bodies do...from thinking to doing aerobics—even sleeping.

In fact, physiology and electricity share a common history, with some of the pioneering work in each field being done in the late 1700's by Count Alessandro Giuseppe Antonio Anastasio Volta and Luigi Galvani. Count Volta, among other things, invented the battery and had a unit of electrical measurement named in his honor (the Volt). These early researchers studied "animal electricity" and were among the first to realize that applying an electrical signal to an isolated animal muscle caused it to twitch. Even today, many classrooms use procedures similar to Count Volta's to demonstrate how muscles can be electrically stimulated.

Through your lab work, you will likely see how your body generates electricity while doing specific things like flexing a muscle or how a beating heart produces a recognizable electric "signature." Many of the lessons covered in this manual measure electrical signals originating in the body. In order to fully understand what an electrical signal is requires a basic understanding of the physics of electricity, which properly establishes the concept of **voltages**, and is too much material to present here. All you really need to know is that electricity is always flowing in your body, and it flows from parts of your body that are negatively charged to parts of your body that are positively charged.

As this electricity is flowing, sensors can "tap in" to this electrical activity and monitor it. The **volt** is a unit of measure of the electrical activity at any instant of time. When we talk about an electrical signal (or just signal) we are talking about how the voltage changes over time.

Electricity is part of everything your body does...from thinking to doing aerobics—even sleeping

The body's electrical signals are detected with transducers and electrodes and sent to the MP data acquisition unit computer via a cable. The electrical signals can be very minute—with amplitudes sometimes in the microVolt (1/1,000,000 of a volt) range—so the MP unit amplifies these signals, filters out unwanted electrical noise or interfering signals, and converts these signals to a set of numbers that the computer can read. These numbers are sent to the computer via a cable and the Biopac Student Lab software then plots these numbers as waveforms on the computer monitor.

Waveform Concepts

A basic understanding of what the waveforms on the screen represent will be useful as you complete the lessons.

Amplitude is determined by the BSL System based on the type of MP input. The units are shown in the vertical scale region; the unit for this example is Volts.

Time is the time from the start of the recording, which is to say that when the recording begins it does so at what the software considers time 0. The units of time are shown in the horizontal scale region along the bottom of the display; the unit for this example is milliseconds (1/1,000 of a second).


Horizontal (time) Scale
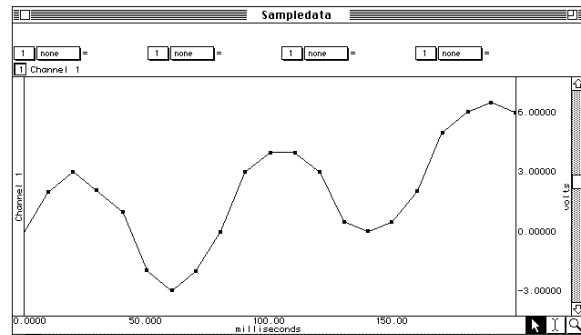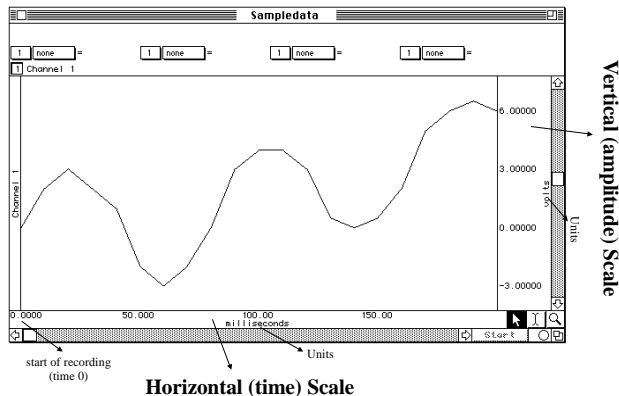
Diving a little deeper into what a waveform represents, you are actually looking at **data points** that have been connected together by straight lines.

These data points are established by the Biopac Student Lab hardware by sampling the signal inputs at consistent time intervals. These data points can also be referred to as **points**, **samples**, or **data**.

The time interval is established by the **sample rate** of the BSL hardware, which is the number of data points the hardware will collect in a unit of time (normally seconds or minutes). The BSL software stores these amplitude values as a string of numbers. Since the sample rate of the data is also stored, the software can reconstruct the waveform.

- Sampling the data is very similar to how a VCR records images from a camera by taking snapshots of the image at specific time intervals. When it plays back the tape, it displays the captured images in quick succession, and our eyes can't see the starting and stopping. Likewise, when you look at the waveform, you see a continuous flow rather than the data points and straight lines.

The Biopac Student Lab Lessons software always uses the same sample rate for all channels on the screen, so the horizontal time scale shown applies to all channels, but each channel has its own vertical scale. A channel's vertical scale units can be in Volts, milliVolts, degrees F, beats per minute, etc. A **baseline** is a reference point for the height or depth ("amplitude") of a waveform.
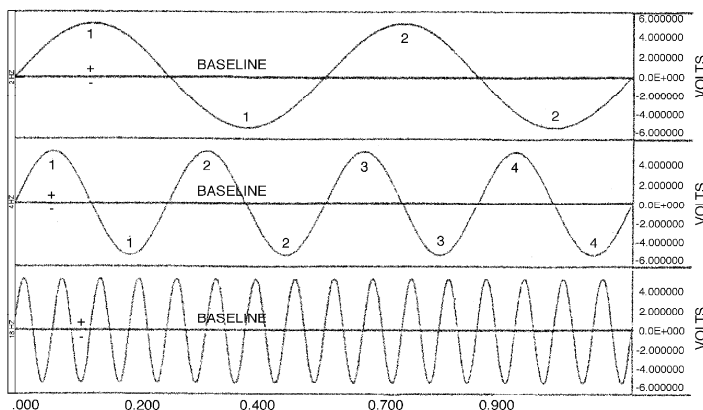

- Amplitude values above the baseline appear as a "hill" or "peak" and are considered positive (+).

- Amplitude values below the baseline appear as a "trough" or "valley" and are considered negative (−)
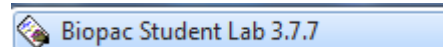
Sample Data File

This Tutorial is designed for you to follow along with a sample data file on a computer without Biopac Student Lab hardware attached. This means that you can complete the Tutorial on a computer outside of the classroom/lab—perhaps at the library, computer lab or home—just as you will always have those options for analyzing data outside the lab. Open the SampleData-L02 file as directed below.

1. Turn the computer ON.

2. Open the program with the desktop icon or the Windows **Start** menu item "BSL Lessons 3.7.7"."
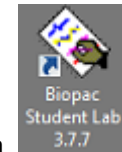
To launch the program, use the desktop icon

or use the Windows® **Start** menu, click Programs and then select:

Biopac Student Lab 3.7.7

3. In the program launcher, choose the "Analyze a saved data file" option and select the **"SampleData-L02"** file from the **"Samples-BSL"** tab. (Any existing Lessons & *PRO* file may also be launched from this window)

NOTE: For the BSL 3.7.7 *Lessons only* version for MP45, choose "Review Saved Data" and navigate to the "Sample Data" folder:
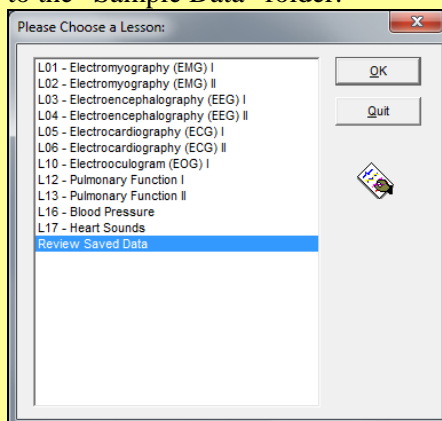
Once the application is open, you may also navigate to the Sample Data folder by choosing **File > Open** or from the **Lessons** menu.

NOTE: If the application has been previously launched in Lessons or *PRO* mode with hardware attached, you may return to the Startup Wizard by selecting it from the **"Go to"** item in the File menu. *(Not present in Lessons-only version)*
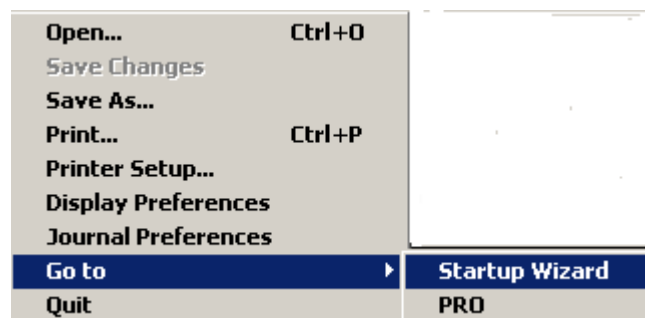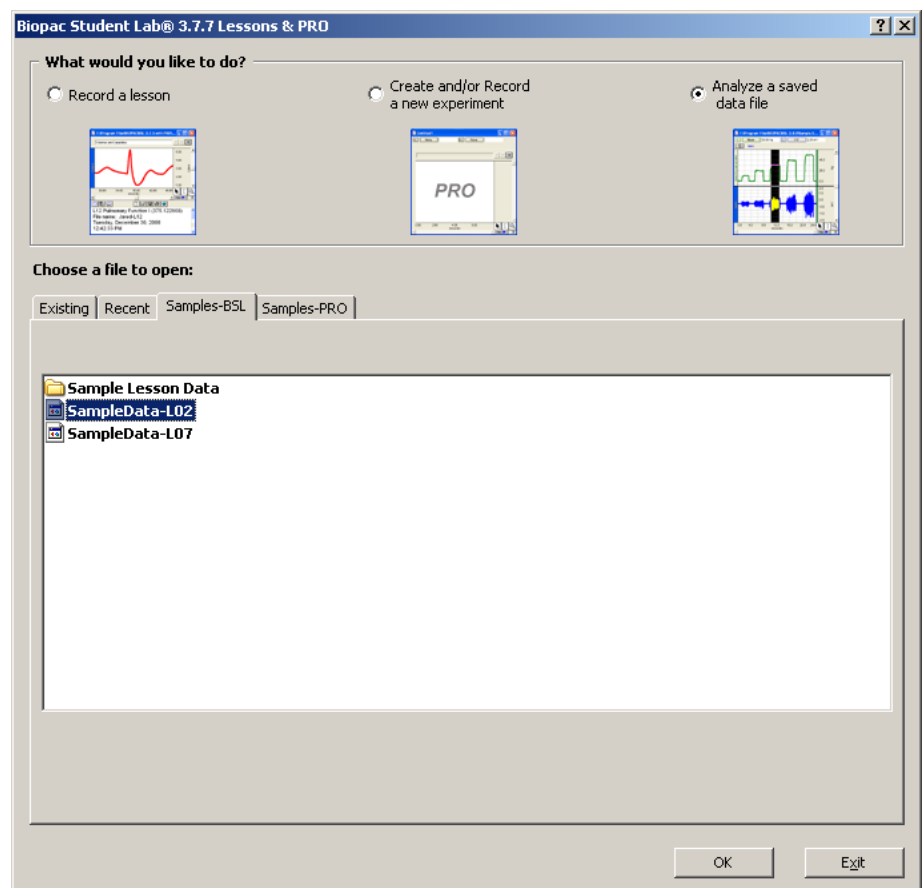
BSL Display

The display includes a Data window and a Journal and both are saved together in one file.

- The **Data window** displays the waveforms and is where you will perform your measurements and analysis.

- The **Journal** is where you will make notes. You can extract information from the Data window and put it in the Journal and you can export the Journal to other programs for further analysis.

The Biopac Student Lab software has a variety of **Display Tools** available that allow you to change the data display by adjusting axis scales, hiding channels, zooming in, adding grids, etc. This can be very useful when you are interested in studying just a portion of a record, or to help you identify and isolate significant data in the record for reporting and/or analysis.

4. Review the display to identify the display elements of the **Data Window** and the **Journal**.

    - The **Data Window** displays waveform(s) during and after recording, and is also called the "Graph Window." Up to eight waveforms can be simultaneously displayed, as controlled by the software and lesson requirements.

    - The **Journal** works like a standard word processor to store recording notes and measurements, which can then be copied to another document, saved or printed.

    - **Lesson Procedures** and **Data Reports** are now accessible under each lesson's Help menu. The Data Report can be filled out electronically, printed or sent as an e-mail attachment.

The SampleData-L02 file should open as shown below:
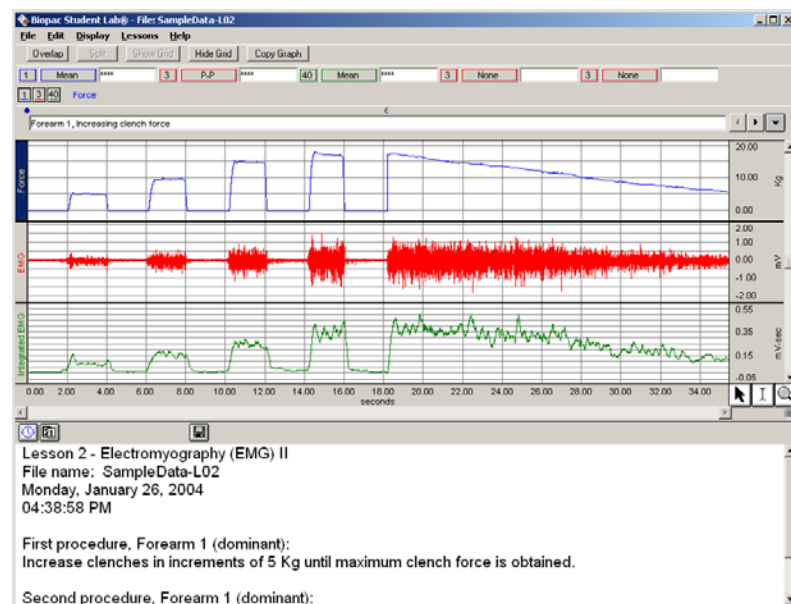
Biopac Student Lab Display

Top down, the sections of the display are:

- Title Bar (BSL program name and file name)
- Menu Bar (File, Edit, Display, Lessons)
- Tool Bar (lesson specific buttons, such as Overlap and Split)
- Measurement Region (channel, type, result)
- Channel Box(es) and Channel Label(s)
- Marker Region (icons, text and menu)
- Data window — waveform display
- Horizontal scroll for Data Window
- Display Tools (to the right of the Horizontal Scale) — Selection, I-beam, and Zoom icons
- Journal Tool Bar (Time and Date icons)
- Journal

Display Tools

The BSL allows you *complete flexibility* in how the data is viewed. Chart recorders lock you into one view, but with the BSL you can expand or compress the visual scales to aid in data analysis. The Data window display is completely adjustable, which makes data viewing and analysis easier.

- View multiple channels or hide channel(s) from the display view.
- Zoom in on specific segments to take measurements, examine anomalies, etc.
- View the entire record at one time to look for trends, locate anomalies, etc.

Editing and Selection Tools

5. Locate the editing and selection tool icons in the lower right of the Data Window.

A good starting point is to understand the editing and selection tools. In the lower right of the data window there are three icons representing the **Arrow**, "**I-Beam**," and **Zoom** tools.


To select any of these tools simply click the mouse on the desired icon, and it will appear recessed to indicate it is active (the Selection tool is active/recessed in the picture above).

Each tool activates a different cursor in the display window:

⤢ Arrow cursor   I I-beam cursor   ⊕ Zoom cursor

Active Channel

6. Click in the CH 1 box to make that the "active channel."

- The channel box of the active channel will be generated to be recessed, and the label for the active channel will be highlighted on the left edge of the channel display.
- You can also click on the channel label to make a channel active.

7. Click in the CH 40 box and note how the label changes.
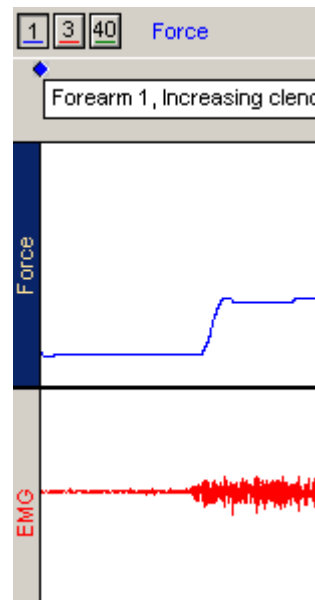
CH 1 active, CH 3 and CH 40 shown (note "Force" is highlighted on the left edge)

CH 1 and CH 3 shown, CH 40 active

Channel boxes are in the upper left of the data window. They enable you to identify the active channel and hide channels from view, so as to concentrate on or print out only specific waveforms at a time.

The display can **Show** one or more data channels, but only one channel can be "active" at any time. The "active" channel box appears recessed.

The Label for the active channel is displayed to the right of the channel boxes and highlighted in the display region.

Show/Hide a channel

8. To Show or Hide a channel hold the "Ctrl" (Control) key down and click on the Channel box.

When you **Hide** a channel, the data is not lost, but simply hidden, so that you can focus on specific channel(s). Hidden channels can be brought back into view at any time. The channel box displays "slash marks" when it is hidden.

a. Hide CH 40.

b. Show CH 40.

c. Hide CH 40.

- Showing a channel enables the channel display but does not make it the active channel.

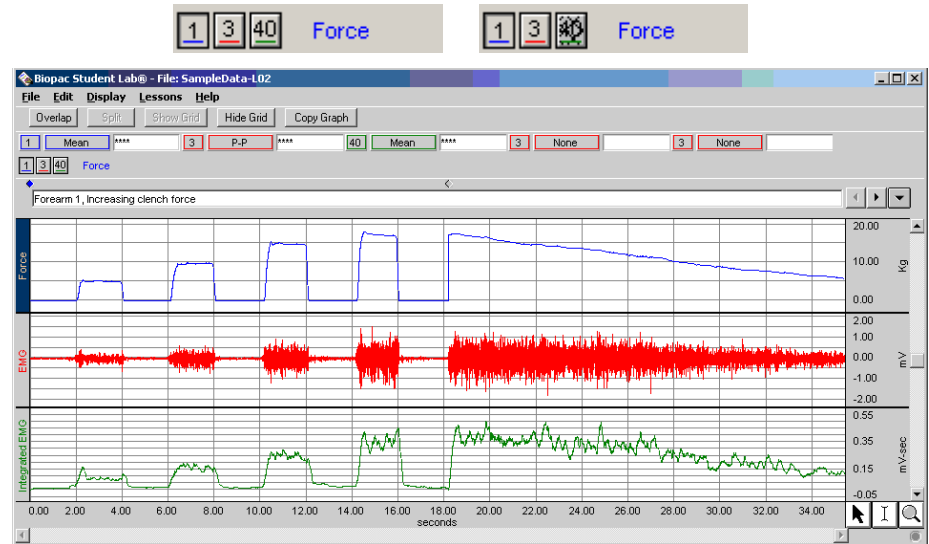- Hiding an active channel does not prevent it from being the active channel.

Show/Hide Grid Display

9. Simply toggle the **Show Grid/Hide Grid** buttons located below the Menu Bar.

Another powerful feature is the ability to Show or Hide the grid display. A **grid** is a series of horizontal and vertical lines that assist the eye with finding data positions with respect to the horizontal and vertical scales. The horizontal grid is the same for all channels (since they share the Time base), but the vertical grid can be set for each channel.
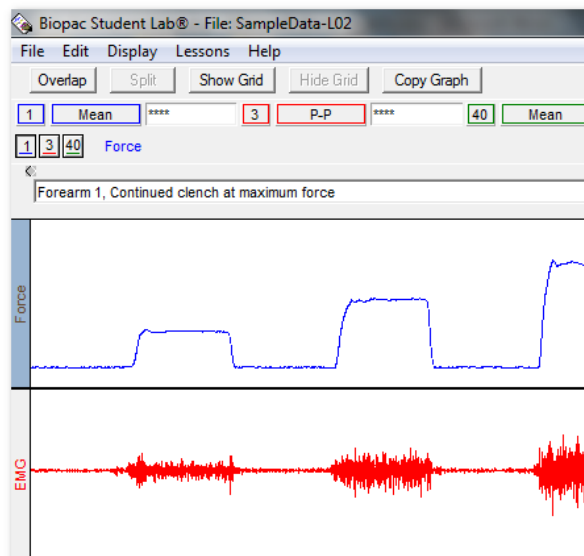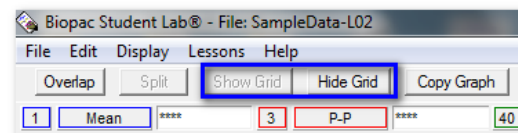

10. Select **Hide Grid** to turn the grid display OFF.

11. Review the display without grids.

Note: The **Show/Hide Grid** toolbar buttons are available during **Review Saved Data** mode only. To set the grid view options when recording a lesson, you must go to File > Preferences > Grids prior to calibration procedure.
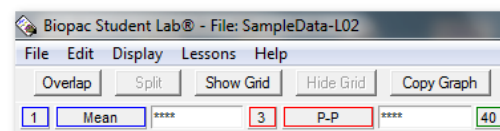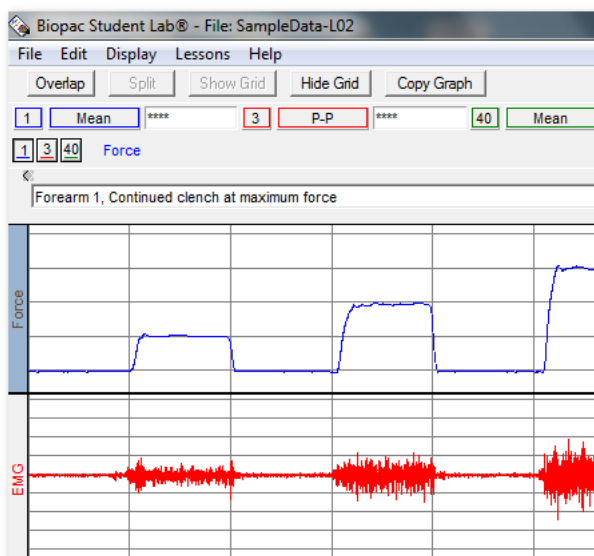

Note that the Grids display affects all channels. If you show a channel that was hidden when Grids were activated, the grid display will show on the channel.

12. Toggle **Show Grid** to turn the grid display ON.

To adjust the grids, see Scales & Grids on page 13.

Scroll - Horizontal

13. Locate the **Horizontal Scroll Bar** at the lower edge of the display.

You can move to different locations in the record by using the horizontal scroll bar. Since the horizontal scale applies to all channels in view, it will move every waveform simultaneously.

The scroll bar is active when only a portion of the waveform is in view. To move forward or backward, select and drag the scroll box or click on the left or right arrow. For a continuous scroll, click on the arrow and hold down the left mouse button.
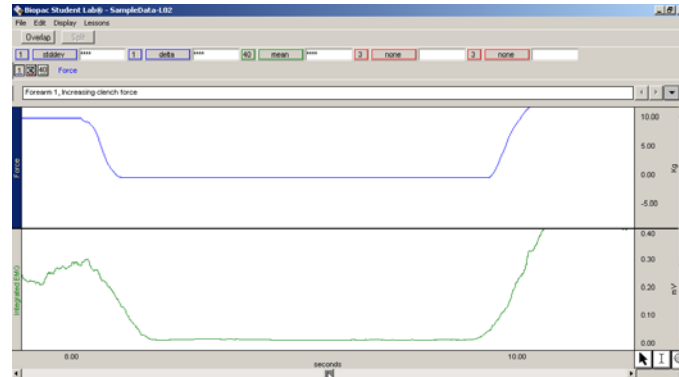

If the entire waveform is displayed, the scroll bar will dim.

14. Use the **Horizontal Scroll** to reposition the data with respect to time.

- Note that both waveforms moved. This is because the horizontal scale is the same for all channels.
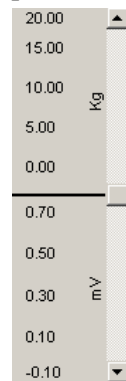

In the sample file, the horizontal scale represents Time in seconds. The software will set the most appropriate Time option for each signal.
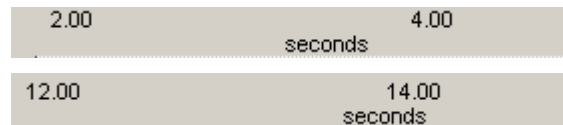
Notice the Horizontal Scale range on the bottom changes to indicate your position in the record.

Scroll – Vertical

15. Locate the Vertical Scroll Bar along the right edge of the display.

A similar scroll bar can be found next to the vertical scale. This is the **Vertical Scroll Bar**, and it allows you to reposition the waveform in the active channel. The Vertical Scroll Bar runs along the entire right edge of the display window, but only applies to the active channel, which is only a portion of the display if more than one channel is displayed.

The Vertical Scale Range for the active channel changes when you reposition a waveform to reflect the displayed range.

16. Use the Vertical Scroll to reposition the CH 1 Force waveform.

- Note that the CH 40 Integrated EMG waveform did not move. This is because the vertical scale is independent for each channel.
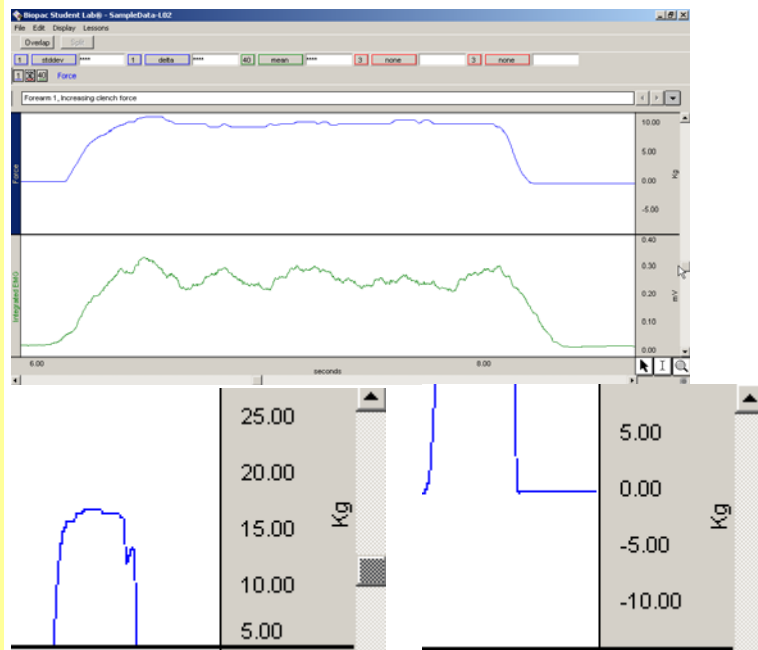
17. Pull down the Display menu and select **Autoscale horizontal** to fit the entire waveform within the data window.

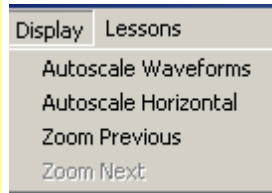**Autoscale horizontal** from the **Display** menu is a quick way to fit the entire waveform within the data window. That is, it will adjust the <u>horizontal</u> scale such that the left most portion of the screen is the start of the recording, and the right most portion is the end of the recording. The time per division setting will not necessarily be even numbers, but you can adjust that.

18. Pull down the **Display** menu and select **Autoscale Waveforms** to center waveforms in their display track.

TIP — Selecting **Autoscale Horizontal** and then **Autoscale Waveforms** from the Display menu is the standard way to quickly and easily return to your original data display and view the entire record at once.
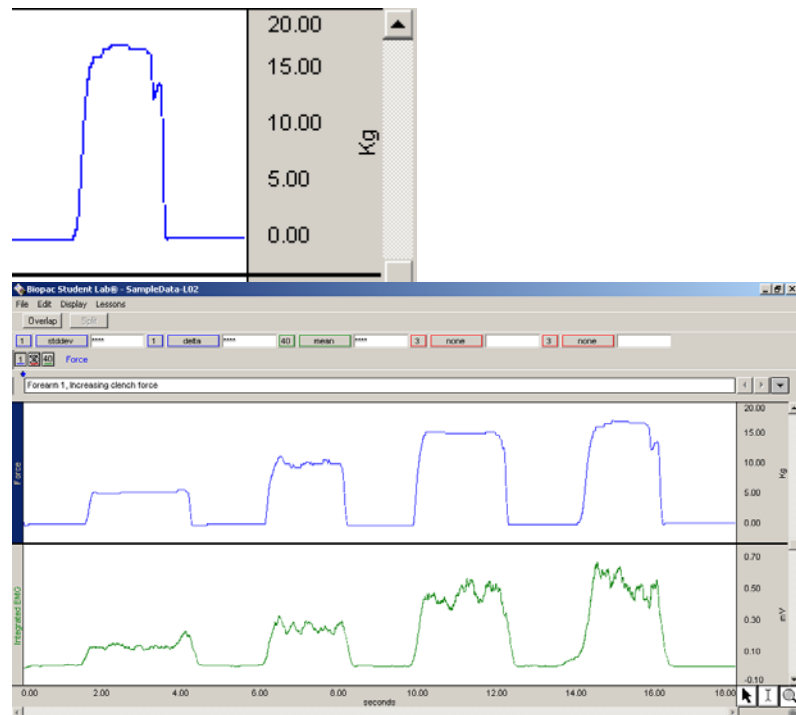
The Autoscale Waveforms option of the Display menu is a very handy tool that performs a "best fit" to each channel's <u>vertical</u> scale. That is, it will adjust the "Scale" and "Midpoint" of each channel's vertical scale, such that the waveform fills approximately two-thirds of the available area.

After autoscaling, the "Scale" will probably not be set to nice even numbers, but you can manually adjust the scale to even numbers.

Zoom

The **Zoom** icon is in the lower right of the data window. The **Zoom** function is very useful for expanding a waveform in order to see more detail.

19. Click on the **Zoom** icon to select it.

20. Position the cursor in the CH 40 Integrated EMG channel at about 6 seconds, then click and hold the mouse button down and drag the cursor to about 9 seconds. This will draw a box around the area.

If you know the precise section of the waveform that you'd like to enlarge, you can use the Zoom tool to draw a box around the area.
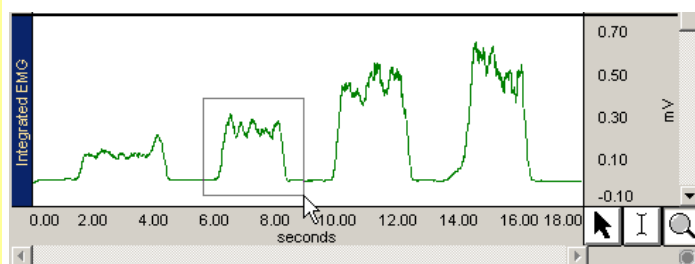
21. Release the mouse button and review the result.

- Note that the Horizontal and Vertical Scales changed for the selected channel.

When the mouse button is released, the boundaries of the selected area become the new boundaries of the data window.
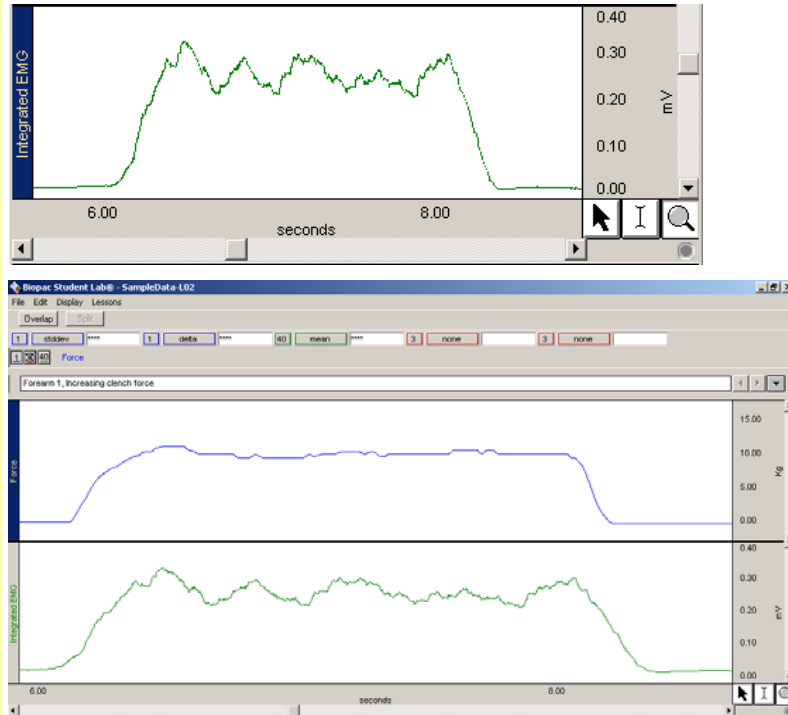
The Vertical Scale will change for the active channel only, but the Horizontal Scale will change for all channels since it (time) is the same for all channels.

22. Select **Zoom previous** to "undo" the Zoom.

After you have zoomed in on a section of the waveform, you may "undo" the zoom and revert to the scale settings (both horizontal and vertical) established prior to the last zoom by selecting **Zoom previous** from the **Display** menu.

The **Zoom previous** function will only go back one **Zoom** function. You cannot select it 6 times, for instance, to go back 6 zooms.

Scale & Grid Controls

Adjust Scales

23. Click anywhere in the **Horizontal Scale** region to generate the adjustment dialog.

   - Review the Scale Range and Grid settings.

24. Click anywhere in the **Vertical Scale** region to generate the adjustment dialog.

   Note that the Vertical Scale is independent for each channel.

   - Review the Scale Range and Grid settings.

If you click anywhere within the **Scale** region (Horizontal or Vertical) an adjustment dialog will be generated. Any change you make to the Horizontal or Vertical Scale only effects how the display and never alters the saved data file. That is to say, you will never lose any data when you change these settings.

The Vertical Scale is independent for each channel, so you need to select the appropriate channel prior to clicking on the Vertical Scale.
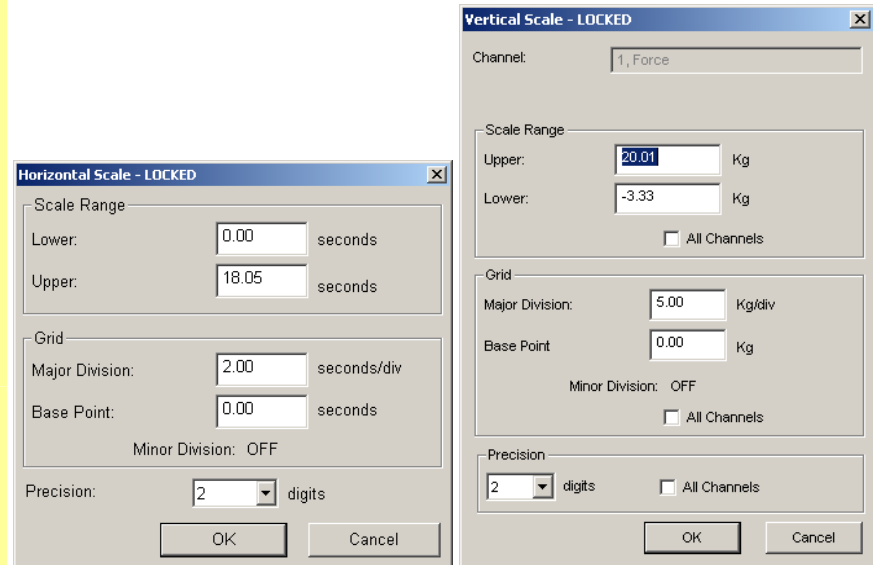
Scale Range: Establishes the boundary values to fit in the display window and is useful for highlighting meaningful segments in the waveform. For instance:

- If the signal has a cycle that repeats every 2 seconds, you could set the Horizontal Scale Range to at 0-8 seconds to show 4 cycles per screen.

- If the signal varies from -2 to +2 Volts, you could set the Vertical Scale Range to match and optimize the display.

Grid: The **Major Division** is the interval for the grid line (i.e., a horizontal line every 2 seconds or a vertical line every 5 Kg). The **Base Point** is the origin for the grid lines, with the Major Divisions drawn above and below (horiz) or left and right (vert) to complete the grid. Minor Divisions are also drawn in relation to the Base Point, if the lesson is set to show them.

All Channels is a quick way to have the scale setting apply to all of the vertical scales in the data window. This is particularly useful when all of the channels are the same type of data (i.e. 2 or 3 channels of ECG data). Repeated clicking in the box will toggle the option on or off.

Precision: Establishes the number of significant digits displayed in the Scale region. Click and hold down the mouse on the precision number to generate a pop-up menu, allowing you to make another selection.

OK: Click on "OK" to initiate the changes made in the dialog.

Cancel: Click on "Cancel" to if no changes are desired.

Measurements

Measurements are fast, accurate, and automatically updated. The measurement tools are used to extract specific information from the waveform(s). Measurements are used in the Data Analysis section of every lesson, so understanding their basic operation is important.

Let's say you wanted to know the force increase between two clenches in the EMG data. You could get a rough estimate by eyeballing the amplitude of the peaks on the vertical scale or by measuring the peak of one and the peak of the next and manually calculating the difference. Or, you could take a much easier and more accurate reading with the "delta" measurement of the Biopac Student Lab. You can use software shortcuts to paste measurement data to the journal or copy waveform data for further analysis in other programs such as Excel.
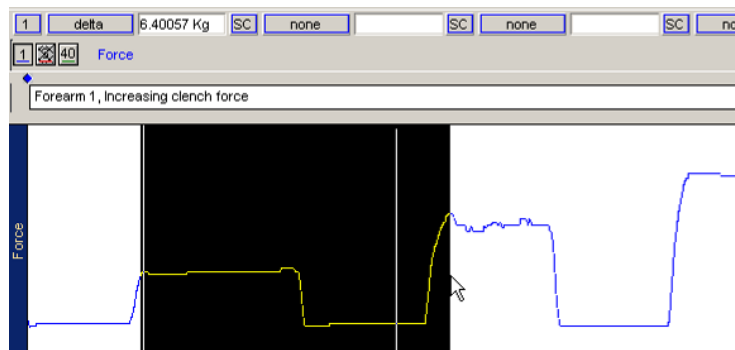
Measurement tools

25. Review a measurement region to identify the Channel select box, the Measurement type box, and the Result box.

Measurement Region
Channel select, Measurement type, Result

The **Channel select** box includes options for all channels, whether shown or hidden, and an "SC" measurement option. The "SC" performs the measurement on the active channel and is a quick way to step through multiple channels. The "SC" option allows you to make quick measurement comparisons between channels using one region. To take a measurement from another channel, simply click on the desired channel box or click anywhere within the data region for the desired channel using the selection tool.

Channel select options

The **measurement type** box is a pop-up menu next to each channel number box that allows you to choose from 23 Biopac Student Lab measurement functions (or "none").

The **measurement result** is the value that the measurement calculates.

Measurement type options

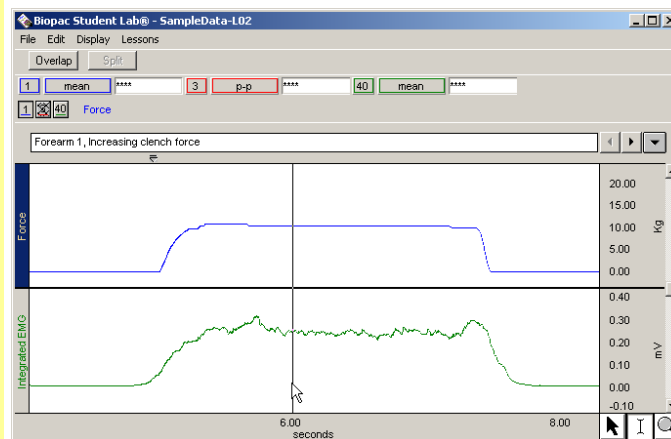|	
26. Read about **Measurement Tools** to the right.	To use the measurement tools, you must a) Set the channel measurement box to the desired channel. b) Select a measurement type from the pop-up menu. c) Select an area for measurement. Note that you can perform these elements in any order, but all three must be completed to achieve a valid measurement. Two important points regarding measurements: 1. The first is that the <u>measurement only applies to data in the selected area</u> of the waveform that the user specifies. 2. The second is that every lesson contains the same measurement options, but some may not be applicable to that particular lesson. This is because the measurement options are a standard set of tools that are always available, much like a scientific calculator contains a standard set of buttons, many of which may not be necessary for any given problem.
The Selected Area 27. Read about the **Selected Area** to the right.	The "**selected area**" for all measurements is the area selected by **the I-Beam tool** (including the endpoints). Note that the "I-beam" cursor position when the mouse button was first pressed defines the starting point and the position at release defines the end position of the selected area. *A critical concept* for the measurement tools is that the measurement results only apply to the area established by the "I-Beam" cursor. • The selected area can be a single point, an area, or the end points of a selected area. • **If there is no point or area highlighted on the screen, then the measurement results are meaningless**. • A result of ** **** ** means the selected area is not appropriate or sufficient for the measurement. • It is up to you to select a point or an area with the I-Beam cursor, as the software will never do it automatically.
Select a single-point area 28. Click on the **I-beam** [I] icon.	
29. Move the cursor over a point on the data.	You will notice that whenever the cursor is over data it is displayed as an "I."
30. Click on the mouse button. *A flashing line should appear at the cursor position.*	When you have a flashing line, you have one point of data selected. If the line is not flashing, it means that you moved the cursor while the mouse button was pressed, and you actually selected more than one point of data. If this occurred simply click on another portion of data.
31. Click on the selection tool icon to deactivate the point.	When you are finished taking measurements, and wish to deactivate a point, click on the selection tool icon.

Selecting an area (several points)

32. Click on the **I-Beam** icon.

33. Move the cursor over a point on the data.

34. Hold the let mouse button down and drag the mouse to the right.

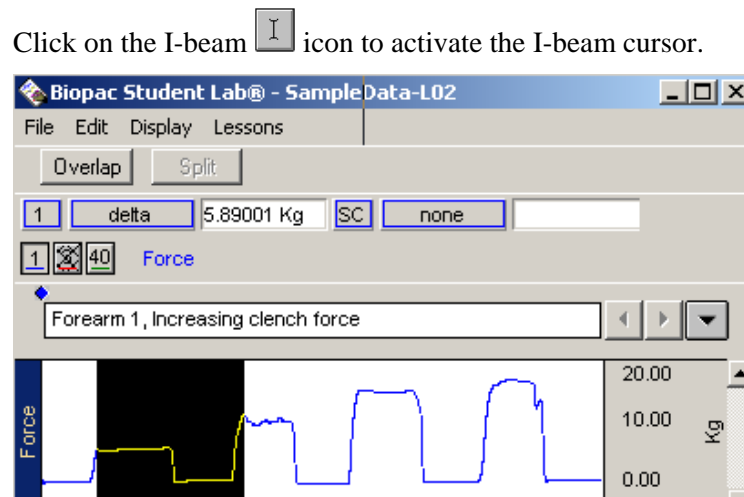35. Release the mouse button.

- An area should be highlighted.
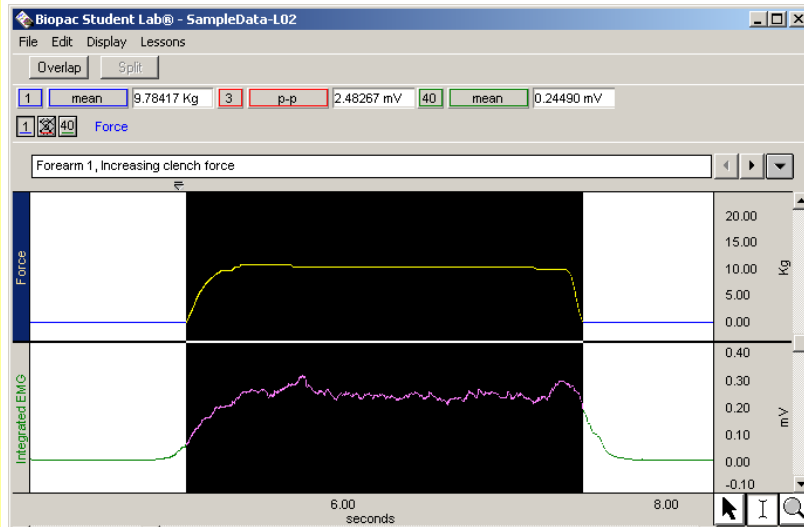
When the mouse button is released, an area should be highlighted (darkened) on the screen, as shown above. This is very similar to how you select words in a word processing program.

36. Click the mouse on another point of data and then click on the selection tool icon to deactivate the point.

When you are finished taking measurements and wish to deactivate a selected area, click the mouse on another portion of data to select just one point (flashing line appears), and then click on the selection tool icon.

37. Set a region for **CH 1 Force** and **delta**.

38. Click on the I-beam icon.

Click on the I-beam icon to activate the I-beam cursor.

39. In the Force channel, use the I-beam to select an area from the peak of one clench to the peak of the next clench.

40. Review the result.

- This example shows an increase of 5.89 Kg. Your result will vary.

If the correct region is not established by the "**I-Beam**" **cursor** for the measurement type, the result will be meaningless.

Results will update automatically when you change the channel selection or the selected area.

41. You can use the Data Window options in the Edit menu to copy measurements to another program.
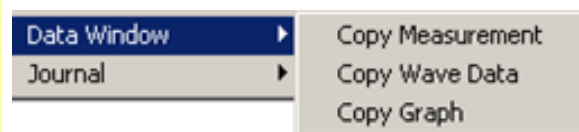
Copy Measurement — Use to copy the measurement values from the data window to another program, such as a Word document or email for your Lab Report.

delta(1) = 0.01392 Kg   P-P(3) = 2.48267 mV   Mean(40) = 0.15282 mV
          Value(1) = 0.06469 Kg   deltaT(40) = 4.19600 sec

Copy Wave Data — Use when you want to copy waveform data as a set of numbers. The data copied will include all wave data within the area selected by the I-beam cursor for all channels, whether displayed or hidden.

sec	Force	EMG	Integrated EMG
4.526	0.0507694	-0.0258789	0.0121948
4.528	0.0507694	-0.0224609	0.0123364
4.53	0.0507694	-0.0141602	0.0124744
4.532	0.0507694	-0.00268555	0.0124585
4.534	0.0507694	-0.0090332	0.0124524
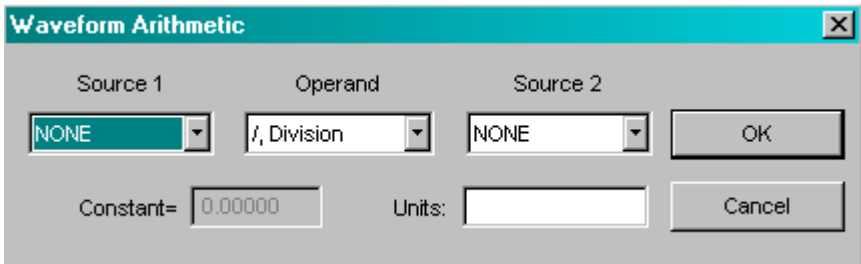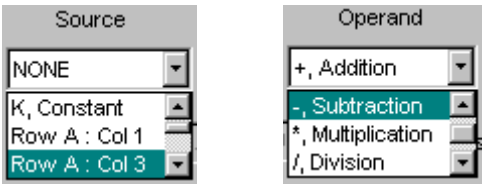
Copy Graph — Use when you want to copy the waveform data as a picture to be imported into other programs. The Data Window Copy functions will be applied to the selected area, if any. If a single point or no area is selected, the Data Window Copy functions will be applied to the <u>entire data file</u>. You may also use the **Copy Graph** button above the measurement region to perform the same operation. (BSL 3.7.7 and above)
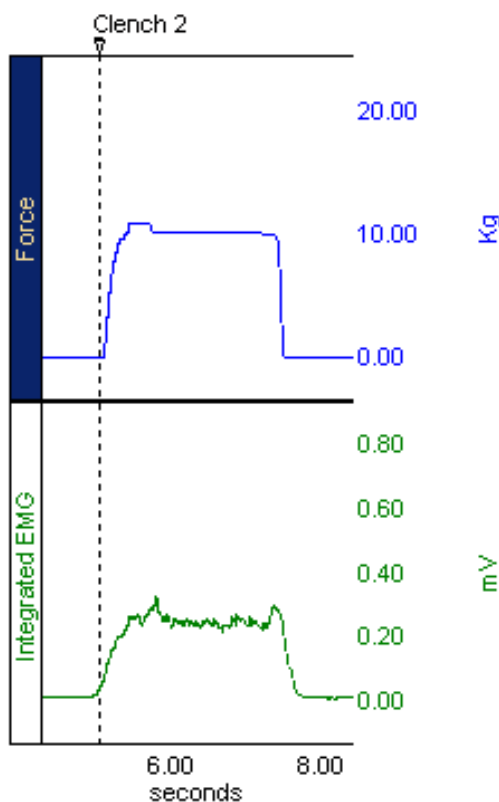
42. You can use the Journal options in the Edit menu to copy measurements to the BSL Journal.
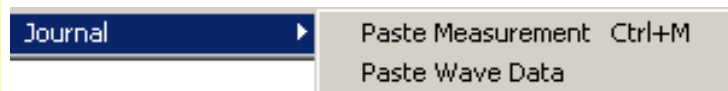
See the Journal section for details.

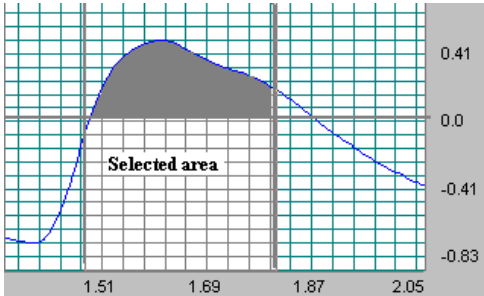| Measurement Tool	Definition
area	**Area** computes the total area among the waveform and the straight line that is drawn between the endpoints. Area is expressed in terms of (amplitude units multiplied by horizontal units).
BPM	The beats per minute (BPM) measurement uses the start and end points of the selected area as a measurement for one beat, calculates the difference in time between the first and last selected points, and divides this value into 60 seconds/minute to extrapolate BPM. This is the result you would obtain if you took $((1/\Delta T)*60)$ for a selected area. If more than one beat is selected, it will not calculate the average (mean) BPM in the selected area. *Note*: In order to get an accurate BPM value, you must select an area with the I-Beam cursor that represents one complete beat-to-beat interval. One way to do this is to select an area that goes from the peak of one cycle's R wave to the peak of the next cycle's R wave (R-R interval).
calculate	**Calculate** can be used to perform a calculation using the other measurement results. For example, you can divide the mean pressure by the mean flow. When **Calculate** is selected, the channel selection box disappears. The result box will read "Off" until a calculation is performed, and then it will display the result of the calculation. As you change the selected area, the calculation will update automatically. To perform a calculation, Ctrl-Click (or on PC, right mouse button click) on the **Calculate** measurement type box to generate the "Waveform Arithmetic" dialog. Use the pull-down menus to select **Sources** and **Operand**. Measurements are listed by their position in the measurement display grid (i.e., the top left measurement is Row A: Col 1). Only active, available channels appear in the **Source** menu. You cannot perform a calculation using the result of another calculation, so calculated measurement channels are not available in the **Source** menu. The **Operand** pull-down menu includes: Addition, Subtraction, Multiplication, Division, Exponential. The **Constant** entry box is activated when you select "Source: K, constant" and it allows you to define the constant value to be used in the calculation.

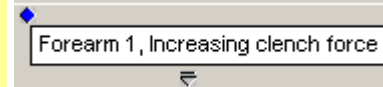| Measurement Tool	Definition
	To add units to the calculation result, select the **Units** entry box and define the unit's abbreviation. Click **OK** to see the calculation result in the calculation measurement box
correlate	**Correlate** provides the *Pearson* product moment correlation coefficient, r**,** over the selected area and reflects the extent of a linear relationship between two data sets: x_i - values of horizontal axis and $f(x_i)$ - values of a curve (vertical axis). You can use Correlate to determine whether two ranges of data move together. *Association* *Correlation* Large values with large values Positive correlation Small values with large values Negative correlation Unrelated Correlation near zero
delta	The Δ (delta amplitude) measurement computes the difference in amplitude between the last point and the first point of the selected area. It is particularly useful for taking ECG measurements because the baseline does not have to be at zero to obtain accurate, quick measurements.
delta S	The ΔS (delta samples) measurement is the difference in sample points between the end and beginning of the selected area.
delta T	The ΔT (delta time) measurement is the difference in time between the end and beginning of the selected area.
freq	The Frequency measurement converts the time segment between the endpoints of the selected area to frequency in cycles/sec. The Freq measurement computes the frequency in Hz between the endpoints of the selected range by computing the reciprocal of the ΔT in that range. It will not calculate the correct frequency if the selected area contains more than one cycle. You must carefully select the start and end of the cycle. *Note*: This measurement applies to all channels since it is calculated from the horizontal time scale.
integral	**Integral** computes the integral value of the data samples between the endpoints of the selected area. This is essentially a running summation of the data. **Integral** is expressed in terms of (amplitude units multiplied by horizontal units) **This plot graphically represents the Integral calculation.** The area of the shaded portion is the result.
lin_reg	**Lin_reg** computes the non-standard regression coefficient, which describes the unit change in *f (x)* (vertical axis values) per unit change in *x* (horizontal axis). **Linear regression** is a better method to calculate the slope when you have noisy, erratic data. *For the selected area*, **Lin_reg** computes the linear regression of the line drawn as a best fit for all selected data points
max	The maximum measurement finds the maximum amplitude value within the selected area (including the endpoints).

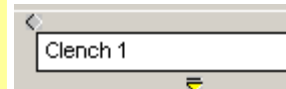| Measurement Tool	Definition
median	**Median** shows the median value from the selected area. *Note* The median calculation is processor-intensive and can take a long time, so you should only select "median" when you are actually ready to calculate. Until then, set the measurement to "none."
mean	The mean measurement computes the mean amplitude value or average of the data samples between the endpoints of the selected area and displays the average value.
min	The minimum measurement finds the minimum amplitude value within the selected area (including the endpoints).
none	Selecting none turns off the measurement channel and no result is provided. It's useful if you are copying a measurement to the clipboard or journal with a window size such that several measurements are shown and you don't want them all copied.
p-p	The p-p (peak-to-peak) finds the maximum value in the selected area and subtracts the minimum value found in the selected area. P-P shows the difference between the maximum amplitude value in the selected area and the minimum amplitude value in the selected area.
samples	The Samples measurement shows the exact sample number of the selected waveform at the cursor position. Since the Biopac Student Lab handles the sampling rate automatically, this measurement is of little use for basic analysis.
slope	The slope measurement uses the endpoints of the selected area to determine the difference in magnitude divided by the time interval. The slope measurement returns the unstandardized regression coefficient, which describes the unit change in Y (vertical axis values) per unit change in X (horizontal axis). This value is normally expressed in unit change per second (rather than sample points) since high sampling rates can artificially deflate the value of the slope. When the horizontal axis is set to display either frequency or arbitrary units, the slope is expressed as a unit change in vertical axis values per change in Hertz or arbitrary units, respectively. When an area is selected, the slope measurement computes the slope of the line drawn as a best fit for all selected data points.
Stddev	Stddev (standard deviation) is a measure of the variability of data points that computes the standard deviation value of the data samples in the selected range. The advantage of the Stddev measurement is that extreme values or artifacts do not unduly influence the measurement.
T @ max	**T @ max** shows the time of the data point that represents the maximum value of the data samples between the endpoints of the selected area.
T @ median	**T @ median** shows the time of the data point that represents the median value of the selected area. *Note* The median calculation is processor-intensive and can take a long time, so you should only select "median" when you are actually ready to calculate. Until then, set the measurement to "none."
T @ min	**T @ min** shows the time of the data point that represent the minimum value of the data samples between the endpoints of the selected area.
x-axis: T (time)	The Time measurement shows the exact time of the selected waveform at the cursor position. If a range of values is selected then the measurement will indicate the time at the last position of the cursor.
value	The value measurement displays the amplitude value for the channel at the point selected by the I-beam cursor. If a single point is selected, the value is for that point, if an area is selected, the value is the endpoint of the selected area.

Markers

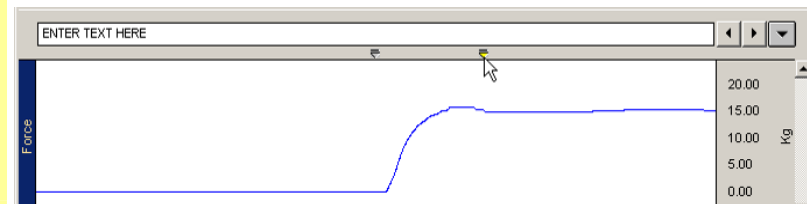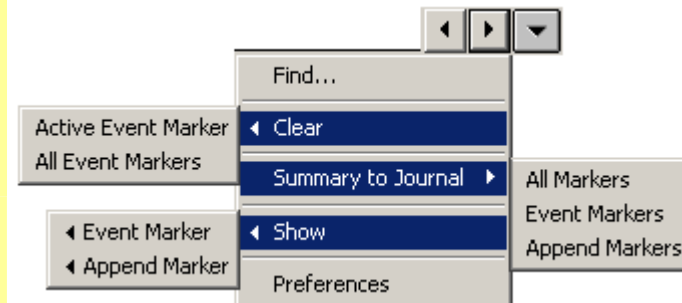|	
43. Read about **Markers** to the right.	Markers are used to reference important locations in the data. There are two types of markers: ◆ Append markers – Appear as a diamond above the marker text box and are blue when active. Append markers are automatically inserted when you begin each new recording segment and are marked with time data ◆ ┌─────────────────────┐ │ Forearm 1, Increasing clench force │ └─────────────────────┘ 　　　　　⇌ ⇌ Event markers — Appear as inverted triangles below the marker text region and are yellow when active. Event markers can be manually entered during or after recording by pressing F9 and are pre-programmed for some lessons. ◇ ┌─────────────────────┐ │ Clench 1 │ └─────────────────────┘ 　　　　　⇌ The marker that is darkened/colored is the active marker for which the marker text shown applies.
Add a marker 44. Use the selection tool to click in the marker region to the right of the "Clench 3" marker to add a new marker. 45. Label the new marker "test marker" by entering text at the flashing cursor in the marker text region. ***Select a marker*** You may change the active marker by using the "marker tools" on the right edge of the marker region.	You may add markers to your data after it has been recorded simply by clicking within the marker region using the selection tool. This new marker will then become the current active marker, and you may type in the marker text box.
46. Click on the **right pointing marker tool.**	Click on the **right-pointing marker tool** to move to the marker that was placed after the current active marker (if one exists). Notice the marker label and the data position.
47. Click on the **left pointing marker tool.**	Click on the **left-pointing marker tool** to move to the marker that was placed prior to the current active marker (if one exists). Notice the marker label and the data position.
48. Click on the **downward pointing marker tool.**	Click on the **downward-pointing marker tool** to generate a pop-up menu as shown above, and drag to select an item or generate a sub-menu.
49. Pull down the downward marker arrow and select the **Find…** option.	The marker menu allows you to **Find** certain markers by entering the marker text you want to locate.
50. Enter "Clench 4" when prompted and click on **Find Next**.	

Selecting **Find again** will move to the next marker with the same label (if one exists).

51. If prompted, click **OK** to restart marker search from the beginning of the record.
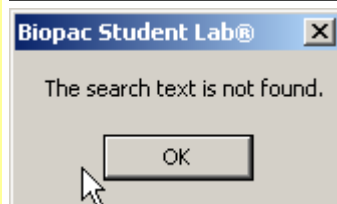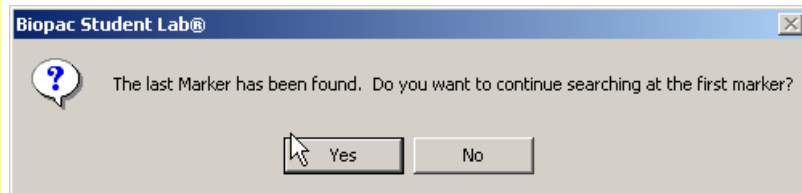
52. Select the **Clear** option to delete the "Test marker."

You cannot clear Append Markers, so these options only apply to Event Markers. **Clear Active Event Marker** will delete the active Event Marker if one is selected, and **Clear All Event Markers** will delete all Event Markers in the file.

> You cannot undo a "Clear" function, so use caution when selecting these functions.

53. Select the **Summary to Journal** option.

These options will paste marker information to the Journal and format the data with an Index, Time, and Label. The "All markers" option will list markers by time, which may mix the Event Markers with Append Markers.
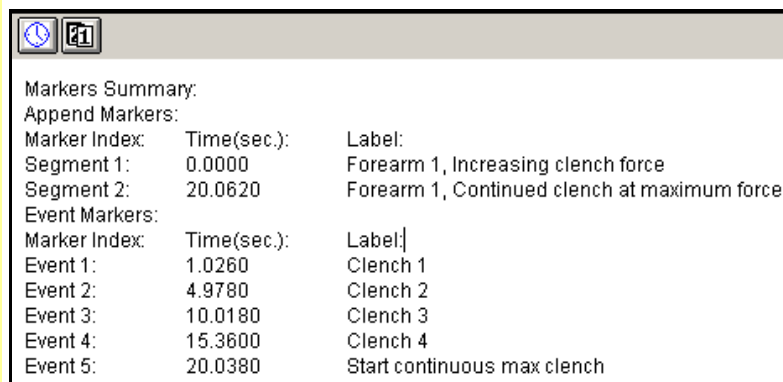
54. Select the **Show** option. Review the list of marker labels at the bottom of the menu and scroll down to select **Clench 4**.

Generate a list of markers. Drag to select a marker and jump to it in the display.

All the marker labels in the record will be listed at the bottom of the menu. The SampleData-L02 file has two markers. You may go to a particular marker by scrolling down to select its label.

- Moving to different markers using this menu may not seem very relevant for the SampleData-L02 file, but when a lot of data has been recorded, it can be a very useful tool.

55. Select the **Preferences** option.
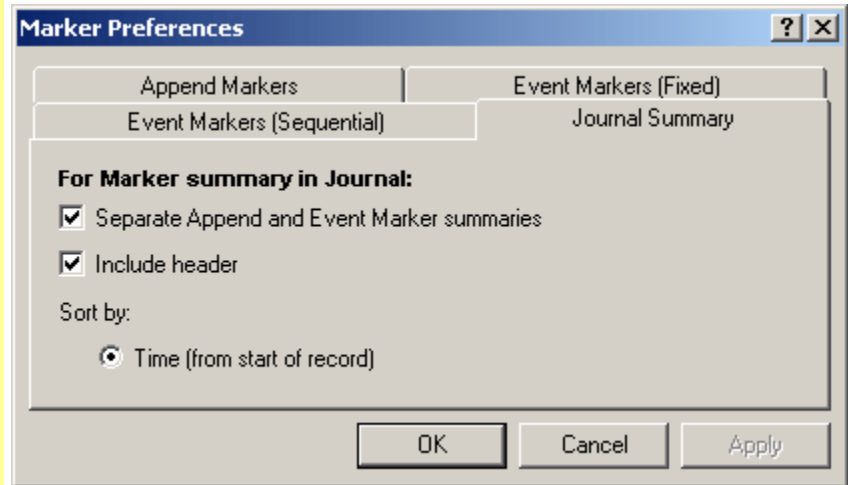
Use the **Journal Summary** tab to set options for ordering and formatting the Summary to Journal option.

Note: The rest of the Marker Preferences are advanced functions for automating marker creation and labeling—your instructor will provide details as needed when you run a Lesson.

Menu Options

56. Click on the **File** menu and review the options.
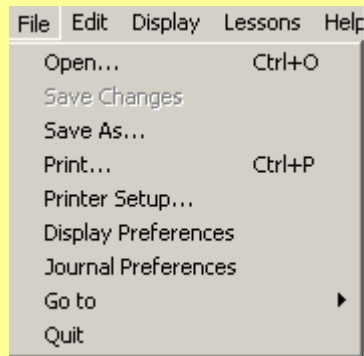
Save As allows you to save to your school's network or other media so you can access the file outside of the lab or send Journal reports to your instructor.

Go To allows you to re-launch into Lessons, *PRO* or Startup Wizard mode without exiting the application.

57. Click on the **Edit** menu and review the options and sub-options.
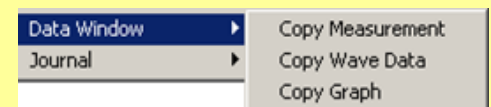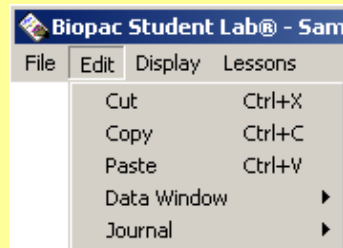
58. Click on the **Display** menu and review the options.
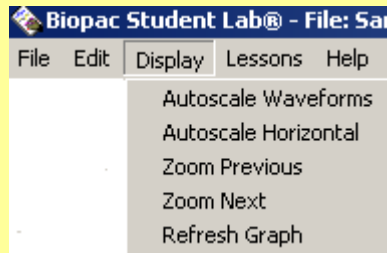
TIP: Use **Autoscale Horizontal** followed by **Autoscale Waveforms** to view all the data in one screen and restore the data display to its original state.

59. Click on the **Lessons** menu and review the options.

NOTE: The BSL 3.7.7 *Lessons only* version for MP45 does not include Lessons 7, 8, 9, 11, 14, 15 & 20.

Biopac Student Lab®

Lessons   Help

L01 EMG I - Electromyography
L02 EMG II - Electromyography
L03 EEG I - Electroencephalography
L04 EEG II - Electroencephalography
L05 ECG I - Electrocardiography
L06 ECG II - Electrocardiography
L07 ECG & Pulse
L08 Respiratory Cycle I
L09 EDA & Polygraph
L10 EOG I - Electrooculogram
L11 Reaction Time I
L12 Pulmonary Function I
L13 Pulmonary Function II
L14 Biofeedback
L15 Aerobic Exercise Physiology
L16 Blood Pressure
L17 Heart Sounds
L20 Spinal Cord Reflexes
Review Saved Data

BSL *PRO* Note —

If your instructor set BSL Lesson preferences to activate the BSL *PRO* software controls in the Review Saved Data mode, the menus will include selected *PRO* options for advanced analysis.

See your instructor or the BSL *PRO* Software Guide for functionality details.

- **Lessons** menu stays the same
- **Help** menu stays the same
- **Transform** menu is only available in *PRO* mode

BSL Analysis Mode

File   Edit   Display   Lessons   Help
Open...   Ctrl+O
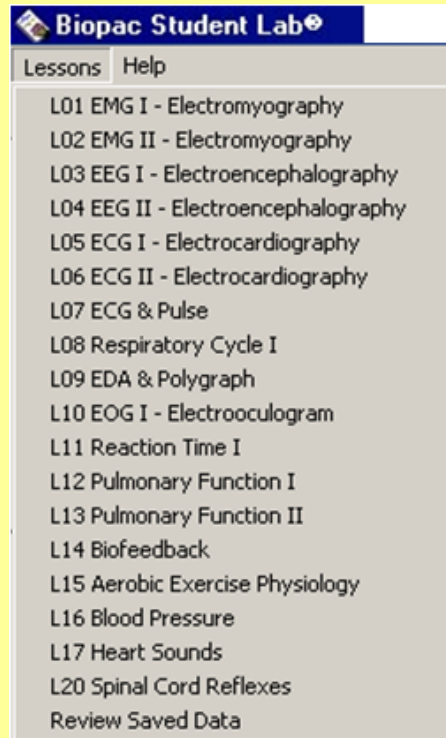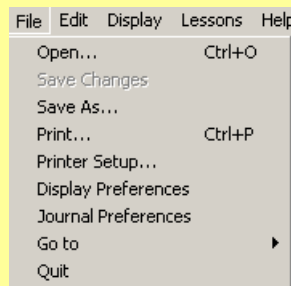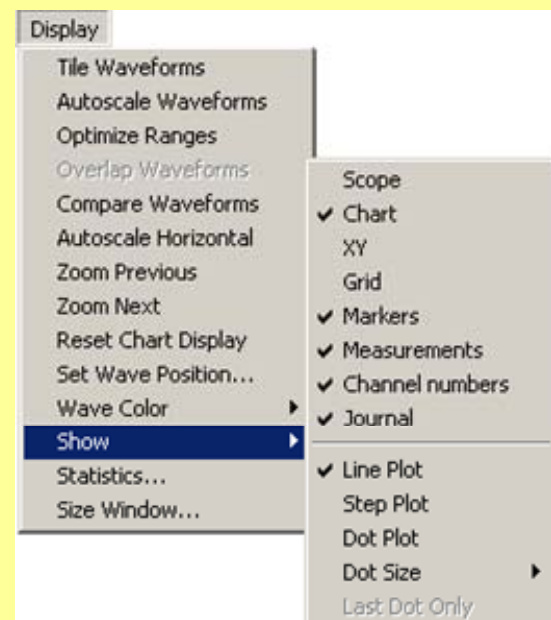Save Changes
Save As...
Print...   Ctrl+P
Printer Setup...
Display Preferences
Journal Preferences
Go to   ▶
Quit

Display   Lessons   Help
    Autoscale Waveforms
    Autoscale Horizontal
    Zoom Previous
    Zoom Next
    Refresh Graph

BSL *PRO* Analysis Mode

File
New   Ctrl+N
Open...   Ctrl+O
Open for Playback...
Close   Ctrl+W
Save   Ctrl+S
Save As...
Print...   Ctrl+P
Printer Setup...
Preferences   ▶
Go to   ▶
Quit   Ctrl+Q

Display
Tile Waveforms
Autoscale Waveforms
Optimize Ranges
Overlap Waveforms
Compare Waveforms   Scope
Autoscale Horizontal   ✔ Chart
Zoom Previous   XY
Zoom Next   Grid
Reset Chart Display   ✔ Markers
Set Wave Position...   ✔ Measurements
Wave Color   ▶   ✔ Channel numbers
Show   ▶   ✔ Journal
Statistics...   ✔ Line Plot
Size Window...   Step Plot
                                   Dot Plot
                                   Dot Size   ▶
                                   Last Dot Only

Journal

60. Read about the **Journal** to the right.	The Review Saved Data mode incorporates a **Journal** feature so you can type notes or copy measurements from previously saved data. You can also copy data directly to the Journal. The Journal needs to be the active window for its options to come up.
61. Click anywhere in the **Journal** window to activate it.	
62. Click on the bar separating the Journal window from the Data window and drag up or down to resize the Journal.	
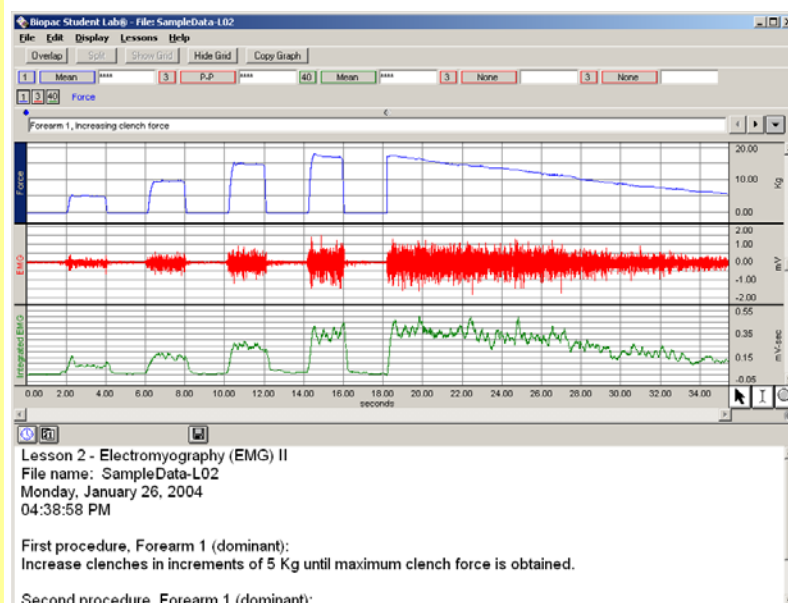
Format Journal Entries

63. Pull down the **File** menu, scroll down to **Journal Preferences.**

```
File  Edit  Display  Lessons  Help
  Open...           Ctrl+O
  Save Changes
  Save As...
  Print...          Ctrl+P
  Printer Setup...
  Display Preferences
  Journal Preferences
  Go to                      ▶
  Quit
```

Journal Preferences   ☒

Tabs: [1.00]   inch   [Change Font]

┌ Measurements Paste Options ─────────────────┐
│ ☑ Include measurement name   │
│ ☑ Include measurement units   │
│ ☑ Include channel numbers   │
│ ☐ Put each measurement on a separate line   │
└──┘
┌ Wave Data Paste Options ────────────────────┐
│ ☑ Include time values   │
└──┘

            [OK]   [Cancel]

64. Review the options that can be set to change the way measurements are pasted into the **Journal**.

You can control formatting for text, measurements and wave data. Click on the "Change Font" button to set the text font, style and size.

65. Click in the box next to each measurement paste option box so that all are selected.

Select these options so that when you paste measurements you can easily identify them.

66. Click in the "Include time values" box in the Wave Data Paste Options section.

Note When you plan to export the measurements to a spreadsheet program (such as Excel), it is best *not* to select all of the Measurements Paste Options or the Wave Data Paste Option as these will affect the formatting.

67. Click **OK** to accept the option changes.

Time and Date Stamps

[🕐] [📅]

The Journal has stamps for the time and date, which can be useful when creating reports. The icons are on the left edge of the Journal toolbar.
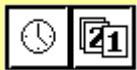
68. Position the cursor at the end of the journal entries and click on the clock icon to activate the **time** stamp.
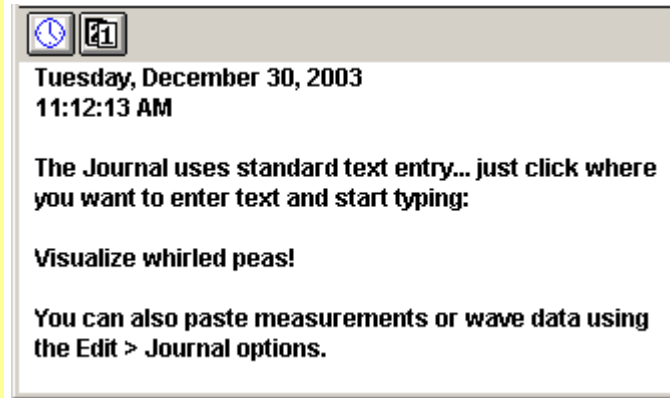
Review the result.

The **time** stamp is the "clock" icon at the top left of the Journal window. When you click on the clock icon, the current time (according to your computer's System clock) will be entered in the Journal at the cursor point.

[🕐] 10:36:20 AM

69. Click on the calendar icon to activate the **date** stamp.

Review the result.

The **date** stamp is the "calendar" button to the right of the time stamp. When you click on the calendar icon, the current date (according to your computer's System calendar) will be entered in the Journal at the cursor point.

[📅] Tuesday, December 30, 2003

Text entry

70. Place the cursor at the point you wish to begin typing and enter text using the standard keyboard functions.

It's possible to write anything you want directly in the Journal. Just click on the Journal window and place the cursor at the point you wish to begin typing.

Tuesday, December 30, 2003
11:12:13 AM

The Journal uses standard text entry... just click where you want to enter text and start typing:

Visualize whirled peas!

You can also paste measurements or wave data using the Edit > Journal options.

Paste Measurement(s) to Journal

71. Read about the Paste Measurement function.

When you use the **Paste Measurement** function, all the pop-up measurements showing a value will be written to the Journal.

TIP Use the "none" measurement option when you don't want a measurement pasted to the Journal.

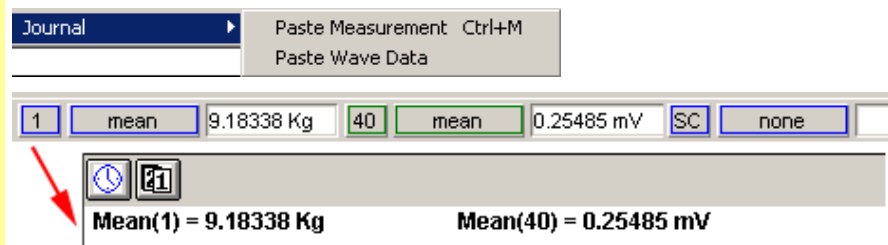To paste a pop-up measurement into the Journal:

1. Select the channel you want to measure by clicking on it with the Selection tool or use the cursor to pick the correct channel number in the boxes just left of each of the pop-up measurements.

2. Choose the appropriate pop-up measurement.

3. Use the I-beam tool to select the portion of the wave you are interested in.

   The pop-up measurement values will update instantly. The pop-up measurements always operate on the selected area you have chosen with the I-beam tool.

   • For instance, if you choose p-p, you will find the peak to peak value of the wave in the selected area. If you choose max, you will get the maximum value of the wave in the selected area.

4. Pull down the Edit menu and select Journal>Paste Measurement. Alternatively, you can use the Ctrl-M keystroke command.

72. Select Channel 1 in the Data Window.

Select the channel you want to measure by clicking on it with the arrow tool or use the cursor to pick the correct channel number in the boxes just left of each of the pop-up measurements.

73. Set a pop-up measurement box for CH 1 mean.

74. Set a second pop-up measurement box for CH 40 mean.

75. Use the I-beam tool to select a region from the peak of one R-wave to the peak of the next R-wave.

76. Pull down the **Edit** menu, scroll to **Journal** and slide right to select **Paste Measurement**.

77. Review the Journal entry.

Paste Wave Data to Journal

78. Read about the Paste Wave Data function.

79. Use the I-beam selection tool to select the portion of the wave you are interested in.

80. Pull down the **Edit** menu, scroll down to **Journal** then scroll right to **Paste Wave Data**.

81. Review the Journal entry.

82. Export Journal Files

Saving the Journal

83. To save with the existing file name and location, click on the **File** menu and select **Save Changes**.

84. To save with a new file name and/or location, click on the **File** menu and select **Save As**.

The **Paste Wave Data** function will write all the points that make up the data in the selected wave area to the Journal.

Note   It's very easy to put a lot of data into the Journal using this command: One second of a wave that was sampled at 200 Hz will paste 200 numbers into the Journal.

To paste wave data into the Journal:

a. Select the channel you wish to measure by clicking on it using the Selection tool or use the cursor to pick the correct channel in the channel boxes just left of each of the pop-up measurements. This will activate the Data Window.

b. Use the I-beam tool to select the portion of the wave you are interested in.

c. Pull down the Edit menu and scroll down to Journal then scroll right to Paste Wave Data.

| Journal | ▶ | Paste Measurement Ctrl+M |
| | | Paste Wave Data |

sec	Force	EMG	Integrated EMG
16.78	20.993	-0.39209	0.686493
16.782	20.993	-0.301025	0.683973

The Journal file is saved in standard text format and can be exported to word processing or spreadsheet programs—or any application that accepts Text or ASCII files.

To export Journal text and/or data to another program:

a. Open the BSL file.

b. Select the desired Journal text.

c. Choose **Edit>Copy** to copy the Journal text.

d. Switch to the other program.

e. Choose **Edit>Paste** to paste the copied data.

Note   When you plan to place the data into a spreadsheet, it's usually a good idea to remove any extraneous comments, so you just have rows and/or columns of numbers.

Use the File menu Save options to save the Journal. The Journal and Graph files are linked and will be opened and saved together.

Save Data

85. Read about the **Save** functions to the right.

Each student's recording is <u>automatically saved</u> at the end of each lesson recording. Students do not need to resave files unless they significantly alter the data window settings or make a change to the journal while in the Review Saved Data mode.

Once in the Review Saved Data mode, you may alter the data display window, or enter more information into the journal. When you make changes to the data window, you are only changing how the data appears on the screen — you are not altering the data that was originally recorded. Saving the changes will never delete any data.

86. Review the save options under the File menu.

   - **Save Changes**

   - **Save As** (*new name or location*)

File	Edit	Display	Lessons	Help
Open...			Ctrl+O	
Save Changes				
Save As...				
Print...			Ctrl+P	
Printer Setup...				
Display Preferences				
Journal Preferences				
Go to			▶	
Quit				
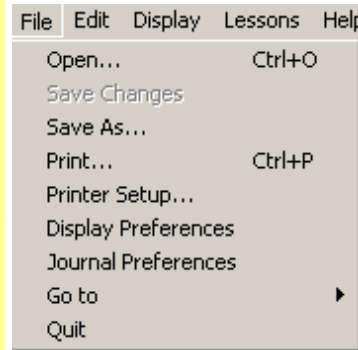
Save Changes

We recommend this option to ensure that lesson files are properly named and saved.
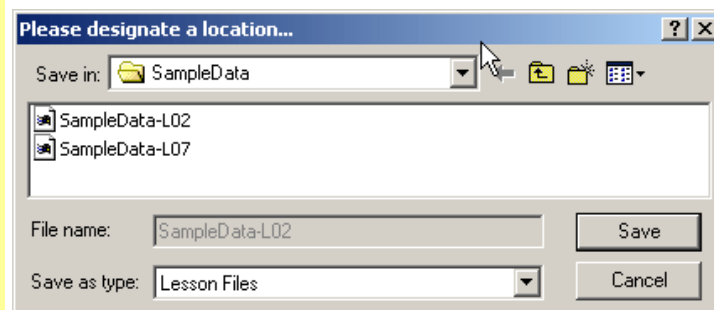Saves the file with the existing file name and location.

Save As

To take data home for analysis, use this option.
Creates a copy of the original file and prompts you for a location to save the copy to — CD, network, or other media.

87. Pull down the **File** menu and select the **Save changes** option.

The save is automatic, no dialog or confirmation is required.

88. Pull down the **File** menu and select the **Save As** option.

The following dialog will be generated so you can designate a location for the file.

Please designate a location...

Save in: SampleData

SampleData-L02
SampleData-L07

File name: SampleData-L02

Save as type: Lesson Files

Save   Cancel

File name <u>cannot be altered from the original name</u>. This allows the Review Saved Data mode to work correctly.

Save as type is locked on "Lesson Files," which is the original way the file was saved and is the waveform display you normally see on screen. This mode copies the journal text as well.

The "**Save**" button instigates the Save function.

Printing

89. Read about the **Print** functions to the right.

   TIP: It's always a good idea to Save before printing.

You control how the data is presented on the printed page by controlling how it is displayed on the screen prior to selecting Print. All of the options relating to printing the data files apply to the waveforms as they are displayed in the data window. If you've zoomed, changed the scale, or hidden a channel, only the portion of data displayed in the data window will be printed. This is actually very useful, because oftentimes you may only want to display a portion of the data.

When you choose **File>Print** you will be prompted to choose which items to print.
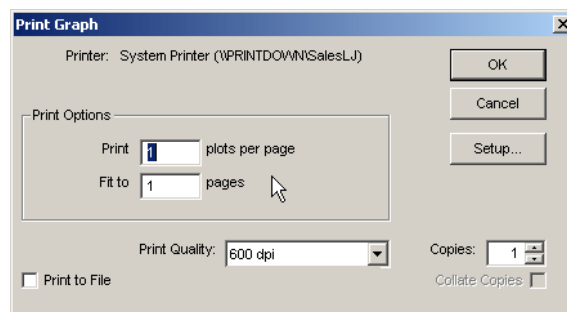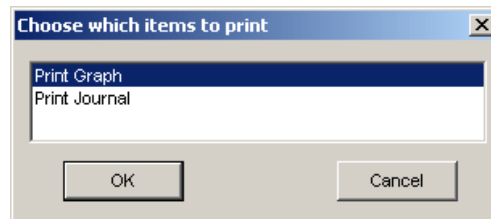
Print Graph

IMPORTANT! The printer only works with the data shown in the data window, <u>which often is not the complete data file</u>.

The preceding Print dialog is just an example. Your actual Print dialog will depend on the printer and Operating System you are using. The dialog should include **Print Options** that allow you to control how much data is printed on each page.

- Depending on your OS, you may need to access the Print Options via a button in the original Print dialog. Refer to the Users Manual for your computer and/or printer for more detail.

- **Print Options**

Print ___ plots per page

   This option determines how each page will be divided up to plot the data displayed in the data window.

   - For example, entering "4" will divide each page into four regions.

   The printed data may have an expanded time scale if the printer made adjustments to plot what was viewed on the screen evenly across the specified area.

Fit to ___ pages

   This option determines how many pages to use to print what is displayed on the screen.

   - For example, entering "2" will print the data displayed in the window evenly across two pages. The first (left) part of the data displayed on screen would print on Page 1 and the second (right) part would print on Page 2.

- **Automatic Adjustments**

The software will automatically make the following adjustments prior to printing, which may result in slight differences between what is displayed and what is printed:

- **Vertical Scale** — If a vertical scale in the data window is set to fractional numbers, then the software will slightly adjust the scale to use even numbers for print.

- **Markers** — When markers are displayed on the screen with associated marker text, the data will print with the marker text directly above the appropriate marker and a dashed vertical line will run through the data to indicate the marker's precise point in time. If the data is compressed, the markers and/or marker text may overlap or be hidden. If this is not acceptable, then you'll need to expand the time scale so that the markers have enough room to print.

Print Journal

This option generates a standard Print dialog to print the Journal text.

90. Print the entire data file

a. Click anywhere in the Data Window to make it the active window.

b. Choose **Display**>**Autoscale Horizontal**.

c. Choose **Display**>**Autoscale Waveforms**.

d. Choose **File**>**Print>Print Graph**.

e. Set Plots per page and Fit to pages as desired.

f. Click **OK.**

91. Review the printed result.

Quit BSL

92. Pull down the file menu and select **Quit**.

During the recording mode, the application close ⊠ icon in the upper right corner of the display window is blocked so you can't inadvertently quit the application when you simply meant to close the data window.

To quit the application, you need to choose **Quit** from the **File** menu.
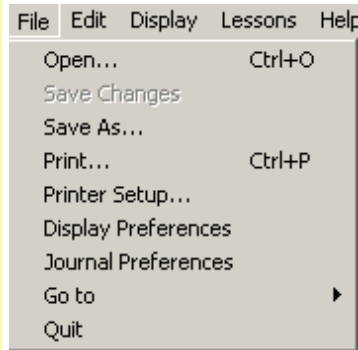
If **Quit** is blocked, click on the STOP button and wait for the recording to end, then try **Quit** again.

93. If prompted, click **Yes** to save all changes.

94. Close the file you opened and close the hard drive window.

When you try to quit the software after altering the data file and/or journal file in any way, the following message will be generated.

<div style="border:1px solid black;">
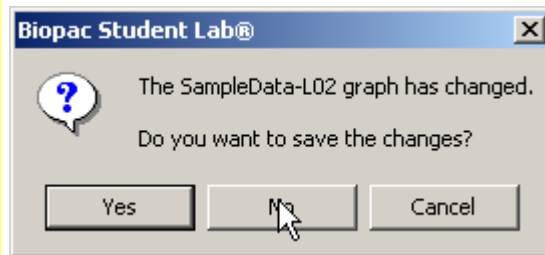
Running a Lesson

</div>

To run a BSL Lesson, you must have an MP data acquisition unit connected. If you installed the BSL software with the Hardware option and have an MP unit connected, you can follow along on your computer; otherwise just read this section so you'll know what to expect in the lab.

> **IMPORTANT** — You are free to download the Biopac Student Lab Analysis software for use on your personal computer. The hardware does not have to be attached for you to review and analyze your data files. See www.biopac.com for the BSL Analysis download.

The primary objective of the Recording section is to assist you in obtaining good data, and the primary objective of the Analysis is to help you understand the data and the physiological concept it represents. Lessons are set up so that you can record data in the lab and then analyze the data after class—in the lab or at home.

FAST TRACK	*Detailed Explanation of Steps*
This side of the lesson (left, shaded column) is the "FAST TRACK" through the lesson, which contains a basic explanation of each step.	This side of the lesson contains more detailed information to clarify the steps and/or concepts in the FAST TRACK, and may include reference diagrams, illustrations, screen shots, and/or references to this manual.

Although it is not absolutely necessary, BIOPAC recommends that students work in groups of at least three. Students should choose a **Director**, a **Recorder**, and a **Subject** from their lab group <u>before</u> beginning Set Up (which often involves the Subject).

Director   The Director reads the lesson steps and tells the Recorder and Subject what to do. The Director also keeps track of the length of time for each condition.

Recorder   During the recording session, the Recorder will insert a marker (press F9 on PC or Esc on Mac) whenever the Subject is requested to do something and will key in the condition to create the marker label. The recording step will indicate what to key in. Note that marker text can be added or edited after the recording is complete.

Subject   This is the person from whom data will be recorded. The Subject will need to perform the tasks as instructed by the Director. It is suggested that the Subject not look at the computer screen while data is being recorded, as there tends to be a "biofeedback" effect that can bias the heart rate.

1. Turn the computer ON.

   To run a lesson, the computer must have an MP unit connected.
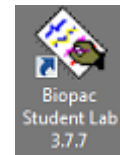
2. Use the desktop icon or the Windows **Start** menu item "BSL Lessons 3.7.7".

   To launch the program, use the desktop icon or use the Windows® **Start** menu, click Programs and then select:
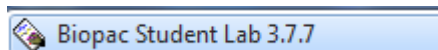

3. Choose the **Record a lesson** option in the Startup Wizard and select a Lesson from the menu.

- The **Review Saved Data** option will generate a standard Open dialog so you can select a file for analysis. (Available in **Lessons** menu only after application has been launched)
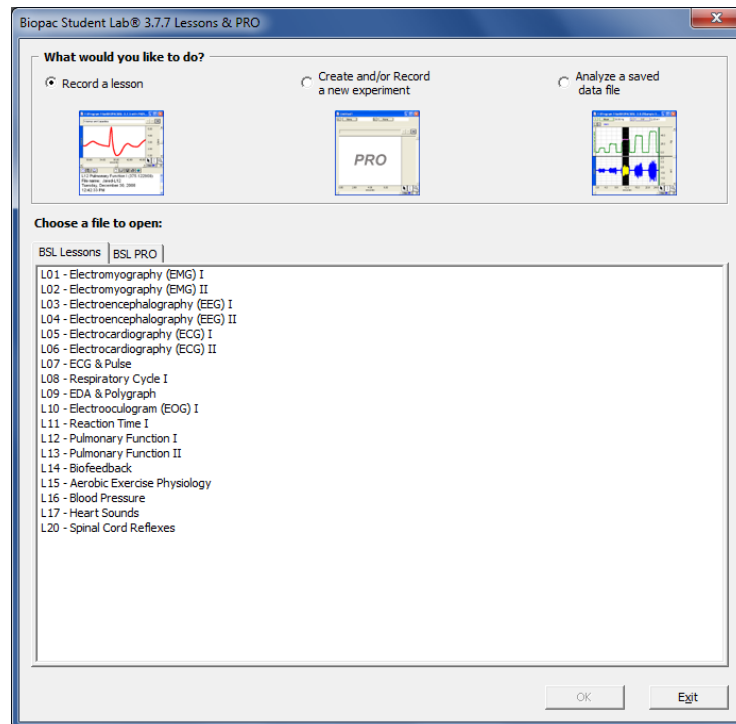

Note—When using MP45 hardware, a subset of the lessons shown above will appear in the Lessons menu. (Lessons 7, 8, 9, 11, 14, 15 and 20 are not supported in MP45 or in the Lessons-only version).

If the hardware is not connected, the following prompt will be generated. To run a lesson, check the power and connections for the MP unit and then click Retry.
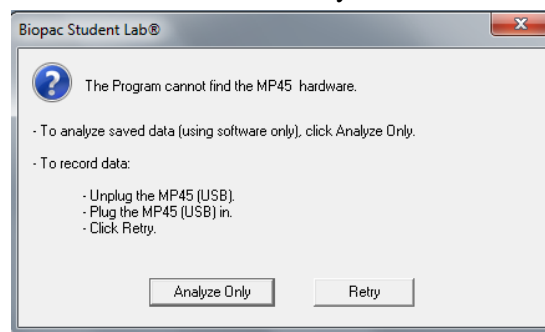
4. Type in your file name.

Type in your name so the BSL System can store all of your data files in one place, and make it easier for you to retrieve data later on.
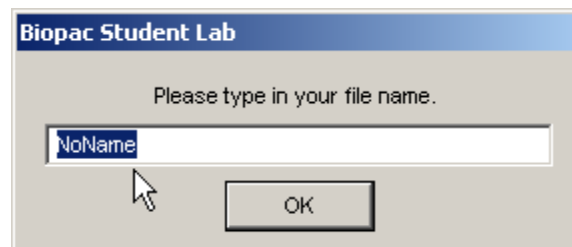

You can enter your real name, a nickname, or the name of your group if you are working with other students. Select and type in a unique identifier, such as the Subject's nickname or student I.D. #, your full name or some combination of your name and other letters and/or numbers (like JohnF or John3).

**It is a good idea to use the same log-on name for each lesson**.

Be sure to write down the log-on name you choose so that you can keep track of where your data is stored.

The Biopac Student Lab software will let you use the same name ten times. If there are a lot of other students using your computer and you try to log on with a general name ("John" vs. "JohnF") there is a good chance the Biopac Student Lab software will ask you to use a different name.
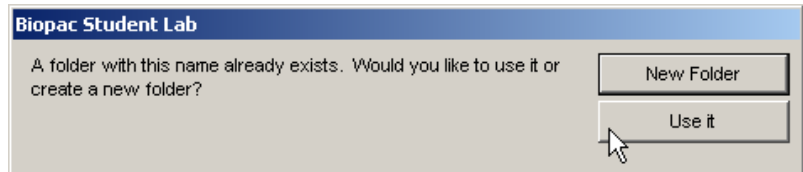
If you know the existing folder is your own, select **Use it**. This is a convenient way to ensure that all of your lesson files for the class term are stored in one folder. If you Rename the folder, just add a character to the last name you used, i.e. "Lauren" becomes "Lauren2." Once you enter your name and choose **OK**, the Biopac Student Lab software creates a folder inside the "Data Files" folder that is inside the "Biopac Student Lab" folder on your computer (or in an alternate location if your instructor modified setup). This is where all your data will be stored. If you choose the same file name for other lessons, they will also be stored in this folder (with the appropriate lesson number extension).

If you try to use the same file name an eleventh time, the program will insist that you choose a different name.
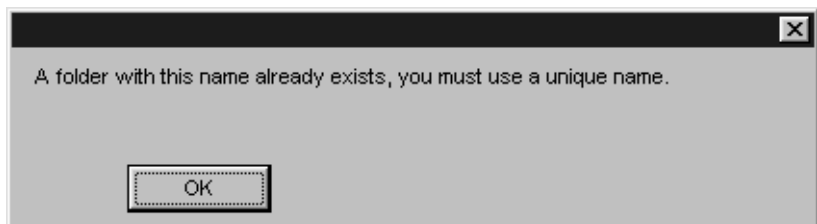
The files inside your folder can be moved, copied, or duplicated, just like any other file. If you wish, you can copy them to a CD or drive as a backup or to be viewed later. Check with your instructor or lab assistant for more information on how to do this.

When you run a lesson, the first step is a prompt for you to enter your name. The Biopac Student Lab software creates a folder with the exact name you enter and places it in the **Data Files** folder of the Biopac Student Lab Program folder. When you press the **Done** button in the lesson to end recording, the BSL program automatically saves your waveform data file to the **Data Files** folder with a file name based on the user name or I.D. given at the start of each lesson.

The software will save the data file with the name you entered plus an extension that identifies the lesson number. This extension is very important because the software will key off this extension and open up different tools for the Review Saved Data Mode, depending on the lesson.
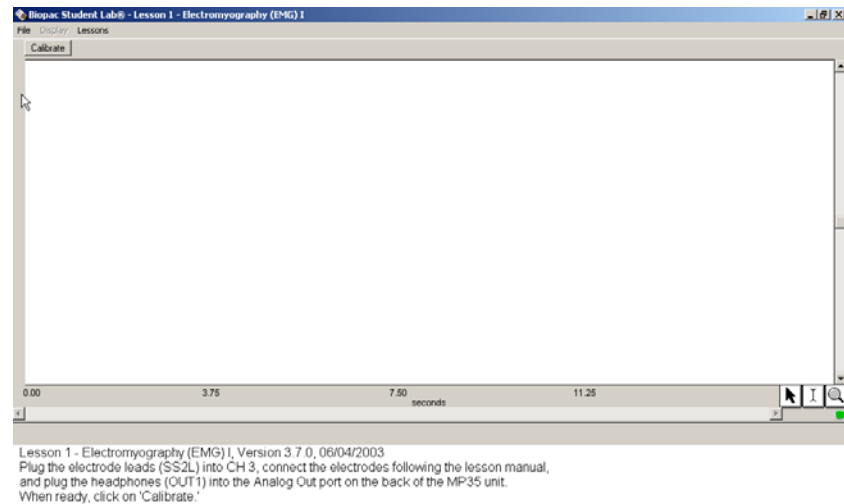
Other lesson data files that use the same name will be placed in this same folder, but the software will never allow you to save a data file

with the same name and lesson number.

As a general note, because the Biopac Student Lab software automatically is saving the files, you must exercise caution when moving things around into different folders.

It is recommended that you never place other files or folders in the Biopac Student Lab program folder, and never take files or folders out of the program folder with the exception of removing data files from the Data Files folder.

5. Follow the instructions in the lesson manual and in the Journal, or proceed as directed by your instructor.

Lesson 1 - Electromyography (EMG) I, Version 3.7.0, 06/04/2003
Plug the electrode leads (SS2L) into CH 3, connect the electrodes following the lesson manual, and plug the headphones (OUT1) into the Analog Out port on the back of the MP35 unit.
When ready, click on 'Calibrate.'

The recording section is very detailed and includes sample screen shots for comparison—so, even if you don't fully understand what is happening when you're running the lesson or feel pressured by time (as is often the case), you should be able to obtain good, meaningful data. Then, you'll be able to analyze and grasp the important concepts later, during the Analysis section.

Normally, there are multiple data segments that need to be recorded, with different tasks occurring during and/or between these segments. It is important that you read ahead to the next step in the lesson so it is clear what task(s) you'll need to perform during each recording segment.

NOTE: Certain data segments may have been disabled by your instructor. If this is the case, please disregard any instructional references to excluded segments.

6. Step through the lesson as guided in the Lesson manual or by your instructor.

    Calibrate

To begin a Lesson, click on the **Calibrate** button. The dynamic calibration procedure will automatically optimize the BSL System for the signal(s) being recorded in the lesson.
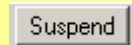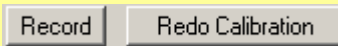
- With equipment such as an oscilloscope, you or your instructor needed to "twiddle" with the dials and switches, e.g., gain or amplification settings, position (vertical or horizontal alignment), voltage/division settings, time/division settings, and sweep speed to make sure a "good" signal was recorded. This entire procedure had to be manually repeated for each new subject. The Biopac Student Lab makes the required adjustments for you during the automatic calibration procedure.

If you did not plug in the hardware as directed, you will be prompted to correct it before continuing. (See prompt on next page)
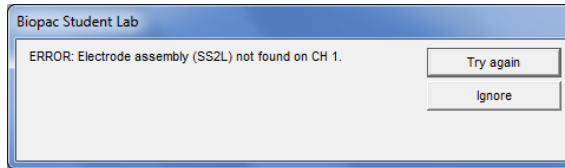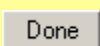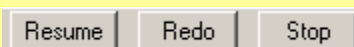
The calibration routine will stop automatically.

If your calibration data does not match the sample screen shot provided, click on **Redo Calibration** to repeat calibration and erase the old data.

If your calibration data matches the sample screen shot, click on **Record** to begin the first recording segment.

Click on "**Suspend**" when you have completed the assigned segment task(s).

- You should click on "Suspend" as soon as possible once you have completed a segment. This is important because every second wasted is memory used up for the data recording. The more memory used, the slower the program will operate, the more disk space will be used up when the data is saved, and the more possibility of problems.
- When selected, the **Suspend** button toggles to "**Resume**."

Review Recorded Data

When you Suspend recording between lesson segments, you can check that you have good data before continuing. You may want to check your data by zooming in on a segment, taking a measurement, adding grids, etc. Review your data before continuing and read ahead to prepare for the next segment.
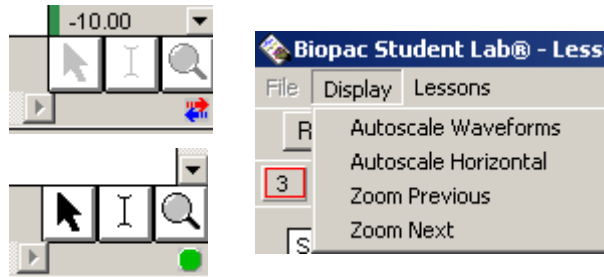

The **Arrow**, "**I-Beam,**" and **Zoom** tools are inactive (greyed) during recording but can be used between segments while in the Recording mode. The Display menu items are also available.

To repeat the last recorded section and erase the old data, click on **Redo**.

- The "Redo" feature is very handy and should prevent you from panicking during the recording. You can redo a recording segment if something goes wrong or if you realize you have not performed the proper tasks.

If you are finished with the data recordings, click on **Stop**.

Click the "Done" button in the Lesson display to generate the closing options dialog.
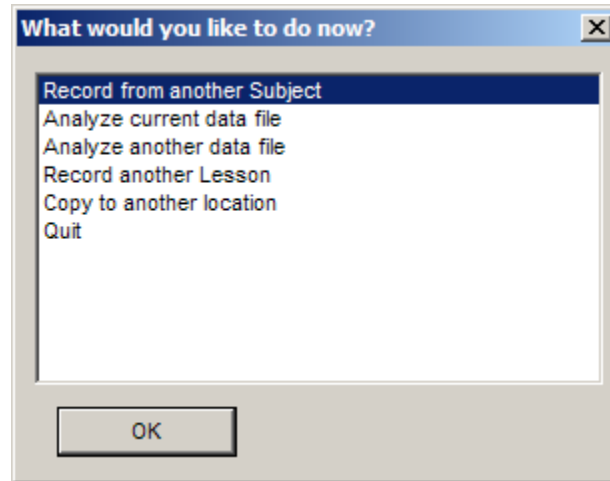
Record from another subject will return you to the first screen of the lesson. Repeat the necessary set up, type in a new Subject name, and repeat the entire recording. Depending on the lesson, you may or may not have to redo the calibration.

Analyze current data file will switch you to the Review Saved Data mode and will automatically open the last recorded data file.

Analyze another data file will switch you to the Review Saved Data mode and will prompt you to find and open a data file for review.

Record another Lesson will generate the lessons menu.

Copy to another location will generate a Save dialog, allowing you to designate the location to save the file to. Note that you cannot change the File name.

Quit will close all lesson windows that are open and then exit the Biopac Student Lab program.

7. Save the recorded lesson data.

Each student's recording is <u>automatically saved</u> at the end of each lesson recording. You do not need to resave files unless you significantly alter the data window settings or make a change to the Journal while in the Review Saved Data mode. You will be prompted to save changes.
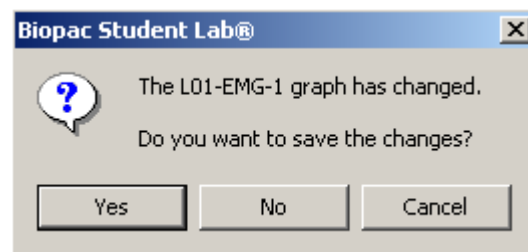

Review Saved Data Mode for Data Analysis

Data Analysis is where you analyze your data to "pull out" measurements that reinforce the concepts presented in the Introduction. Analysis can be done right after the data is recorded, or can be done off-line on another computer (the hardware does not need to be attached). The analysis should be done after all students have recorded their data.

Measurements taken in the Analysis section are to be placed in the Data Report section and may also be placed in the on-screen journal for saving and printing. Whenever a measurement needs to be placed in the Data Report, a reference icon will direct you to the proper section of the Data Report.

Help Menu Data Reports in Rich Text Format

Printable electronic copies of the Lesson Data Reports in Rich Text format are accessible under every Lesson Help menu while in Review Saved Data mode. These reports are specific to the lesson under review and appear within a Data Report Editor window, which contains simple tools for modifying the reports as desired.
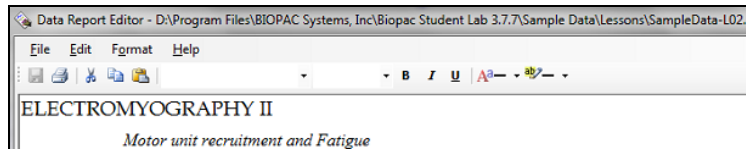
By default, the Help Menu Data Reports are saved to the Data Files folder of the associated lesson, but can be resaved to a different directory as needed. If the option to "Save As" has been disabled by your instructor, you will not be able to save modifications to the reports nor save them to anywhere but the default location.
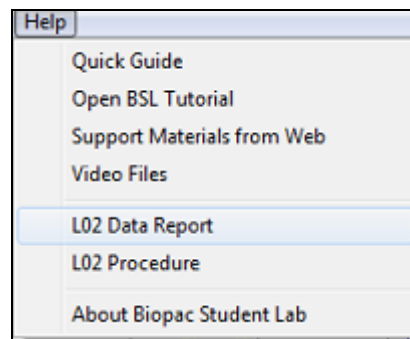
NOTE: In the web-downloadable BSL 3.7.7 Analysis-only version, the Data Report and Lesson Procedure Help menu items are **hidden** by default. To enable these items in the Analysis-only version, you must modify the "LessonPreferences" script in the BSL application folder. To accomplish this:

1. Locate the "LessonPreferences" script file (normally installed to 'Drive:\Program Files\Biopac Systems, Inc\Biopac Student Lab Analysis 3.7.7')

2. Open the "LessonPreferences" script file in Notepad or Wordpad.

3. Scroll down to **"Data Report Preferences"** and **"Lesson Procedures Preference"** and change the entries highlighted below from **"OFF"** to **"ON":**

4. Save the file. (You may again remove these Help menu items by simply repeating the above steps and editing these entries back to **"OFF)**.

Lesson Specific Buttons

Some lessons have extra buttons (under the menu bar) for features appropriate to the lesson signal and/or protocol. The following buttons are not in the sample file, so just read about them below.

The **Listen** button allows you to listen to the signal as output if you have headphones or other listening hardware connected.

The **Overlap** and **Split** buttons allow you to merge or separate the data channels ("tracks") in the display window.
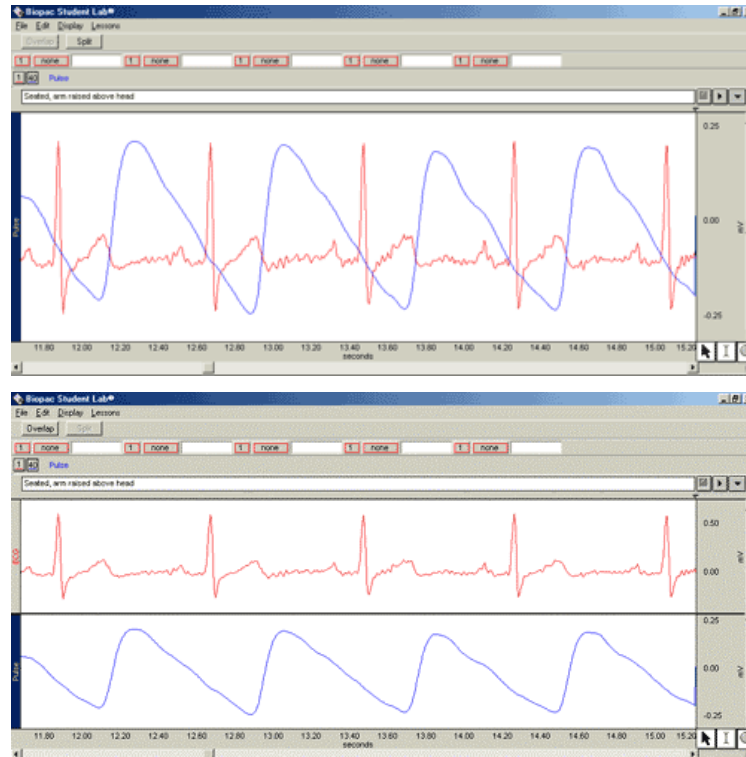
You cannot successfully apply grids after the Overlap function is activated. Grids can change the scale, so begin in the Split mode, then apply grids, then Autoscale, then apply the Overlap.

The **Show Grid** and **Hide Grid** buttons allow you to toggle the grids on and off. (Available in Analysis mode)

Copy Graph allows you to copy the waveform data as a picture to be imported or pasted into other programs. (Available in Analysis mode)

The **Adjust Baseline** button is only used in *"Lesson 5 ECG I"* and it allows you to position the waveform up or down in small increments so that the baseline can be exactly zero. This is not necessary to get accurate amplitude measurements, but may be desired before making a printout or when using grids.

When you click the **Adjust Baseline** button, **Up** and **Down** buttons will be generated. Simply click on these to move the waveform up or down. The **Exit** button will close the Adjust Baseline options and return to the waveform display.

These buttons are in Lesson 3 and will filter the signal into the bandwidth for alpha, beta, delta and theta analysis.

These buttons allow toggling between **Random Interval** or **Fixed Interval** presentation when additional Lesson 11 segments are recorded.

Legalese

Copyright

Information in this document is subject to change without notice and does not represent a commitment on the part of BIOPAC Systems, Inc. This tutorial and the software it describes are copyrighted with all rights reserved. Under copyright laws, this tutorial or the software may not be copied, in whole or part, without the written consent of BIOPAC Systems, Inc., except in the normal use of the software or to make a backup copy.

The same proprietary and copyright notices must be affixed to any permitted copies as were affixed to the original. This exception does not allow copies to be made for others, whether or not sold, but all of the material purchased (with all backup copies) may be sold, given, or loaned to another person. Under the law, copying includes translating into another language or format.

Biopac Student Lab Tutorial, including all text and graphics, are ©1998-2010 BIOPAC Systems, Inc., with all rights reserved.

Warranty

BIOPAC Systems, Inc. warrants its hardware products against defects in materials and workmanship for a period of 12 months from the date of purchase. If BIOPAC Systems, Inc. receives notice of such defects during the warranty period, it will, at its option, repair or replace the hardware products that prove to be defective.

This warranty applies only if your BIOPAC Systems, Inc. product fails to function properly under normal use and within the manufacturer's specifications. This warranty does not apply if, in the sole opinion of BIOPAC Systems, Inc., the BIOPAC product has been damaged by accident, misuse, neglect, improper packing, shipping, modification, or servicing by other than BIOPAC Systems, Inc.

Any returns should be supported by a Return Mail Authorization (RMA) number issued by BIOPAC Systems, Inc. BIOPAC Systems, Inc. reserves the right to refuse delivery of any shipment containing any shipping carton without the RMA number(s) displayed on the outside. The Buyer shall prepay transportation charges to the site designated by BIOPAC Systems, Inc.

BIOPAC Systems, Inc. makes no warranty or representation, either expressed or implied, with respect to this software, its quality, performance, merchantability, or fitness for a particular purpose. As a result, this software is sold "as is" and you, the Buyer, are assuming the entire risk as to its quality and performance.

In no event will BIOPAC Systems, Inc. be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect in the software or its documentation, even if advised of the possibility of such damages, or for damage of any equipment connected to a BIOPAC Systems, Inc. product.

Trademarks

BIOPAC is a registered trademark of BIOPAC Systems, Inc.

Apple and Macintosh are trademarks of Apple Computer, Inc.

Windows is a trademark of Microsoft Corporation.

This document was created with Microsoft Word for Windows, Adobe Photoshop, Corel Draw 7.0. Mainstay Capture, JASC, Inc. JasCapture and FastStone Capture.