Biopac Student Lab

BSL for Windows® 10, 8, 7
Or Mac OS X 10.10-10.15

Jocelyn Mariah Kremer,
Mike Mullins
Documentation
BIOPAC Systems, Inc.

William McMullen
Vice President
BIOPAC Systems, Inc.
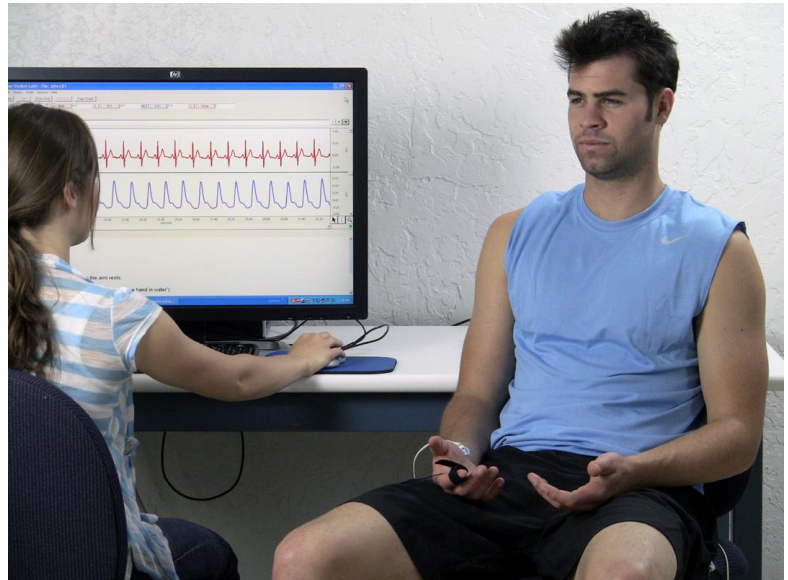
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⬤ Biopac Student Lab

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A Note to Instructors —

Thank you for putting your trust in BIOPAC Products and welcome to the global community of Biopac Student Lab Instructors and Researchers. The Biopac Student Lab System was designed with ease of use as its main goal. We have made every effort to design a system that allows the student to concentrate on the study of physiology instead of the interconnections of the hardware or complicated transducer calibration. We have also designed the system to be "student proof" to prevent new users from tampering with the recording parameters or calibration procedures.

This purpose of this **Instructor's Guide** is to detail the setup and customization features of the Biopac Student Lab program for instructors and lab assistants, and to offer supplemental material with a focus on configuring the BSL Lesson content and preferences to best suit your curriculum. This guide assumes you have some basic familiarity with using the BSL program. For a complete overview of the Biopac Student Lab software, please see the Biopac Student Lab Tutorial under the Help Menu or watch the BSL Tutorial video here.

Please keep these important points in mind when working with the Biopac Student Lab:

1. The BSL Lessons software automatically saves the data files under a file name created by the student at the start of each lesson.

2. The software expects to see the files and folders within the "Biopac Student Lab" folder. Never rename these files and folders, or move any files or folders out of the Biopac Student Lab folder.

    *   The lone exception is that the student's data and journal files contained in the "Data Files" folder can be copied, moved and/or deleted. The entire folder should be moved rather than individual files.

    It is also a good practice to keep unrelated files or folders out of the "Biopac Student Lab" folder.

3. If students gather a basic understanding of the Biopac Student Lab software before starting the first lab, they'll have a much better chance of recording good data and having a positive experience. We recommend that Students download our free Analysis only software (Mac or Windows) which also provides lesson preparation material. At the very least, Students should review the BSL Tutorial video here. If this is not an option, then Students should review the Biopac Student Lab Tutorial (under the Help menu) to obtain a basic understanding of how the Biopac Student Lab works.

4. Each student's recording is automatically saved at the end of each lesson. Students do not need to resave the file unless they make a change to the Journal or the data window settings while in the Review Saved Data (Analysis) mode.

    *   It is recommended that students **use the "Save Changes" option** under the **File** menu rather than the "Save As" option. This will ensure that the student's files are saved to the location specified for the lab (computer hard drive, school network, etc). Saving in this way to a consistent location will help manage the files/folders and prevent student errors.

    *   If students wish to take a file home for analysis, simply copy the file to a flash drive or other media, or email the file. The files can also be shared to any Dropbox account by choosing the Dropbox options in the File menu. (BSL 4.1 and higher)

5. If time permits, students are advised to read the "Beyond Basics" section and follow along on the computer with the Sample Data file.

Typically, labs work most efficiently with three or more students working per station. Usually a more experienced student runs and calibrates the equipment, another student acts as the Subject for transducer attachment, another takes notes, and there are often one or more students that act as observers.

The BSL System is designed to allow at least four students to record and save data in a normal lab period (60-90 minutes). The Lessons are broken down into four main sections: **Introduction**, **Recording**, **Analysis**, and **Data Report**. The **Recording** section includes the Set Up and Calibration procedures. The Lesson Procedure PDFs and onscreen Lesson Journal instructions will guide students through the recording steps in order to ensure that high quality data is collected and saved.

The **Analysis** section can be looked at as a separate step. If time permits in the normal lab period, the students can go right from recording to analysis. However, to relieve perceived time pressure, we allow the student to copy their data and analyze it later on their own time, with their own computer if they wish.

If the BIOPAC data acquisition unit (MP36/35/46/45) is unavailable or not connected to the computer, students may still run the BSL application in "Review Saved Data" mode. This allows full analysis of previously recorded data. Many schools using our equipment keep the program and data files available on a server for review after the lab session.

Our lesson procedures contain exercises or tasks to perform for each lesson. These descriptions are reflected in the easy-to-follow onscreen Journal while the lesson is running. If the instructor prefers to use a different description for a lesson, instruct the students running the lesson to go to "**File**" menu and select "**Lesson Recordings**" from the "**Preferences**" option. Then deselect all of the Lesson Recording checkboxes. This will turn off the lesson specific text.

Instructors can then use their own lab manual with the BSL lessons or integrate the BSL Lab Manual into theirs (contact the Sales Department at BIOPAC Systems, Inc. for details).

Instructors may further customize lesson procedures and even onscreen Journal instructions with the BSL Curriculum Management System, a licensed feature available in BSL versions 4.1 and higher for advanced lesson customization. See page 70 for further details on the Curriculum Management System, or contact BIOPAC for more information.

We understand that the default lessons may not offer the flexibility desired by some users. For more complicated operations, we include the Biopac Student Lab *PRO* software. It is very similar software to that used on our Research System, and allows the user to mix and match any of the four channels, define the recording parameters and perform advanced analysis. These parameters may be saved as graph templates for future recordings. For more details on BSL *PRO* software, see your BSL *PRO* Tutorial, or the BSL *PRO* Software Manual.

Support Materials are available

Use the Biopac Student Lab **Help Menu** PDFs and visit the Support section of our web site at www.biopac.com for more support materials.

See a demo of the **Biopac Student Lab** in action here.

Help
Open Quick Guide
Open BSL Tutorial
Support Materials from Web
Open Lesson Introduction
Open Lesson Procedure
About Biopac Student Lab…
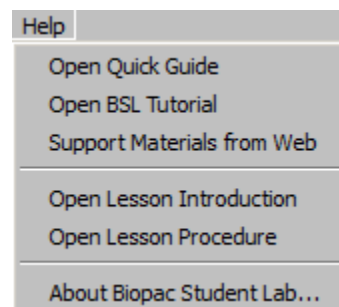
Please do not hesitate to contact us with your concerns or comments.
We're eager to work with you to create ***total solutions***
for your life science application and research needs.

Human Anatomy & Physiology Society Position Statement on Animal Use

(Adopted July 28, 1995, Modified January 2001, Approved April 29, 2012)

It is the position of the Human Anatomy and Physiology Society (HAPS) that dissection and the manipulation of animal tissues and organs are important elements in scientific investigation that introduce students to the excitement and challenge of their future careers. HAPS supports the use of biological specimens as part of a program of study, provided their use is in strict compliance with federal legislation and the guidelines of the National Institutes of Health and the United States Department of Agriculture, and that such use fulfills clearly defined educational objectives.

The mission of the Human Anatomy and Physiology Society (HAPS) is to promote excellence in the teaching of anatomy and physiology. A fundamental tenet of science is the ordered process of inquiry requiring careful and thoughtful observation by the investigator. As subdivisions of biology, both anatomy and physiology share a long history of careful and detailed examination, exploration and critical inquiry into the structure and function of the human and animal body.

Consistent with the origins and nature of scientific inquiry, HAPS endorses the use of animals as part of the laboratory experiences in both human anatomy and human physiology.

Historically, an important tool of investigation in human and animal anatomy has been dissection. A complete anatomy learning experience that includes dissection goes beyond naming structures and leads the student to conclusions and insights about the nature and relatedness of living organisms that are not otherwise possible. To succeed in their future careers, students must become thoroughly familiar with anatomical structures, their design features and their relationships to one another. Dissection is based on observational and kinesthetic learning that instills a recognition and appreciation for the three-dimensional structure of the animal body, the interconnections between organs and organ systems, and the uniqueness of biological material. Dissection conveys the inherent variability of living organisms not otherwise observable in simulations and models. Physiology experiments involving humans and live animals provide an excellent opportunity to learn the basic elements specific to scientific investigation and experimentation. It is here that students pose questions, propose hypotheses, develop technical skills, collect data, analyze results and develop and improve critical thinking and problem solving skills

Since effective teaching requires a diversity of strategies and approaches, HAPS endorses the use of computer atlases and simulations, modeling, and video programs to meet educational objectives and the needs of students. Science educators choosing not to use animals or biological specimens should choose alternatives that are able to convey equivalent anatomical and physiological intricacies to meet their educational objectives.

Science educators have in common a respect and reverence for the natural world and therefore have a responsibility to share this with their students. They must communicate the importance of a serious approach to the study of anatomy and physiology. HAPS also encourages educators to be responsive to student concerns regarding use of animals and to provide students who object to animal use with alternative learning materials.

HAPS contends that science educators should retain responsibility for making decisions regarding the educational uses of animals and other strategies and techniques for the betterment of their student's learning. Furthermore, it opposes any legislation or administrative policy that would erode the educator's role in decision making or restrict dissection and animal experimentation in biology.

Used with permission of:
The Human Anatomy & Physiology Society (HAPS)
251 S. L. White Blvd., P. O. Box 2945, LaGrange, GA 30241-2945
800-448-HAPS (4277)   Fax: (706) 883-8215   www.hapsweb.org

IMPORTANT SAFETY NOTICE

BIOPAC Systems, Inc. instrumentation is designed for educational and research oriented life science investigations.

BIOPAC Systems, Inc. does not condone the use of its instruments for clinical medical applications.

Instruments, components, and accessories provided by BIOPAC Systems, Inc. are not intended for the cure, mitigation, treatment, or prevention of disease.

The MP data acquisition unit is an electrically isolated data acquisition system, designed for biophysical measurements.

Exercise extreme caution when applying electrodes and taking bioelectric measurements while using the MP System (MP36, MP35 or MP46/45) with other external equipment that also uses electrodes or transducers that may make electrical contact with the Subject.

Always assume that currents can flow between any electrodes or electrical contact points.

Extreme caution is also required when performing general stimulation (electrical or otherwise) on a subject. Stimulation currents should not be allowed to pass through the heart.

It is very important (in case of equipment failure) that significant currents are not allowed to pass through the heart. If electrocautery or defibrillation equipment is used, it is recommended that all BIOPAC Systems, Inc. instrumentation be disconnected from the Subject.

Setting Up Your Lab

To set up your lab, you will need the following items:

- Biopac Student Lab 4 software download.
- MP36 (or MP35 or MP46/45) Data Acquisition hardware, power supply and USB cable (included).
- SSL transducers, electrodes and lab materials necessary for running the various BSL Lessons.
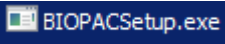- Administrator access to all lab computers.

Before you begin:

PLEASE DO NOT CONNECT OR POWER ON YOUR MP HARDWARE UNTIL PROMPTED DURING SOFTWARE INSTALLATION. THIS MAY RESULT IN INCOMPLETE DRIVER INSTALLATION.

BSL Software & MP Driver Installation

Windows

a) Download the Biopac Student Lab installation software from the link provided by your BIOPAC representative.

b) Double-click the **BIOPACSetup.exe** icon in the installation folder and follow the installation prompts. The Biopac Student Lab program is large (1.5 gb) and this operation may take several minutes.

   Windows default installation directory (with C representing the main drive):
   C:\Program Files (x86)\BIOPAC Systems, Inc\Biopac Student Lab 4.1

c) When prompted, select the desired MP hardware type(s) being used in the lab. (MP36/35/46/45)

   The selected MP driver will be installed or updated automatically. The MP unit(s) must be present and ready to connect and power on in order to complete driver installation. (If MP hardware and drivers have been installed previously and are known to be current, you may cancel the driver installation and continue to step "e".)

d) Connect or power on the MP unit when prompted. For more information on physical hardware connections and other MP hardware functionality, see page 10.

e) Follow the remaining prompts to install the KEYLOK license (if required) and BIOPAC Bonjour Service. (Bonjour Service is required in order for BSL 4.1 to run properly.)

   If your lab has purchased the optionally-licensed BSL Curriculum Management System, see the license activation instructions provided with your license purchase. (Windows only)

Mac

a) Download Biopac Student Lab installation software from https://www.biopac.com/4TEACHER16

b) Double-click the **BiopacStudentLab.pkg** and follow the installation prompts.

c) *Mac* default installation directory: **MacIntosh HD:\Applications\Biopac Student Lab 4.1**

d) No driver installation procedure is necessary for Mac OS X. When software installation is complete, simply connect the MP hardware to a USB port and power it on.

Repeat the above installation steps for all additional lab machines.

Hardware Connections for Recording

To acquire data, the MP Data Acquisition Unit must be connected to the computer and the correct electrodes, transducers, and/or I/O (Input/Output) devices must then be connected to the MP unit. These connections will vary from lesson to lesson. You are encouraged to take a few minutes to familiarize yourself with the MP unit's front and rear panels prior to making any connections.

The front panel of the MP36/35 has an electrode check port, four analog input ports, and two status indicators.

MP3X Front Panel

The channel input ports are on the front of the MP acquisition unit and are labeled CH 1, CH 2, CH 3, and CH 4; the MP46/45 is CH 1 and CH 2 only. The BIOPAC Simple Sensors are connected to these inputs as directed by the lesson procedures. The Biopac Student Lab software will always check to see that you have the proper sensors connected for a particular lesson. (See following page for Simple Sensor information.)

The "**Electrode Check**" port is a diagnostic tool not required for most lessons, but is used optionally in EEG Lessons 3 and 4 to check signal quality prior to calibration.

The back panel of the MP36/35 has an analog output port, a USB port, a 3.5 mm headphone input, an I/O Port, a Trigger Port, a DC input, a fuse holder, a power switch, and the unit's serial number.

MP3X Back Panel

The **Analog Out port** on the back of the MP Unit that allows signals to be amplified and sent out to devices such as headphones.

NOTE: The 2-channel **MP46/45** data acquisition unit does not support triggering or electrode check, and has a 3.5 mm headphone jack in place of an I/O port.

Connecting Devices to the MP Unit

There are three types of input devices that connect to the MP Acquisition Unit as an interface between the subject and the hardware: electrodes, transducers, and I/O devices.

Electrodes are adhesive pads that attach to the surface of the skin and gather electrical signals from the body. Depending on where electrodes are placed, different signal types will be picked up and sent to the MP unit, where they are amplified and sent to the computer and the Biopac Student Lab software.

Electrode lead cables connect to the **electrodes**, directly attached to the subject's skin and record biopotential signals directly from the body.

It is critical that the electrodes be properly applied to the Subject. Poor electrode contact with skin = poor data. On the first day of lab requiring the use of electrodes, instructors should emphasize and demonstrate proper skin preparation and electrode placement. See the Lesson Procedures for guidance on proper application of electrodes.
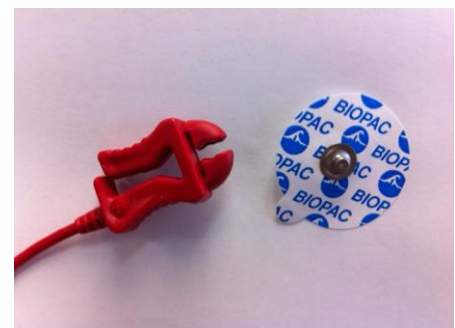
Electrode lead cable clip and electrode

Transducers are hardware that plug directly into an MP unit's channel input and convert a physiological parameter to a proportional electrical signal. An example of this would be the SS5LB Respiratory Transducer, which is a bow-tie shaped transducer attached to an elastic band positioned around the Subject's chest. The transducer records the expansion and contraction of the Subject's respiration cycles.
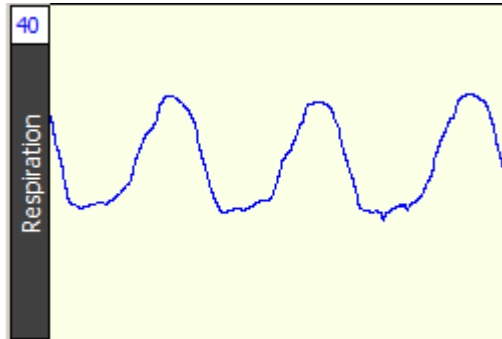
The resulting data is plotted in real time in Biopac Student Lab, where it appears as a waveform in the Lesson graph.

I/O devices are specialized input/output devices (I/O for short), such as push-button handswitches and headphones. The push-button handswitch connects to the front panel of the MP Unit, whereas headphones connect to the Analog Out port (or 3.5 mm headphone jack depending on headphone type) on the back panel of the MP Unit.

Using Simple Sensors

Every electrode lead, transducer, or I/O device connects to the Biopac Student Lab MP acquisition unit using a "Simple Sensor" (SSL) connector. The Simple Sensor connector is designed to plug it into the MP Unit on way only, so it's not possible to plug the connector in upside down. It's not necessary to tighten the thumbscrews on either side of the connector. This makes it easy to change a lesson set up and experiment with different transducers.


Input connection to the MP UNIT

Simple Sensor Connector

For full technical details about MP hardware, transducers and electrodes, see the BIOPAC BSL Hardware Guide.pdf (in the Biopac Student Lab 4.x > 'User Support' folder).

Launching the BSL Lessons Program

<u>*Windows*</u>

Double-click the Biopac Student Lab 4.1 Desktop shortcut (or click "Start > All Programs" and navigate to the Biopac Student Lab 4 program.)
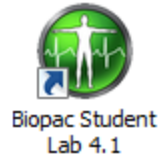
<u>*Mac OS X*</u>

From the Finder, choose "Go > Applications > Biopac Student Lab 4.1" and double-click the BIOPAC BSL 4.1 icon.

The BSL Startup Wizard

Biopac Student Lab Lessons and the full Biopac Student Lab *PRO* application are installed at the same time and both are selectable in a main Startup Wizard window (below right). The "Startup Wizard" window appears by default when the BSL application is launched, and is a "gatekeeper" interface to all BSL Lesson and BSL *PRO* functionality. Let's look at the main "**What would you like to do?**" startup options.

Record or Analyze a BIOPAC Lesson – this is the default Startup selection and presents the BSL Lessons menu and Review Saved Data (analysis) mode. The *PRO* Lessons tab reveals a menu of advanced curriculum lessons

Create/Record a new experiment – Selecting this option launches the application into BSL *PRO* mode, with advanced data acquisition and analysis functionality.

If preferred, the Startup Wizard can be bypassed, and the application can be launched directly to an empty graph window (BSL *PRO*) or to the "classic" Lesson menu (BSL Lessons). To access this preference, choose "Create/Record a new experiment > Display > Preferences > Other" and select the desired launch option (below).
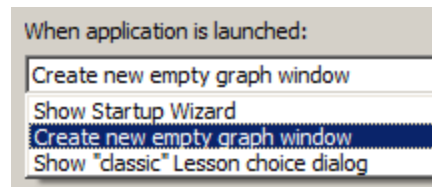
Note that each side of the application must be run individually—it is not possible to run BSL Lessons and BSL *PRO* at the same time.

For the purposes of the following user interface overview, we will use the Startup Wizard navigate to a sample data file.

1. With "Record or Analyze a BIOPAC Lesson" selected, choose "**Review Saved Data**" and click OK.

2. Browse to **C:\Program Files (x86)\BIOPAC Systems, Inc\Biopac Student Lab 4.1\Sample Data\English – en**

3. Choose "**SampleData-L07**" and click OK. (MP hardware is not necessary to run in analysis mode.)

For an overview on running a lesson, see the "**Experimental Methods**" section on page 34.

To open a sample data file in BSL *PRO* analysis mode, which displays the maximum available toolbars and menu options, choose "**Open a graph file**" > "**Sample data file**," select the desired sample data file and click **OK**. Using this file opening method offers access to all BSL *PRO* functionality. For a summary of *PRO*
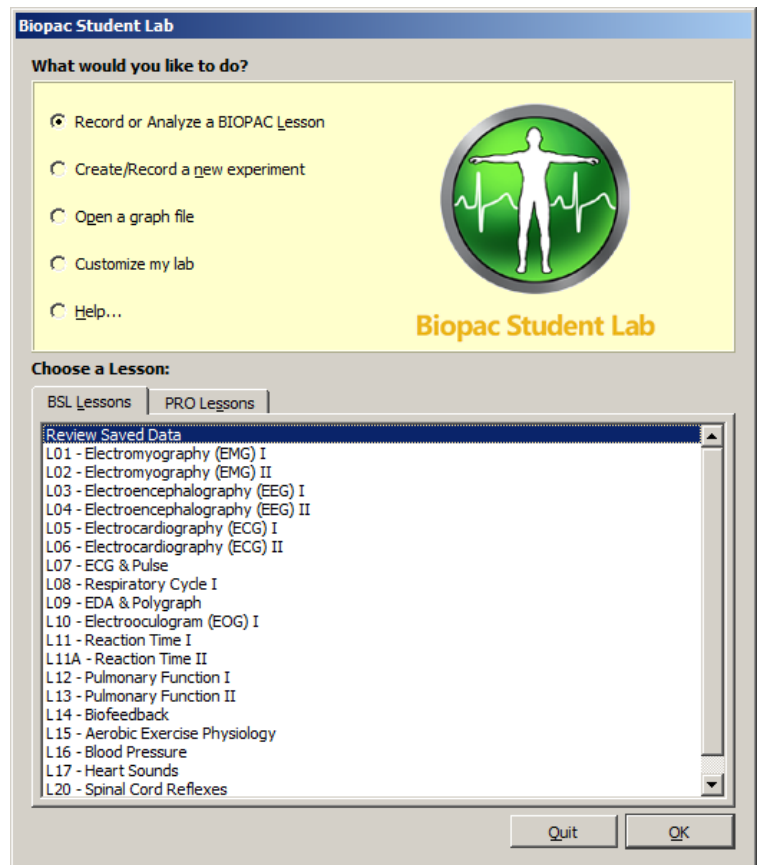
features, see page 67. For detailed information on BSL *PRO* functionality, see the BSL *PRO* Tutorial under the Help menu of the *PRO* application or in the User Support folder.

Graph Window and Lesson User Interface

The Biopac Student Lab software generates two basic display windows: **Graph Window** and **Journal**.
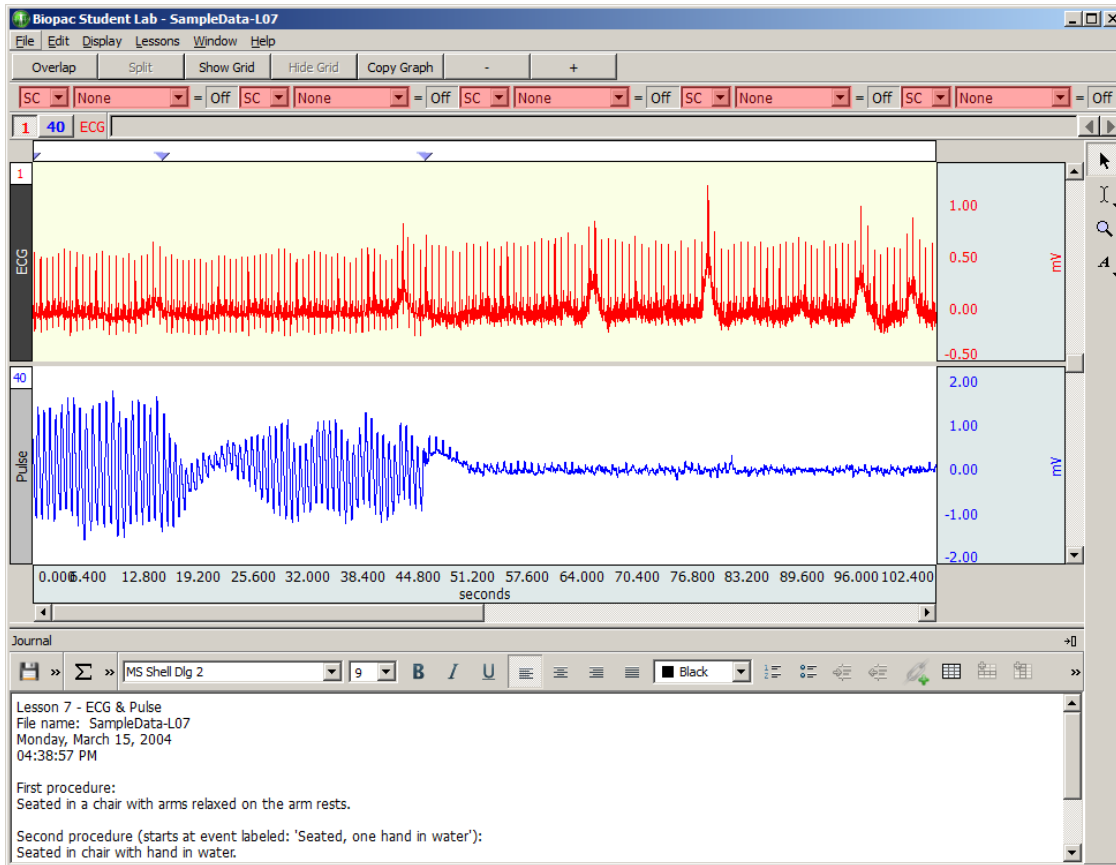
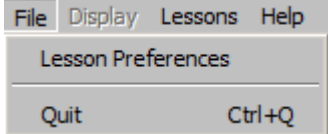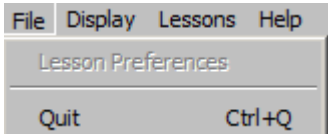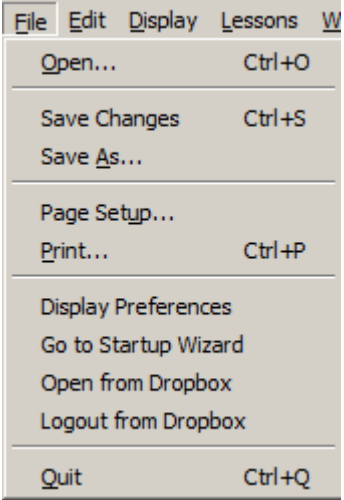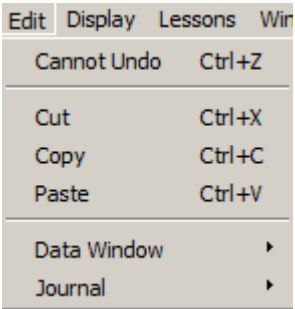***Biopac Student Lab Graph Window and Journal (SampleData-L07)***
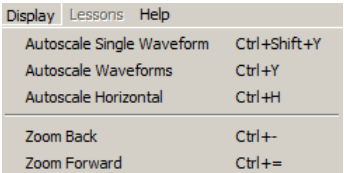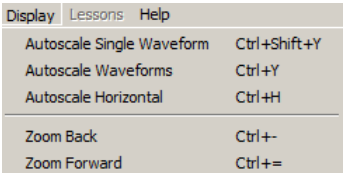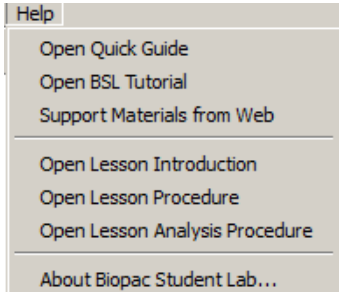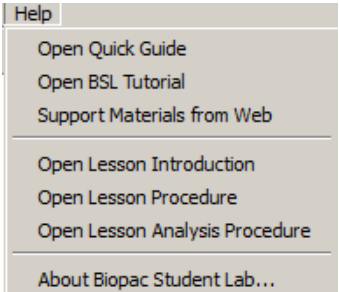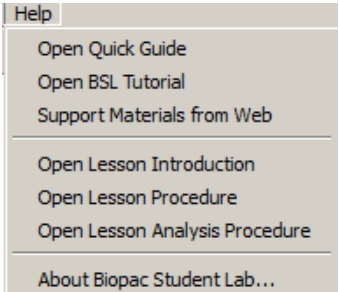
The **graph window** displays the waveform channels during or after recording. Up to eight waveforms (channels) can be simultaneously displayed, as controlled by the software and lesson requirements.

The **Journal** contains lesson text, measurements, tables, links or graphics, which can then be copied to another document, saved or printed. The Journal can be shown or hidden by toggling the "Show/Hide Journal" button on the graph window toolbar. By default, the Journal appears at the bottom edge of the graph, but can also be docked at any edge of the graph window, or be free-floating. To set this option, go to **Display > Preferences > Journal > Display Style** (This preference must be accessed in BSL *PRO* "Create/Record a new experiment" mode.)

Graph window functionality and menu options vary by software mode and is detailed in the following section.

BSL Lessons Menu Options

The BSL Lessons Menu functionality varies by mode as shown below.

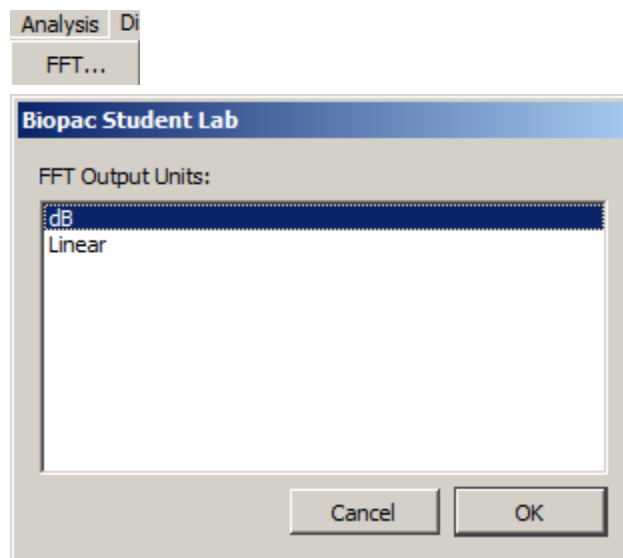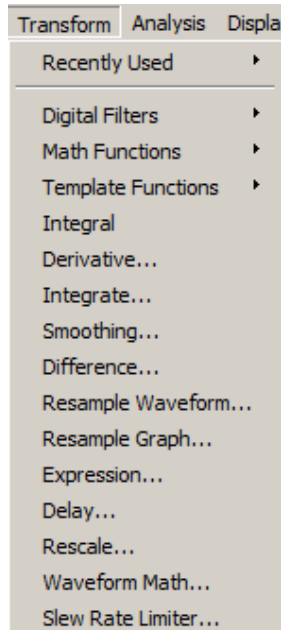| Menu	Calibration	Recording Mode	Analysis Mode
File	Prior to calibration (when lesson is launched) or after "Redo calibration is selected: File Display Lessons Help Lesson Preferences Quit Ctrl+Q During calibration: No menus available. After calibration: File Display Lessons Help Lesson Preferences Quit Ctrl+Q	(File menu not available during or immediately after suspending recording)	File Edit Display Lessons W Open... Ctrl+O Save Changes Ctrl+S Save As... Page Setup... Print... Ctrl+P Display Preferences Go to Startup Wizard Open from Dropbox Logout from Dropbox Quit Ctrl+Q
Edit	Not available during Calibration.	Not available in this mode.	Edit Display Lessons Win Cannot Undo Ctrl+Z Cut Ctrl+X Copy Ctrl+C Paste Ctrl+V Data Window ▶ Journal ▶
Display	Not available during Calibration.	Display Lessons Help Autoscale Single Waveform Ctrl+Shift+Y Autoscale Waveforms Ctrl+Y Autoscale Horizontal Ctrl+H Zoom Back Ctrl+- Zoom Forward Ctrl+=	Display Lessons Help Autoscale Single Waveform Ctrl+Shift+Y Autoscale Waveforms Ctrl+Y Autoscale Horizontal Ctrl+H Zoom Back Ctrl+- Zoom Forward Ctrl+=
Help	Help Open Quick Guide Open BSL Tutorial Support Materials from Web Open Lesson Introduction Open Lesson Procedure Open Lesson Analysis Procedure About Biopac Student Lab... On the Mac, "About…" info is under the **Biopac Student Lab** menu.	Help Open Quick Guide Open BSL Tutorial Support Materials from Web Open Lesson Introduction Open Lesson Procedure Open Lesson Analysis Procedure About Biopac Student Lab... On the Mac, "About…" info is under the **Biopac Student Lab** menu.	Help Open Quick Guide Open BSL Tutorial Support Materials from Web Open Lesson Introduction Open Lesson Procedure Open Lesson Analysis Procedure About Biopac Student Lab... On the Mac, "About…" info is under the **Biopac Student Lab** menu.

Menu	Calibration	Recording Mode	Analysis Mode
Lessons	Lessons Help Review Saved Data L01 - Electromyography (EMG) I L02 - Electromyography (EMG) II L03 - Electroencephalography (EEG) I L04 - Electroencephalography (EEG) II L05 - Electrocardiography (ECG) I L06 - Electrocardiography (ECG) II L07 - ECG & Pulse L08 - Respiratory Cycle I L09 - EDA & Polygraph L10 - Electrooculogram (EOG) I L11 - Reaction Time I L11A - Reaction Time II L12 - Pulmonary Function I L13 - Pulmonary Function II L14 - Biofeedback L15 - Aerobic Exercise Physiology L16 - Blood Pressure L17 - Heart Sounds L20 - Spinal Cord Reflexes	Lessons Help Review Saved Data L01 - Electromyography (EMG) I L02 - Electromyography (EMG) II L03 - Electroencephalography (EEG) I L04 - Electroencephalography (EEG) II L05 - Electrocardiography (ECG) I L06 - Electrocardiography (ECG) II L07 - ECG & Pulse L08 - Respiratory Cycle I L09 - EDA & Polygraph L10 - Electrooculogram (EOG) I L11 - Reaction Time I L11A - Reaction Time II L12 - Pulmonary Function I L13 - Pulmonary Function II L14 - Biofeedback L15 - Aerobic Exercise Physiology L16 - Blood Pressure L17 - Heart Sounds L20 - Spinal Cord Reflexes Data from the recording must be saved before the Lessons menu can be activated. • Menu is only available in lessons with multiple recordings and only after the "Stop" button has been pressed. • In lessons with only one recording, use the "Done" button option to *Record another lesson.*	Lessons Help Review Saved Data L01 - Electromyography (EMG) I L02 - Electromyography (EMG) II L03 - Electroencephalography (EEG) I L04 - Electroencephalography (EEG) II L05 - Electrocardiography (ECG) I L06 - Electrocardiography (ECG) II L07 - ECG & Pulse L08 - Respiratory Cycle I L09 - EDA & Polygraph L10 - Electrooculogram (EOG) I L11 - Reaction Time I L11A - Reaction Time II L12 - Pulmonary Function I L13 - Pulmonary Function II L14 - Biofeedback L15 - Aerobic Exercise Physiology L16 - Blood Pressure L17 - Heart Sounds L20 - Spinal Cord Reflexes

Analysis Mode menus available in Advanced Lesson Preferences

BSL *PRO*-style Transform and an FFT Analysis menus can be added to Lessons Analysis Mode by modifying the BSL *PRO* Advanced Lesson Preferences. See page 24 for more details.

Lesson Graph Window Functionality

BSL Lessons display and graph control functionality varies by the three modes as shown below.

FUNCTION	CALIBRATION	RECORDING	ANALYSIS "Review Saved Data"
Measurement	Normally off.	Defaulted to "none" and normally not used. If required, the lesson will give detailed instructions for use.	Initially defaulted to "none." User must select tools required for Analysis and Data Report.
Data Window	User does not control.	Display is set by the lesson macro; user does not control.	User sets display options for waveform measurements (for up to eight waveforms, as determined by the software and/or required for the lesson).
Grids	Automatic when required by lesson; not controlled by user.	Automatic when required by lesson; not controlled by user.	User can Show, Hide or reformat the grid display.
Journal	Read only.	Read only. Guides user through recording steps.	Becomes a text editor for text and measurement data.
Preferences	Must be set prior to calibration; see page 16	Not available.	Not applicable.
Printing	Not available.	Not available.	All print options available.
Event Markers	Not available.	Automatic for most lessons, user can insert and edit as required.	User can insert and edit.
Save	Not available.	Automatically saved when "Done" button is pressed.	User activated Save options.
X-axis/Y-axis Scales	Not controllable.	Not controllable.	Vertical and Horizontal Scales are adjustable (using Lower/Upper settings)

Lesson Preferences

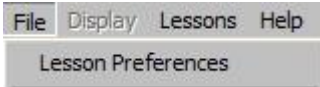Preferences are lesson specific and are saved independently for each lesson, as follows:

PREFERENCE	INCLUDED IN LESSON ("X" indicates the preference is included))																		
	1	2	3	4	5	6	7	8	9	10	11	11A	12	13	14	15	16	17	20
BP Cuff Type																	X		
Calibration Syringe Values													X	X					
Calibration Syringe Size													X	X					
Cardiac Signal									X										
Clench Force Transducer		X																	
ECG Filter					X	X													
ECG Lead II Data																	X		
Grids	X		X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
Gauge Color																	X		
Headphone Volume											X								
Light Intensity											X								
Heart Rate					X	X	X												
Lesson Recordings	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
Residual Volume													X						
Respiration Transducer								X	X										
Response Options																			X
Resting Skin Temp.																X			
SS11LB Calibration Option													X	X					
Temperature Scale																X			
Time Scale					X														

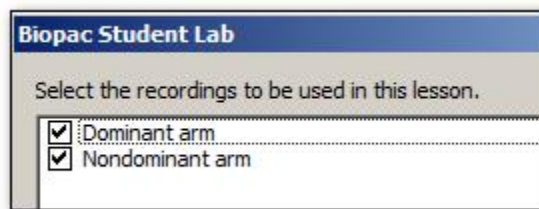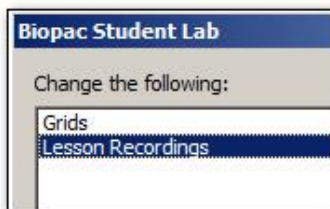**Establish Lesson Preferences <u>before</u> calibrating or recording data.**

Preference settings are stored on the local computer. To ensure that all students use the same Preference settings, you must establish the Preferences before any student begins recording. Any changes to the Preference settings are preserved until manually changed. Limited/Restricted user accounts will run using Preference settings established under the Administrator account.

To change a Lesson Preference:

1. Open a lesson from the Startup Wizard "Choose a lesson" menu or from the "Lessons" menu of an open lesson file. (Lesson 1 – EMG is used in this example.)

2. Click on the **File** menu and select **Lesson Preferences**.

   File Display Lessons Help

   Lesson Preferences

3. Select a Preference option to change and click **OK** to generate the settings dialog**.**

   Biopac Student Lab

   Change the following:

   Grids
   Lesson Recordings

   Biopac Student Lab

   Select the recordings to be used in this lesson.

   ☑ Dominant arm
   ☑ Nondominant arm

   Cancel   OK

4. Choose an option and click **OK**.

<div style="background-color: red; text-align: center;">**IMPORTANT!**</div>

<u>Lesson Preferences are saved when you click OK</u> in the Preference setting dialog, whether or not you record or save the lesson. They do not default back to the factory settings once they have been modified and saved.

This makes it easy for instructors to establish custom Preferences for each lesson based on the lab setup and equipment the students will use; when students open a lesson, the Preferences established by the instructor remain intact.

It is important that the instructor properly set up all of the Lesson Preferences before the application is launched by any user account that does not have WRITE access to the default preference file locations. This is because under this condition, the application will, upon the first launch of a lesson, copy the preference file -
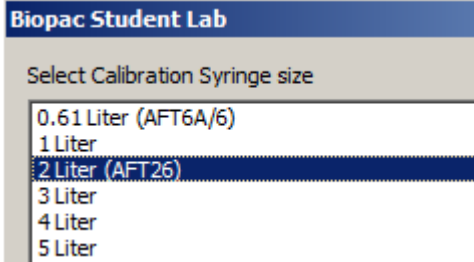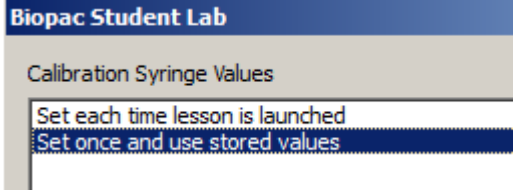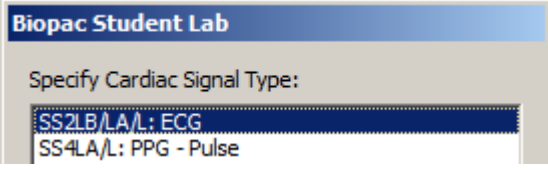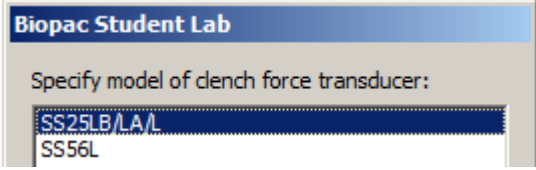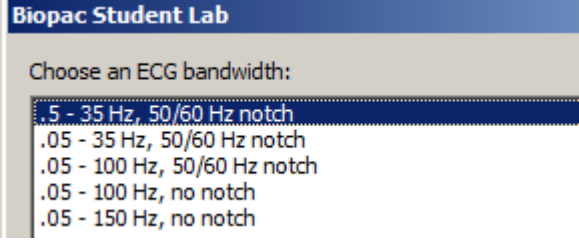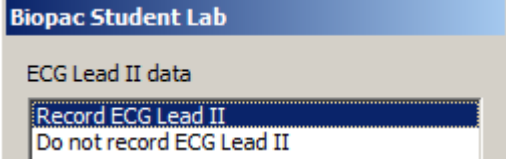
   from

   Main Drive:\Program Files (x86)\BIOPAC Systems, Inc\Biopac Student Lab 4.x\LessonsSupport\all-lang
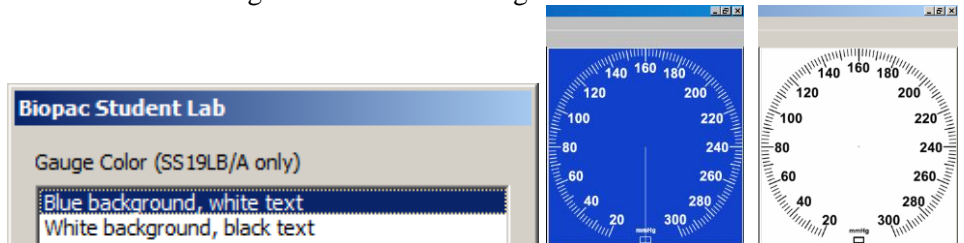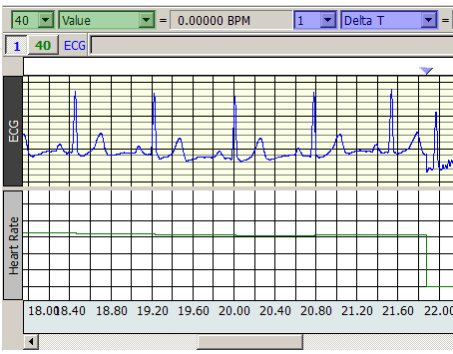
   to

   C or main drive:\Documents and Settings\All Users\Documents\BSL Lessons\Lesson Preferences
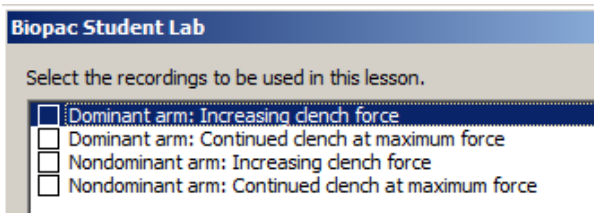
Various Lesson Preference Types

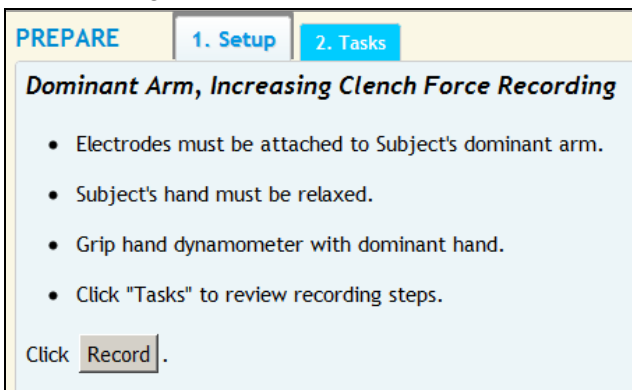| PREFERENCE	EXPLANATION
Blood Pressure Cuff Type (L16)	Select between standard SS19L cuff sphygmomanometer, or SS19LB/LA, which supports onscreen BP gauge.
Calibration Syringe Size (L12, L13)	
Calibration Syringe Values (L12, L13)	Calibration of the syringe assembly can be required only once per session or repeated each time the lesson is launched. (This procedure must always be repeated upon fresh launch of the application)
Cardiac Signal Type (L09)	Choose between ECG or PPG (Pulse) signal type, depending on transducer used.

PREFERENCE	EXPLANATION
Clench Force transducer (L02)	**Biopac Student Lab** Specify model of clench force transducer: SS25LB/LA/L SS56L Choose between SS25L hand dynamometer or SS56L bulb transducer.

ECG Filter (L05, L06)	**Biopac Student Lab**
	Choose an ECG bandwidth:
	.5 - 35 Hz, 50/60 Hz notch
	.05 - 35 Hz, 50/60 Hz notch
	.05 - 100 Hz, 50/60 Hz notch
	.05 - 100 Hz, no notch
	.05 - 150 Hz, no notch
	
	There are multiple ECG filter Preferences so you can select filtering appropriate to the artifact in your lab. The default (0.5-35 Hz with a 50/60 Hz filter) is set for maximized filtering so that if students do not read this description and/or do not understand filtering issues, results will still be reasonable. As you move down the Preference options, filtering is decreased.
	
	About ECG filtering
	
	Most of the frequencies of the ECG signal are in a band from 0 to 150 Hz. Unfortunately, other signals present on the body can also contain frequencies in this band. These other signals, known as "artifact," can distort the ECG signal.
	
	Three of the main sources of ECG artifact are:
	
	  c) EMG (muscle) signals (10 to 5,000 Hz)
	
	  c) Line frequency signals induced onto the body from wires carrying electricity (50 or 60 Hz)
	
	  c) Electrode offset potentials (0 to 1 Hz), known as "baseline drift," caused when electrode contact with the skin varies (due to poor electrode contact, electrode strain, etc.).
	
	The most common way to get rid of the artifact is to use electronic filters to block the frequencies of the artifact but pass other frequencies in the ECG band. This, however, is a tradeoff because the filters may remove some of the desired ECG frequencies, and the filters themselves can cause small distortions in the ECG signal.
	
	The amplitude of the ECG components is not important in many analyses, so filtering is acceptable. Lessons 5 and 6, however, look specifically at the amplitude of the ECG components, so filtering needs to be minimized as much as possible, which means that the ECG artifact must also be minimized if you want a clean signal.
	
	Factors influencing artifact will vary from lab to lab and subject to subject, depending on the lab layout, attention to detail when attaching electrodes and cables to the subject, and the degree of subject movement during recording. It may take some experimentation to determine the best setting for your lab.

ECG Lead II Data (L16)	**Biopac Student Lab** ECG Lead II data Record ECG Lead II Do not record ECG Lead II Provides an option to show or hide ECG data channel.

Gauge Color (L16)	Choose blue or background with contrasting dial.
Grids (All lessons except L02, L11, L11A)	The grid is a series of horizontal and vertical lines that create a visual guide to find data positions with respect to the horizontal and vertical scales. Grids provide a quick visual guide to determine amplitude and duration. Most lessons include the Grids Preference. The Show/Hide options control grid display during recording; grids are not applied during calibration. If you record with grids off, you can still show grids in the analysis mode via the Show Grid/Hide Grid toolbar buttons.
Headphone Volume (L11)	Use to adjust the volume level of the "click" generated in Lesson 11.
Heart Rate Data (L05, L06, L07)	
Lesson Recordings (All lessons except L12, L13)	Enables default lesson recordings to be selected or deselected as desired. Use this option to present an abbreviated subset of lesson recordings.

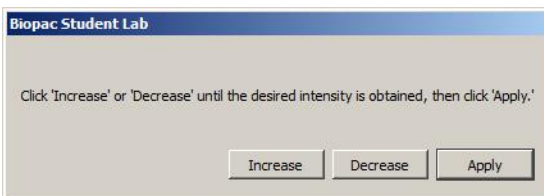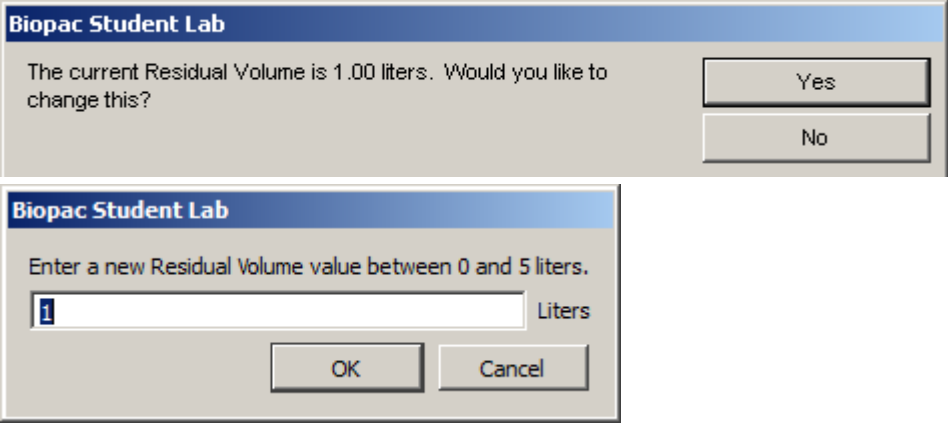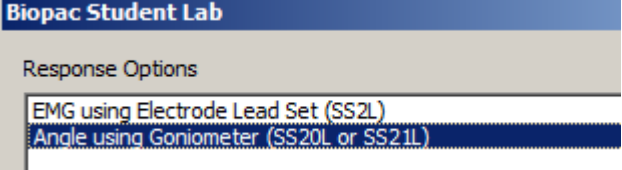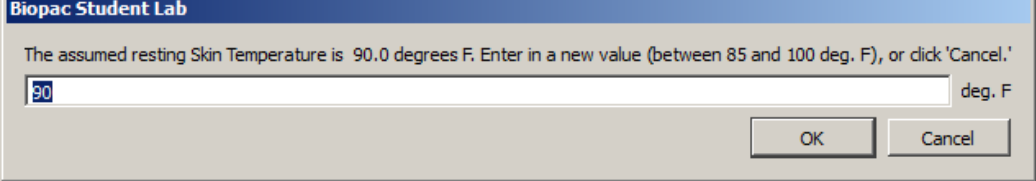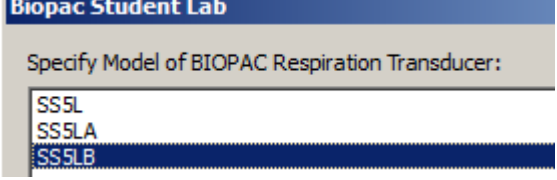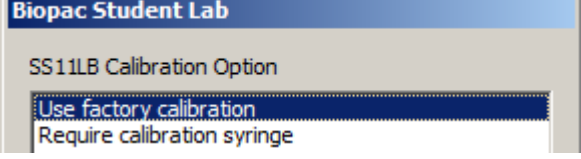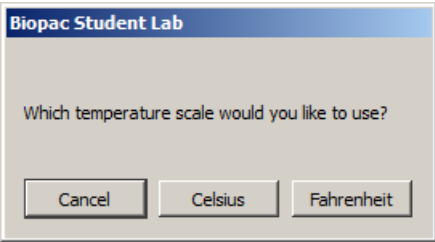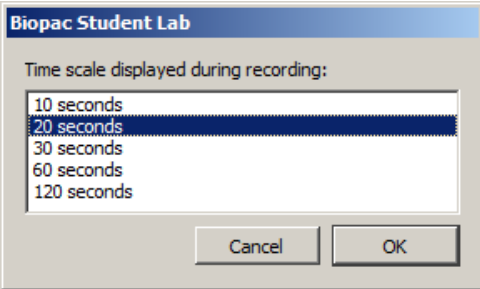|	
Limiting Lesson Recordings and suppressing default Journal Text (All lessons except L12, L13)	**Biopac Student Lab** Select the recordings to be used in this lesson. ☐ Dominant arm: Increasing clench force ☐ Dominant arm: Continued clench at maximum force ☐ Nondominant arm: Increasing clench force ☐ Nondominant arm: Continued clench at maximum force The minimum amount of HTML Journal text can be shown by deselecting all available lesson recordings and clicking OK. **PREPARE** 1. Setup 2. Tasks **Dominant Arm, Increasing Clench Force Recording** • Electrodes must be attached to Subject's dominant arm. • Subject's hand must be relaxed. • Grip hand dynamometer with dominant hand. • Click "Tasks" to review recording steps. Click Record . *Default Journal text option (at least one lesson recording must be selected)* ** <u>Showing only the minimum amount of Journal text</u> hides all lesson specific text and shows only the software control text (button functions, recording time, etc.). No Marker text will be displayed, and Journal functions in the Review Saved Data mode will be limited. **Use this if you have written your own lab procedure** and want students to follow your separate instructions. **PREPARE** **Prepare for Recording** • Prepare the Subject and any materials for the recording. • Click Record . • If all recordings have been completed, click Stop to end the Lesson. *Journal text with no lesson recordings selected* For detailed customization options, use the **Biopac Student Lab** *PRO* software (see page 67 for details). For advanced lesson customization options that exceed the scope of standard lesson customization, see the BSL Curriculum Management System (licensed functionality), details on page 70.
Light Intensity (L11A)	**Biopac Student Lab** Click 'Increase' or 'Decrease' until the desired intensity is obtained, then click 'Apply.' Increase Decrease Apply Use to adjust the brightness level of the LED blink generated in Lesson 11A.
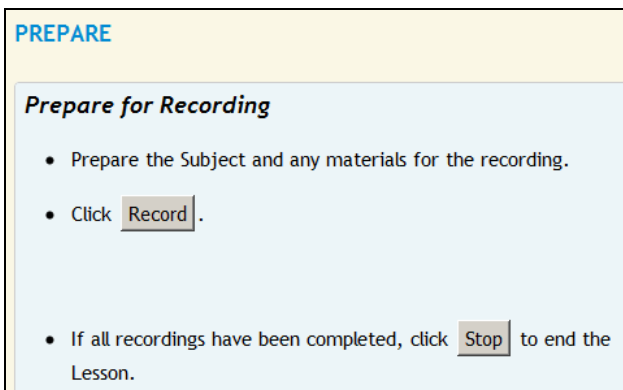
Residual Volume (L12)	**Biopac Student Lab** The current Residual Volume is 1.00 liters. Would you like to change this? [Yes] [No] **Biopac Student Lab** Enter a new Residual Volume value between 0 and 5 liters. `1` Liters [OK] [Cancel] Residual Volume (RV) cannot be determined using a normal spirometer or airflow transducer, so the Biopac Student Lab software lets you enter this value manually. The default setting is 1 Liter. The maximum value is 5 Liters; a warning dialog will appear if a value greater than 5 Liters is entered.
Response Options (L20)	**Biopac Student Lab** Response Options EMG using Electrode Lead Set (SS2L) Angle using Goniometer (SS20L or SS21L) Used to select the response type transducer for measuring leg movement in Lesson 20.
Resting Skin Temperature (L15)	**Biopac Student Lab** The assumed resting Skin Temperature is 90.0 degrees F. Enter in a new value (between 85 and 100 deg. F), or click 'Cancel.' `90` deg. F [OK] [Cancel] The BIOPAC thermistor (SS6L) accurately measures temperature in relation to a starting value (the assumed resting skin temperature). For Lesson 15, the *relative* temperature is sufficient, so calculations using the assumed value are fine. If *absolute* accuracy is required, enter an accurate starting value (from a digital thermometer or other temperature device) rather than using the assumed value.
Respiration Transducer (L08, L09)	**Biopac Student Lab** Specify Model of BIOPAC Respiration Transducer: SS5L SS5LA SS5LB Specify the SS5L model number; settings will be optimized for your selection.
SS11LB Calibration (L12)	**Biopac Student Lab** SS11LB Calibration Option Use factory calibration Require calibration syringe Use to set calibration preferences if SS11LB Airflow Transducer is used.

|	
Temperature scale (L15)	**Biopac Student Lab** Which temperature scale would you like to use? [Cancel] [Celsius] [Fahrenheit] The vertical scale will display your selection.
Time Scale (L05, L06)	**Biopac Student Lab** Time scale displayed during recording: 10 seconds 20 seconds 30 seconds 60 seconds 120 seconds [Cancel] [OK] Use to set the length of the visible horizontal time scale in the lesson (x-axis).

Lesson Customization Options

Setting which Lessons appear in the Program (Showing/Hiding Lessons)

Lessons can be shown or hidden as desired in the BSL *PRO* application preferences. If certain lessons aren't to be used in a particular curriculum, they may be "removed" from the Startup Wizard or Lessons menu via the following steps:
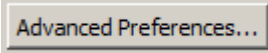
1. Launch the BSL *PRO* application (choose "Create/Record a new experiment in the Startup Wizard).

2. Go to Display > Preferences or click the "Preferences" toolbar button ⚙.

3. Select "Lessons" in the Preferences menu.

4. Simply check or uncheck lessons as desired and click OK. Unchecked lessons will not appear in the startup menus.
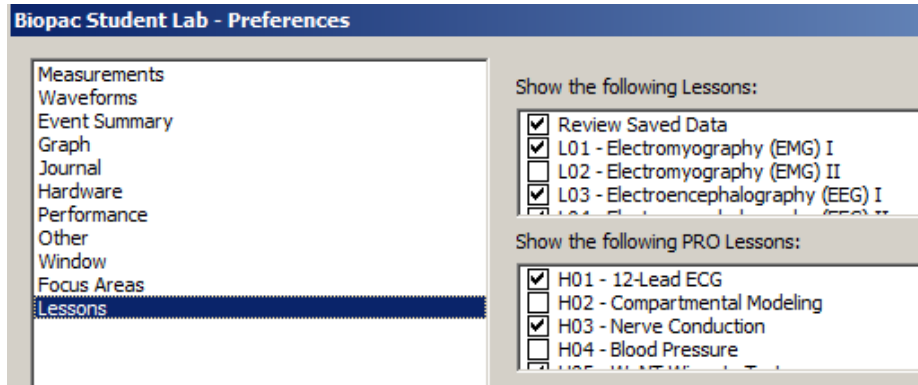
NOTE: Unless the optional BSL Curriculum Management System is installed, modified Lessons preferences apply to the local machine only and must be performed on each workstation.
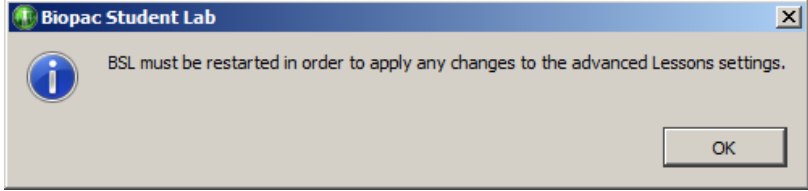
Global Lesson Preference Settings – BSL 4.1.3 and higher:

In BSL 4.1.3 and higher, many default BSL Lessons Global Preference settings for can be easily modified to include enhanced functionality. This is accomplished by selecting the desired options in the BSL *PRO* "Advanced Lesson Preferences" dialog. To access the Advanced Lesson Preferences:

1. Launch the BSL application and select "Create/Record a new experiment" in the Startup Wizard.

2. Go to Display > Preferences > Lessons and click the Advanced Preferences... button to launch the Advanced Lessons Settings setup screen:

🌑 Biopac Student Lab
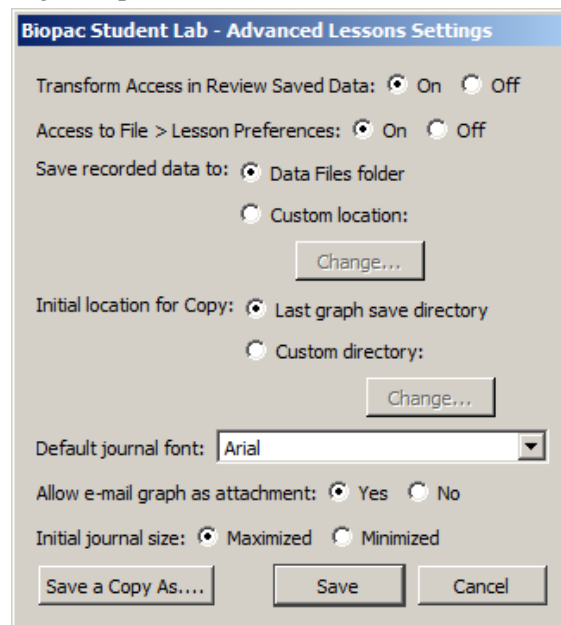
The following Advanced Lessons Settings controls are available:

Transform Access in Review Saved Data:	Adds the BSL *PRO* Transform menu and FFT analysis* to BSL Lesson files opened in Review Saved Data mode.
Access to File > Lesson Preferences:	Controls whether students have access to the BSL Lesson Preferences menu item while running a lesson.
Save recorded data to:	Controls whether lesson files are saved to the default Data Files folder or to a user-defined location. Choosing "Custom location" enables the "Change" button for choosing the new Save location.
Initial location for Copy:	Controls where the BSL Lessons "Copy to another location" option saves the copied file. "Last graph save directory" saves the copy to the most recent location the data file was saved to. Choosing "Custom location" enables the "Change" button for choosing a new "copy to" location.
Default journal font:	Selects the default font used for all lesson journals.
Allow e-mail as graph attachment:	Controls whether students have access to the BSL Lessons "File > Email graph as attachment" menu item.
Initial journal size:	Sets the default Journal size to maximized or minimized for the Lesson file under analysis.
Save a copy as…	Creates a file containing a copy of all selected Lessons preferences. This file can be opened in Notepad or any other text editor. It can also be used as a lesson preference setting file for adding *PRO* functions to the BSL Analysis-only version.
Save	Saves all selected settings and applies them to all subsequent BSL Lesson files opened in Review Saved Data mode. Note that modified settings are not applied until the BSL application is closed and relaunched.
Cancel	Dismisses any modified settings without applying them.

*For details about the Transform menu and FFT analysis, see the BSL *PRO* Manual.

To modify global lesson preference settings in BSL versions 4.1.2 and earlier, see the next section.

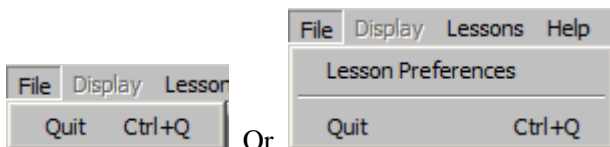### Global Lesson Preference Settings – BSL 4.1.2 and earlier:

To modify the default Lessons preferences in BSL 4.1.2 and earlier, it's necessary to manually edit the BSL Lessons global Preference text file (LessonPrefSettings.txt) which holds the instructor-established Preference options. This Preference file can be found here:

Main Drive:\ProgramData\BIOPAC Systems, Inc\Biopac Student Lab 4.x\LessonsSupport\all-lang

The instructor can either allow or disallow student access to the Preference settings.

Instructor Editable Variables for lesson customization
Show or hide lessons in menus and Startup Wizard (see above)
Review Saved Data Mode options (add BSL *PRO* functionality)
Preference menu (lock lesson setup so students follow your Preferences)
Location for saving lesson data file
Location for "Copy to another location" function
Font style for journal text display
Modify Journal Data Report content (*.jcq files) See Data Report, page 41.
Turn 'Email Graph as Attachment' on or off

These customization features allow you to choose the program features to display as menu options. If you have a specific procedure in mind, you can limit the menu options to list only those functions you need, thereby reducing the chances for confusion or error. For instance, you might choose to remove the **Preferences** option to lock the setup to your established protocol. With simple text editing of the startup script, you can control the program features accessible to your students. You can show or hide the **Preferences** menu and can control the **analysis functions** available in Review Saved Data mode by allowing basic BSL functions or BSL *PRO* functionality.
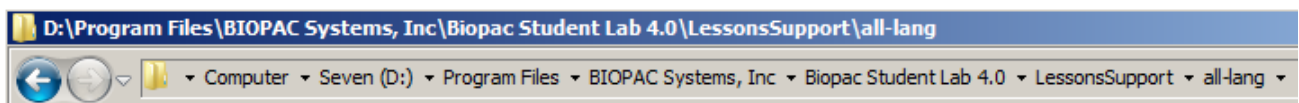
Preferences Menu

Or

Review Saved Data Mode

Or
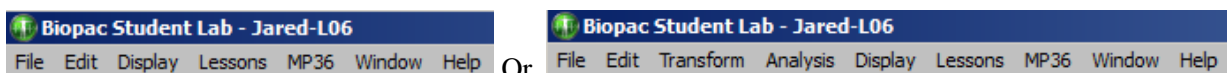
### Customizing Preferences (BSL 4.1.2 and earlier)

Follow this simple procedure to customize menu display for your own needs.

1. Navigate to the LessonPrefSettings.txt file.
   - **Windows** default: Drive>:\Program Files\BIOPAC Systems, Inc\Biopac Student Lab 4.x\LessonsSupport\all lang
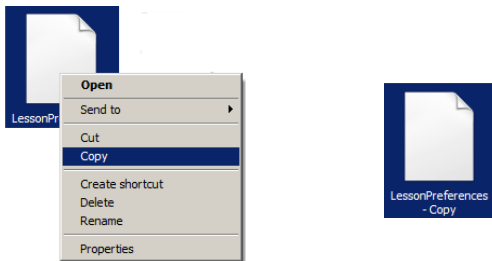

   - **Mac** default installation: Finder > Applications\Biopac Student Lab 4.x.
     o Highlight "Biopac Student Lab 4.x" and choose "Show Package Contents".
     o Browse to LessonsSupport\all lang\

2. Open the BSL Lessons folder.
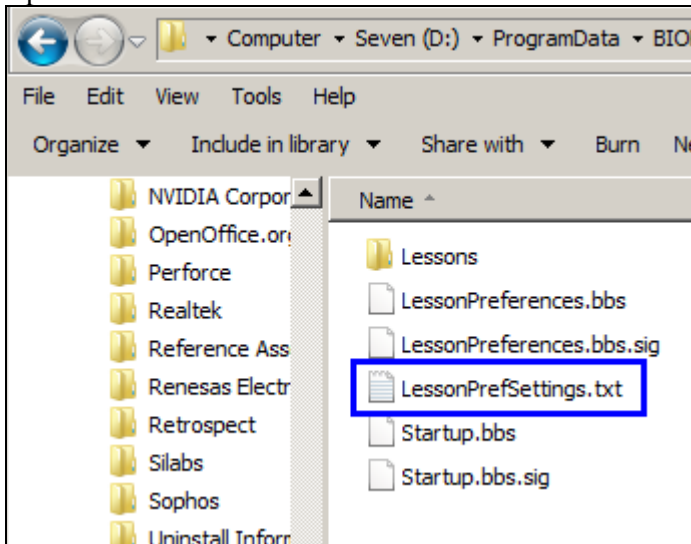
3. Copy the LessonPrefSettings.txt file as follows:

   a.) Right-click and scroll to select "Copy."

   b.) Right-click and scroll to select "Paste."

4. **Windows users:** choose a compatible text editor and right-click to choose "Run as administrator" to enable required save permissions.

Sample errors for Windows OS when not opening or saving as "administrator"

⬤ Biopac Student Lab
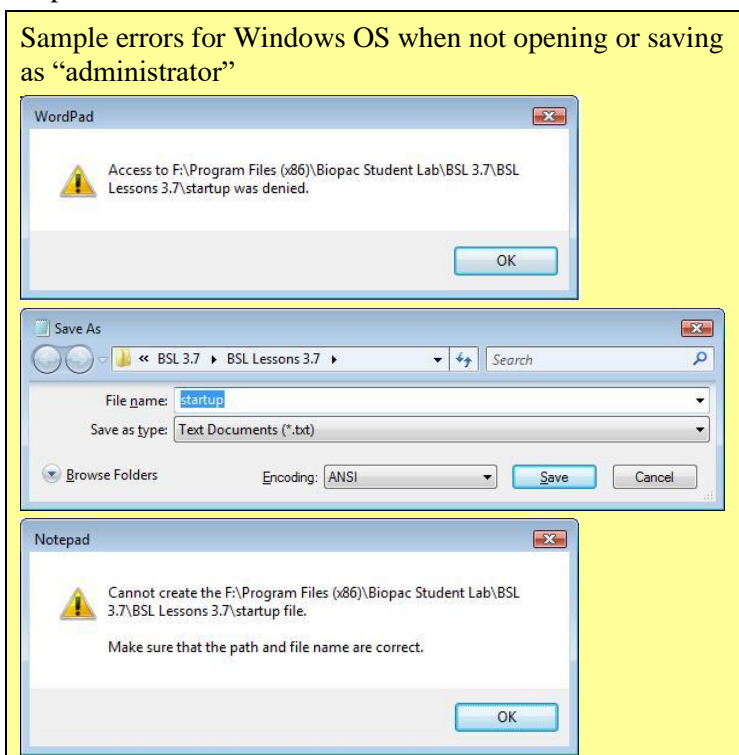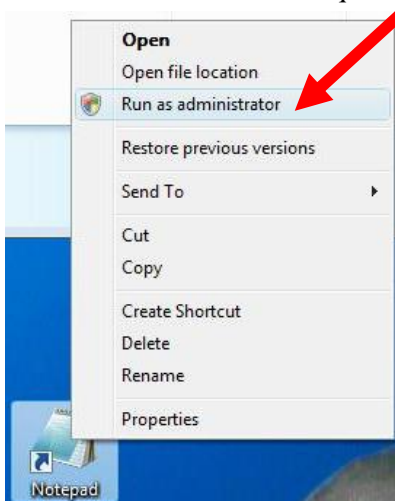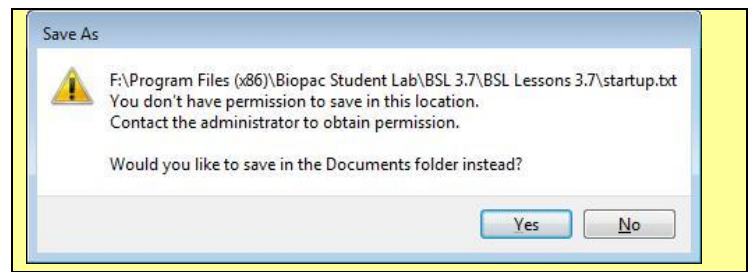
5. Open the original LessonPrefSettings file ("Copy of LessonPrefSettings" is for backup) with a compatible text editor.
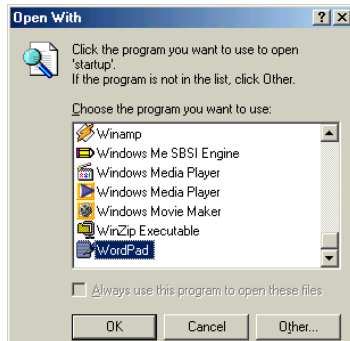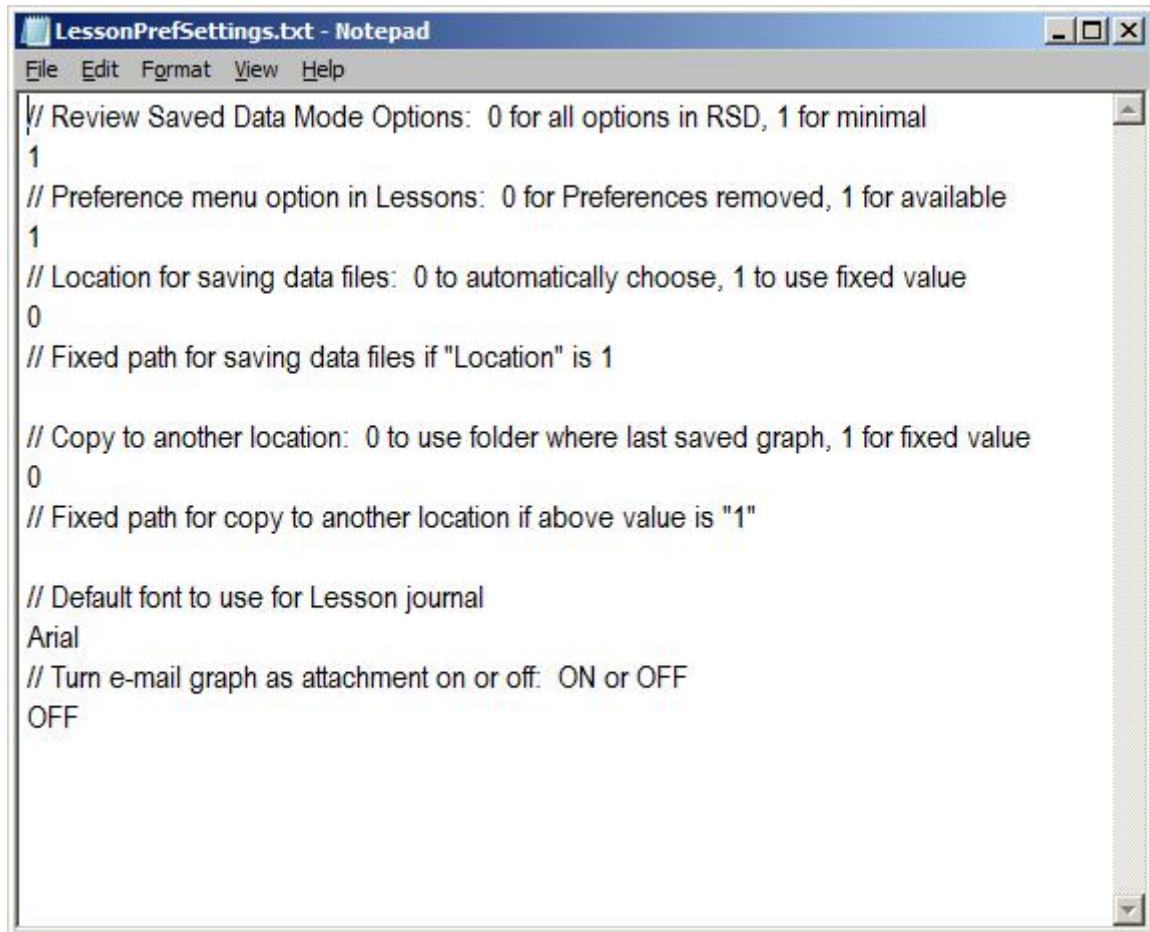

Windows OS: Microsoft **WordPad** or **Notepad**

Mac OS: To edit the LessonPreferences file on a Mac, you must use a text editor that will retain the **type/creator code** "**AcqP/AcqS**" when saving the file; the application will not recognize preference files without this type/creator code.

- TextWrangler™ from Bare Bones Software, Inc. is a compatible freeware text editor. http://www.barebones.com/products/textwrangler/index.s html
- If the type/creator code is lost, use ResEdit or another Macintosh resource editor to manually set the code.

6. Follow the instructions provided in the LessonPrefSettings file (as shown on the following page) to change the Instructor Editable Variables.

    * The LessonPrefSettings or Startup script is sensitive to syntax errors, font change, name change, etc., so **be extremely careful** not to change anything except the "1" or "0" on the line that contains the menu item you want to change.

    * Remember to use **File > Save** (*not* Save As!) to save your changes so the script file name is exactly the same — the program will not recognize an altered file name.

    * Select **File>Save** to save the revised Startup file.

    * If you receive an "access denied" prompt when attempting to save the LessonPrefSettings.txt file, reopen the file by right-clicking it and choose the "Run as administrator" from the contextual menu before modifying and saving it.

    * DO NOT USE the "SAVE AS" option.

    * Restart the BSL 4 program.

7. Check your menu listing.

    * The menus on page 26 show the result of changing the **Review Saved Data Mode Options** and the **Preference Menu Option** per step 6 above. Note that the Preferences option is no longer included in the menu listing (rather than simply being disabled and grayed-out).

8. If you have the desired menu result, you may delete "Copy of LessonPrefSettings.txt" from the program folder.

LessonPreferences file – BSL 4


```
LessonPrefSettings.txt - Notepad

File   Edit   Format   View   Help

// Review Saved Data Mode Options:  0 for all options in RSD, 1 for minimal
1
// Preference menu option in Lessons:  0 for Preferences removed, 1 for available
1
// Location for saving data files:  0 to automatically choose, 1 to use fixed value
0
// Fixed path for saving data files if "Location" is 1

// Copy to another location:  0 to use folder where last saved graph, 1 for fixed value
0
// Fixed path for copy to another location if above value is "1"

// Default font to use for Lesson journal
Arial
// Turn e-mail graph as attachment on or off:  ON or OFF
OFF
```

Changing the Default Location for Saving Lesson Data Files (BSL 4.1.2 and earlier)

The default path used by BSL for saving Lesson data files is: **Drive:\Users\Public\Documents**.

If desired, the default save path can be changed by making some simple edits to the "**LessonPrefSettings.txt**" file. Note that in order to edit this file, Administrator privileges are necessary.

To change the default lesson file path:

1. Decide where you would like the lesson data files to be saved and create a folder in that directory.

2. Browse to the "**LessonPrefSettings.txt**" file in Program Files:

Drive:\Program Files (x86)\BIOPAC Systems Inc\Biopac Student Lab 4.1\LessonsSupport\all-lang
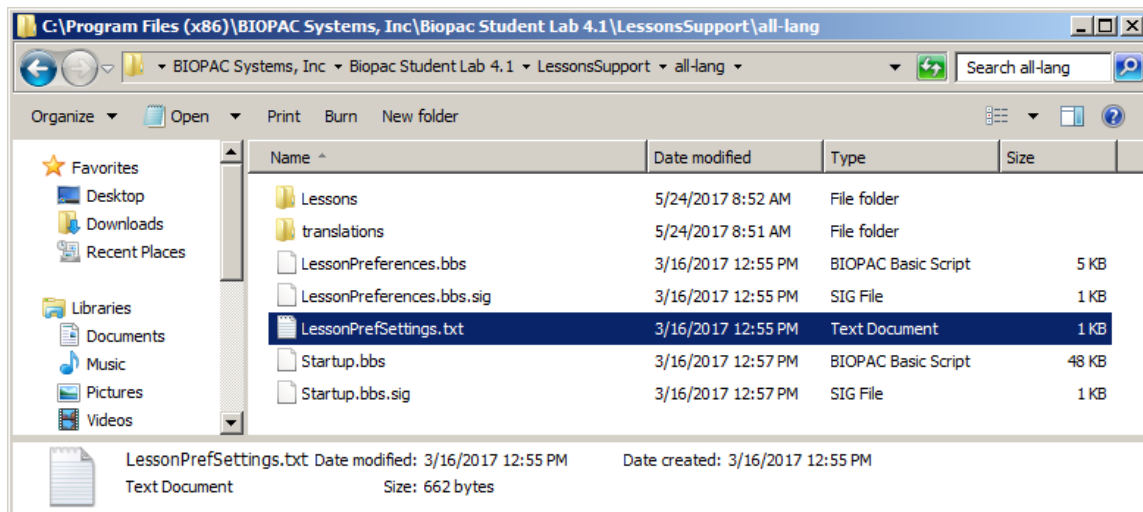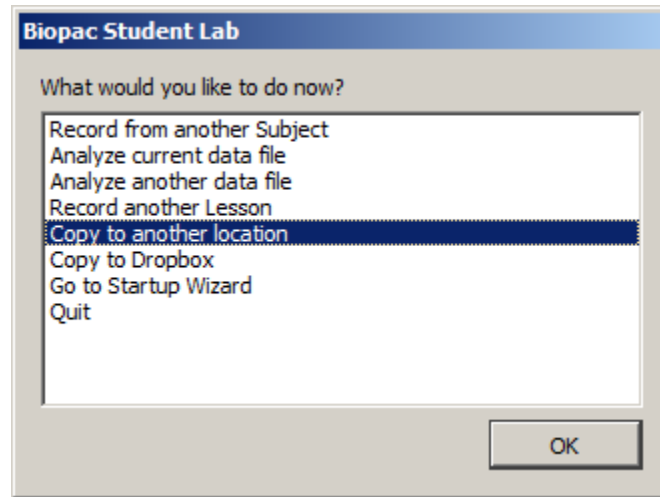

3. Double click the "**LessonsPreSettings.txt**" file to open it in Notepad (or any text editor).

4. Change the "**Location for saving data files**" value to "1" as shown below example.

5. Enter your new file path into the space below the "Fixed path for saving data files…" line. (Note that the file path shown below is for example purposes only. Your file location may be different.)
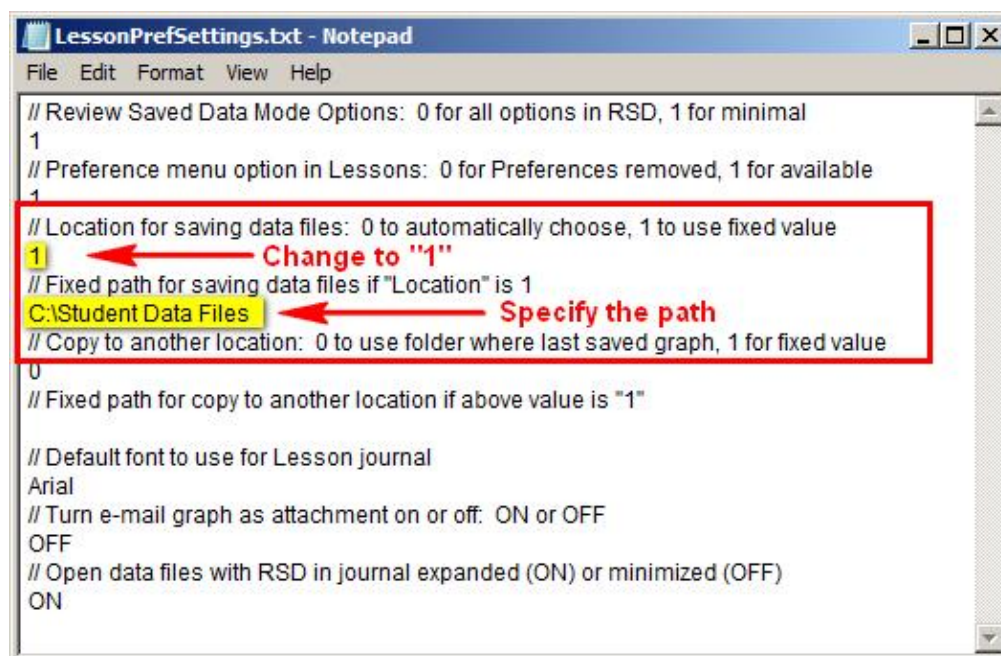
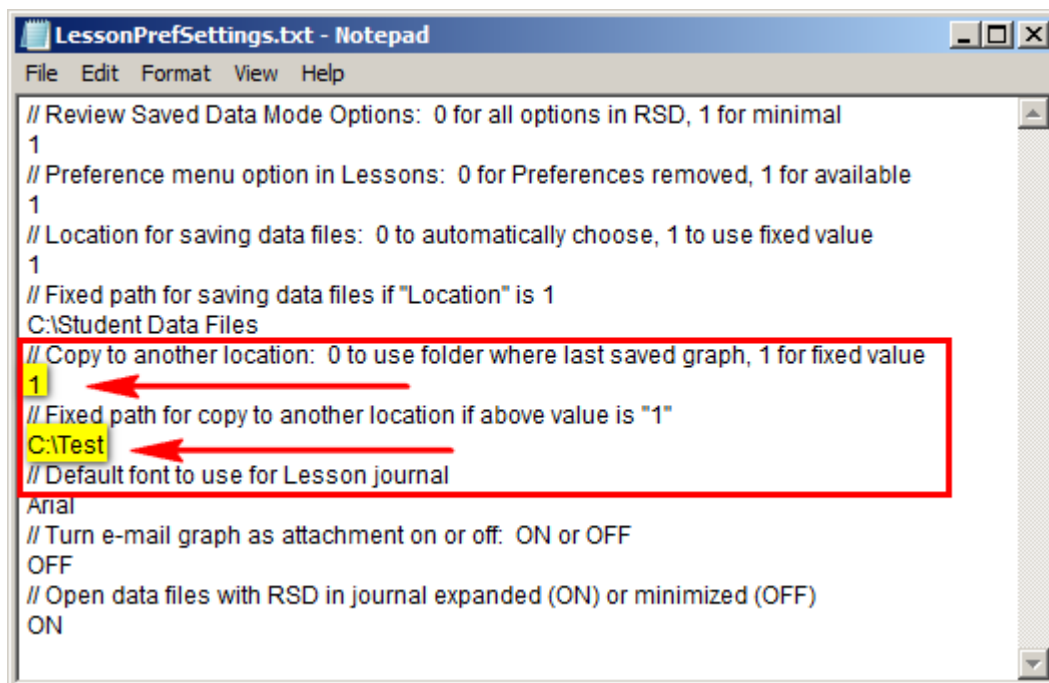6. Choose "**File > Save**" or **Ctrl+S** to save the changes.

On subsequent BSL launches, all completed lesson files will be saved in the new location in a subfolder titled "Data Files." (This folder is automatically created by BSL, regardless of main folder location.)

If saving the lesson files to a location over a network, it it recommended to first save the files to a local hard drive, then instruct the students to choose the "**Copy to another location**" option at the end of the lesson. Saving initially to a local hard drive will create a backup copy of the lesson files in the event of a network problem.

To change the "Copy to another location" path: (BSL 4.1.2 and earlier)

1. Double click the "**LessonsPreSettings.txt**" file to open it in Notepad (or any text editor).

2. Change the "**Copy to another location**" value to "1" as shown below example.

3. Enter your new file path into the space below the "Fixed path for saving data files…" line. (The file path shown below is for example purposes only. Your file location may be different.)

4. Choose "**File > Save**" or **Ctrl+S** to save the changes.

Access to Lesson Procedures and Intro PDFs

During Lesson recording and analysis, the associated Lesson Procedure, Intro and Analysis procedure are available in the Lesson's Help menu. Lesson Procedure PDFs are also accessible via the following methods:

- From the Help menu of any Lesson file opened via 'Review Saved Data' in the BSL Startup Wizard.
- By selecting the 'Help" radio button in the BSL Startup Wizard.
- By browsing directly to the 'User Support System' folder:

Windows: Drive:\Program Files (x86)\Biopac Systems, Inc\Biopac Student Lab 4.x\User Support System

Mac OS X: Finder:\Applications\Biopac Student Lab 4.x\User Support System

Recording Mode Basics and Lesson Structure

Recording mode functions are detailed in each lesson procedure and lesson Journal. The structure of the supporting lesson text is explained below, and at the end of that section, there is an overview of display options applicable in the Recording mode.

Each Biopac Student Lab lesson provides an overview of the specific area of Physiology that can be recorded using the Biopac Student Lab system.

> **IMPORTANT** — Use the *free* **Biopac Student Lab Analysis Only (RSD) Software** to review and analyze data files use on your personal computer, outside the lab; the MP UNIT does not have to be attached. Download available at www.biopac.com.

Each lesson includes the following sections:
- Introduction
- Experimental Objectives
- Materials
- Experimental Methods
  - — Set up
  - — Calibration
  - — Recording
- Data Analysis
- Data Report

The Biopac Student Lab was designed to make setup and calibration quick and easy, with the intention of allowing each student in the group to rotate to be the recorded Subject within a lab period. The way to do this is to collect data from a Subject, then switch to a new Subject at the end of the recording section and repeat the Calibration and Recording sections. This continues until all students have been the Subject.

Introduction

The Introduction is a refined presentation of the physiological concept addressed in the lesson. The Introduction should assist you with concepts and definitions needed for the Analysis and Data Report, but is not intended to be a substitute for your textbook. The main objective is to give you the proper information to collect good data.

Experimental Objectives

The Experimental Objectives summarize the principles demonstrated in the Lesson. For a complete list of Experimental Objectives by lesson, see page 63.

Materials

The Materials list contains everything necessary to perform the Lesson. This is not just a list of BIOPAC equipment, but includes items such as rulers, protractors, bucket of water, etc. required to complete the Lesson. Check the equipment list prior to beginning a recording.

In addition to the lesson-specific materials, some instructors have found the following items useful when performing Biopac Student Lab experiments:

Ruler	Protractor
Measuring tape	Calculator
Step stool	Storage boxes
Pillow with paper covers	Head bandage for EEG
Cotton balls	Additional rainbow construction paper (PAPER1) for ED

Experimental Methods

Experimental Methods contains the Set Up, Calibration, and Recording sections. Each section is presented in a two-column format, as described below:

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 before 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) 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.

Set Up

Set Up explains how to connect transducers and electrodes to the MP acquisition unit and to the Subject. You should follow the figures provided.

Starting the Biopac Student Lab program

To **START** the Biopac Student Lab 4 program, simply click on the Desktop shortcut and choose a lesson.

Biopac
Student Lab
4.1

Start the BSL program

Note: You can select the language version to install (English, Español, or Français). Language versions contain translated menu items, screen prompts, dialogs, etc. You can install multiple language versions on your computer (but only one program may be open at a time). Full translation requires the corresponding Operating System with appropriate 'Regional Settings."
To change settings, open the "Regional settings" or "Region and language" dialog as follows:


Adjust **Location (Country)** to Spanish →Spain (traditional) or French→French (standard) and click **OK**. See the Installation Guide for more detailed instructions.

Choosing a Lesson

After launching the application, click a lesson to select it (scroll down to see full list) and then click **OK**. If the MP unit is not ON or is not properly connected, the message below right will be displayed. Check the MP device power switch and connections, then click "Retry."
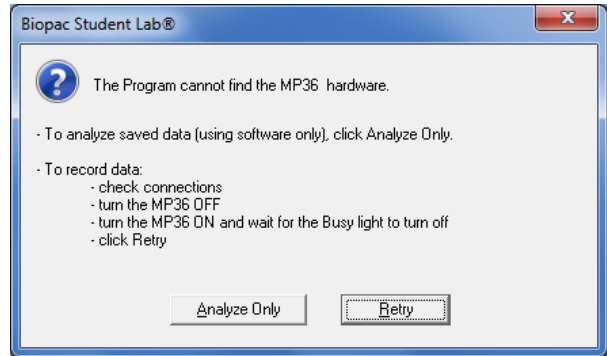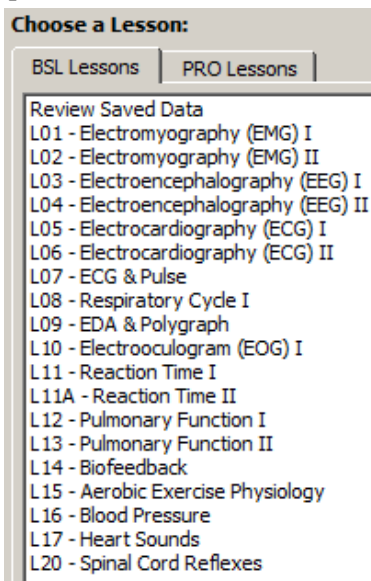
Type in a file name
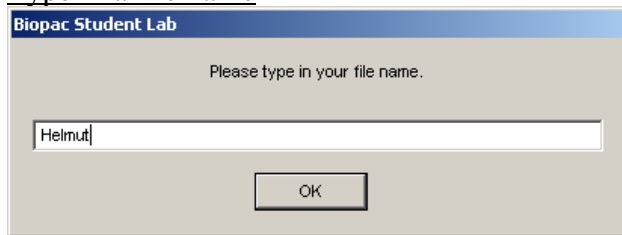
Upon selecting a lesson, a prompt for creating a file name will appear. Type in a unique identifier and click OK.

The Biopac Student Lab software doesn't allow for duplicate names, so if a lot of other students are using the same computer, the Biopac Student Lab software may prompt for a different name. Appending a number or letter to an existing name is a good solution to this problem.
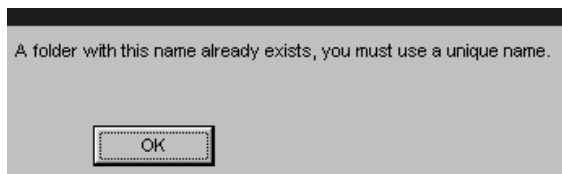
To save to the existing folder, select **Use it**. This is a convenient way to ensure that a student's lesson files for the class term are stored in one folder.
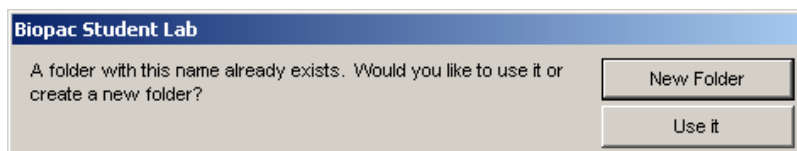
Each folder can contain up to 10 recordings of the same lesson. If 10 recordings are exceeded, the folder name prompt will appear.
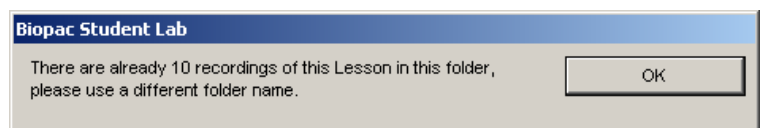
Data files inside a folder can be moved, duplicated or copied to a flash drive as a backup or to be viewed later.

◉ Biopac Student Lab

Calibration

Calibrate

For each lesson, a calibration cycle is required to establish the internal hardware parameters (such as gain, offset and scaling) of the MP acquisition unit and is critical for optimum performance. It's important to pay close attention to the calibration procedure, which in most instances require only eight seconds. (The calibration can be easily repeated if the results are not within the expected limits.)

Calibration procedures for all BSL Lessons are assisted by onscreen instructions in the Lesson's Journal. The Lesson Procedure PDFs in the Help Menu also fully explain the calibration procedures. This helps assure optimal data accuracy with no guesswork.

If the **Subject** must respond in some fashion during the calibration, a prompt will appear on the computer screen describing the desired action (i.e., inhale deeply when a beep tone is heard).

Lessons 3 and 4 (EEG-1 and EEG-2) include an optional step to "Check Electrode Impedance" prior to Calibration to assure that scalp electrodes are properly attached. See Lesson Procedures for more details.

Sample calibration graphs are provided in the lesson text so you can check your calibration data. Your data may not match the sample precisely, but key points will be indicated, and if your data matches these key points you may not have to redo calibration.

Recording

Record

The recording phase follows the calibration phase. During the active recording phase, the lesson Journal instructions will guide the Subject through the necessary steps required by the lesson.

The Journal instructions are very detailed and include sample screen shots and embedded videos for comparison—so, even if the **Subject** doesn't fully understand the science behind the lesson or in under a time constraint, it's still easy to obtain meaningful data. Important concepts are often made clear after the lesson during the Analysis section.

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

Factors to consider for the recording mode:

* Clicking **Suspend** will pause the recording, allowing time to review the data and prepare for the next recording. Once selected, the **Suspend** button changes to a **Continue** button. The **Continue** button is a gateway to the **Record** button for the next recording segment.

* The **Redo** feature is very handy and should prevent panic from setting in following a less-than-great recording. It's easy to redo a recording segment if something goes wrong or if the proper tasks were not performed.

* Printing is only available in the **Review Saved Data** analysis mode — it is not available in the recording mode.

* **Grids** cannot be turned on while in recording mode; if the recording requires grids, they will be turned on automatically.

* Some lessons utilize a sound event. Sound events can be controlled via the Control Panel **Sounds** dialog (Start > All Programs > Control Panel > Sound/Sounds). Select "Default sound" and the desired "Name" for the sound.

    If a computer does not have a sound card installed, or cannot play the default sound event for any other reason, the beep will be generated through the computer's internal speaker.

Done button options

After completion of all recording segments, click **Done** to generate the following options:
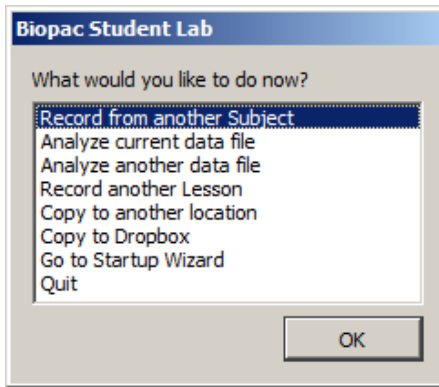
Dialog options after pressing "Done"

Record from another subject

Return 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, the calibration may need to be repeated.

Analyze current data file

Switch to the "Review Saved Data" mode and automatically open the last recorded data file.

Analyze another data file

Switch to the "Review Saved Data" mode to open a data file for review.

Record another Lesson

Generate the Lessons menu.

Copy to another location

Generate a Save dialog to designate the location to save the file to. Note that the file name cannot be changed.

- Use the **Lesson Customization Options** (detailed on page 26) to designate the default file location for "Copy to another location."

Copy to Dropbox

Copy the file to an online Dropbox account. (A Dropbox account is necessary to use this feature.)

Go to Startup Wizard

Exits the current lesson to the Startup Wizard.

Quit

Closes all open lesson windows and exits the Biopac Student Lab application.

### *Data Window Functions in the Recording Mode*

Grids

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. Grids can be fixed or variable. A **fixed grid** has grid lines locked to the data. When fixed grids are on, the horizontal and vertical scale adjustments are locked out, but the user may still use the zoom options. In general, any lesson that records an ECG signal will use fixed grids, but there are exceptions to this.

Grids will appear in the recording mode of selected lessons, to assist the user in obtaining certain values (like the grip strengths required in Lesson 2 EMG II). Grids will only be displayed in the recording mode when they are absolutely needed, so the waveform can be more clearly displayed.
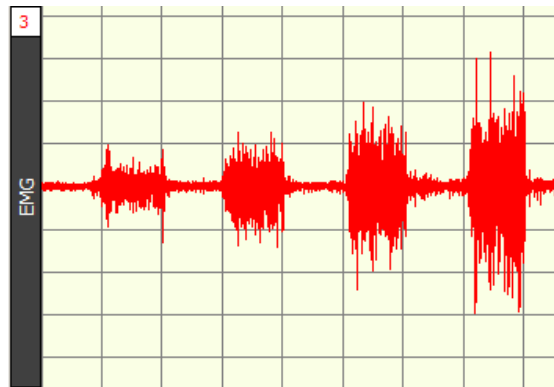
Event Markers

Event Markers are used to reference important locations in the data. Markers are the inverted triangles that are placed within the marker region and each can have marker label text. The lessons specify when to place markers during the recording, and you can add or edit markers during analysis. The specific elements of markers are shown below:
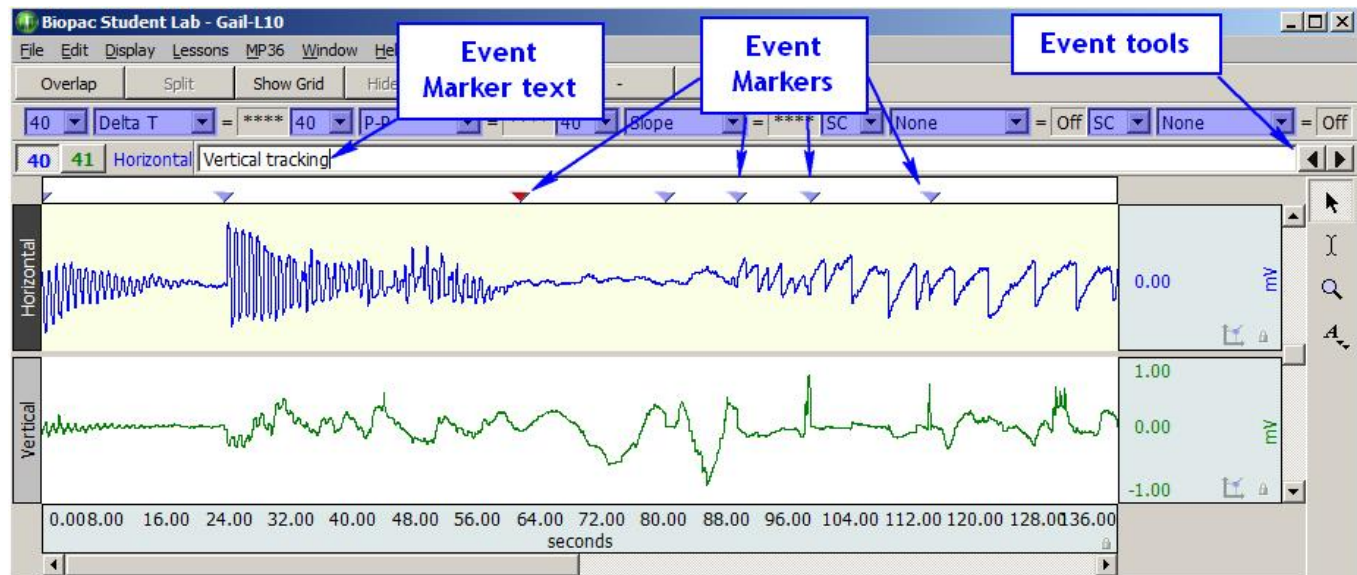

Event Marker elements

To insert a marker while the data is being recorded, press the **F9** key. (**ESC** in Mac)

You may then type in text, which will be linked to that marker, but which is displayed in the left portion of the marker region.

The "active" marker appears darkened, and the marker text corresponds to the active marker ("exhale" in the figure above). You may change the active marker by using the "marker tools" in the right portion of the marker region (see figure above).

Journal Functions in the Recording Mode

During the Recording mode, the HTML Journal is read-only and cannot be edited. In this mode, the Journal provides lesson-specific information to guide you through the calibration and recording.
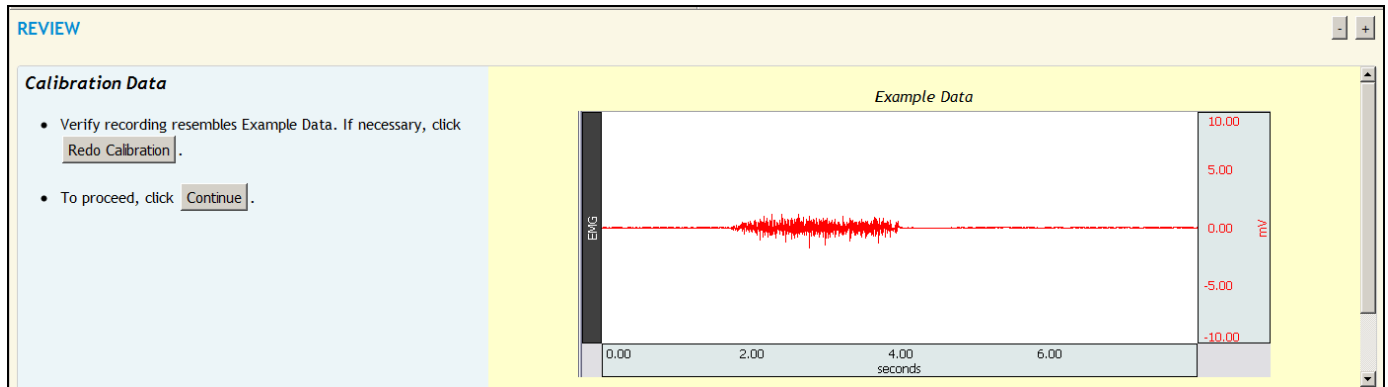
Journal text in the Recording mode

The **Journal** function varies from the Recording mode to the Analysis mode.

*   In the Recording mode, the Journal contains HTML text, images and embedded videos that guide the user through the lesson. Use the Recordings preference (page 6) to show all Journal text or show minimal Journal text.

*   In the Analysis mode (Review Saved Data), the Journal can be used to write notes and record measurements, which can then be copied to another document, saved, or printed.

NOTE The instructional Journal text is read-only in the standard Biopac Student Lab application. To edit onscreen Journal content, you must purchase an activation license for the BSL Curriculum Management System. This powerful add-on allows for flexible modification of lesson content and allows you to create your own custom lessons. See page 70 for more details on the BSL Curriculum Management System, or see Chapter 18 in the BSL *PRO* Manual.

Save

As data is recorded, it is saved to the computer's internal memory. After recording, data is transferred and saved to the computer's hard drive (or wherever the Biopac Student Lab application is running). The program will save the data file automatically, with a file name based on the username or I.D. created at the start of each lesson.

The lesson name, file name, date and time will automatically be appended to the Journal when a file is saved from the Recording mode.

Closing the Application

During the recording mode, the application close icon ⊠ in the upper right corner of the display window is blocked to prevent inadvertently quitting the application while recording.

If **Quit** is blocked, click on the STOP button to suspend the recording, and then try **Quit** again.
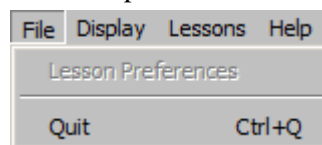
Help > About Biopac Student Lab

Select **About Biopac Student Lab** from the Help menu for information about the software version, hardware connections or computer system. (Use **Biopac Student Lab** menu in Mac OS X)

Any Lesson Procedure PDF can also be opened from within in the Help menu.

Data Analysis

Data Analysis is performed following the lesson to extract measurements that reinforce the concepts presented in the lesson's introduction. Analysis can be performed right after the data is recorded, or can be done later off-line on another computer. (Hardware does not need to be attached in order to analyze data). The analysis should be performed after all students have recorded their data.

Each lesson involves some degree of analysis, but the Biopac Student Lab software generally handles anything more complex than adding two numbers together. The lesson text will walk **Subjects** through the analysis and explain what needs to be done at each step. Refer to the following sections on measurements, as necessary.

The measurements taken in the Analysis section are subsequently placed in the Data Report section and may also be copied to the on-screen Journal for saving and printing. Whenever a measurement needs to be placed in the Data Report, a reference icon will direct **Subjects** to the proper section of the Data Report.

See the following section on "**Analysis Mode** (**Review saved data**)" for details on how to access your files for Analysis.

Data Report

The Data Report is where you note and summarize your data. The Data Report contains questions that reinforce the concepts presented in the Introduction. At least a few of the questions are designed to have you answer on the particulars of your own data. Whenever practical, the Data Report has reinforced good scientific practices like having "control" data and using statistics to look at data from the class. In addition to being included at the end of every Lesson Procedure, Data Reports are presented in the Journal while in Analysis mode. Journal Data Reports can be freely edited, customized, saved to an alternate location, printed or emailed as an attachment. The email as attachment option must be enabled in the BSL preferences file. See page 26 for more information about customizing the preference file.

- Journal Data Reports can be easily customized using the Journal toolbar editing tools. (Analysis mode only)
- Journals and Data Reports are in BIOPAC's *.jcq format but can also be exported in spreadsheet *.xls,) Journal template (*.jtl,) or OpenDocument (*.odt) formats. To save the content to other document formats, select and copy the contents, open the document application you wish to use, and paste the contents.
- The "BSL Answer Guide" for Data Reports is included on the Biopac Student Lab installation CD but is not installed with the program. See the User Support folder on the CD.

Modifying the Journal Data Report file: Journal Data Reports are stored in the BSL program folder in a special text format called *.jcq format. These files can be modified in an active Lesson's Review Saved Data mode or in the BSL *PRO* side of the application. The file can be resaved in the same Journal *.jcq format and used in place of the default Journal Data Report. To modify the default Journal Data Report content:

1. Launch the application in BSL *PRO* mode. ("Create/Record a new experiment" and click OK.)
2. Go to File > Open and choose "Journal *.jcq" from the file type list.
3. Navigate to the location of the Lesson Journal file you with to modify (Example: Drive:\Program Files\BIOPAC Systems, Inc\Biopac Student Lab 4.1\LessonsSupport\all-lang\Lessons\L01-EMG-1\html\en\L01 Data Report.jcq) and click "Open."
4. The Data Report will open in an editable Journal window. Make the desired edits and save the file (File > Save) or File > Save As to save under a different name or directory.

Note that Journal Data Report files saved under the same name (e.g., "L01 Data Report.jcq) to the default directory of the Lesson will overwrite the default Journal Data Report file. For this reason, it's advisable to make a copy of the default Journal Data Report file and keep it in an alternate location in case you'd like to restore it at a future date. To restore it, simply copy it back to the default lesson directory and overwrite the modified file.

**Analysis Mode (Review Saved Data) Basics**

Getting into Review Saved Data mode

You can enter the Review Saved Data mode immediately following the recording or at a later date — even from another computer.

Immediately following the recording

After clicking "**Done**" to complete a lesson, choose "**Analyze current data file**" or **"Analyze another data file**" to enter the Review Saved Data mode.


* **Analyze current data file**   The program will automatically open for analysis the file just recorded.

* **Analyze another data file**   The program will display an Open dialog for browsing to the desired file for analysis. (See "Selecting a file for review" on the following page.)
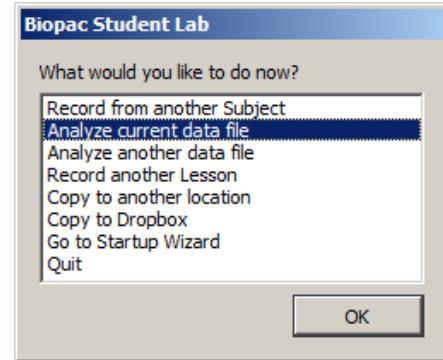
At a later time

If Biopac Student Lab is running…

1. Pull down the **Lessons** menu and select **Review Saved Data**.
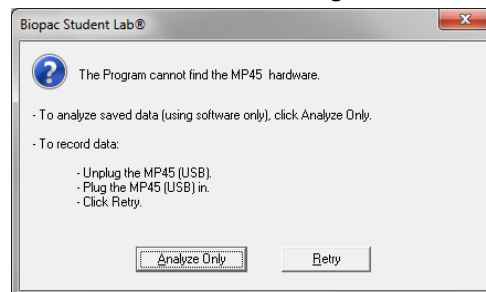
2. Select a lesson file to review (see next section).
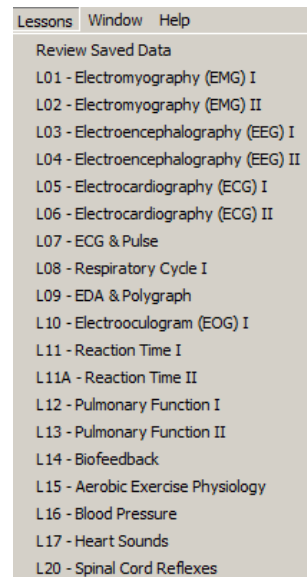
Biopac Student Lab Lessons menu
(Analyze mode)

If Biopac Student Lab program is not running…

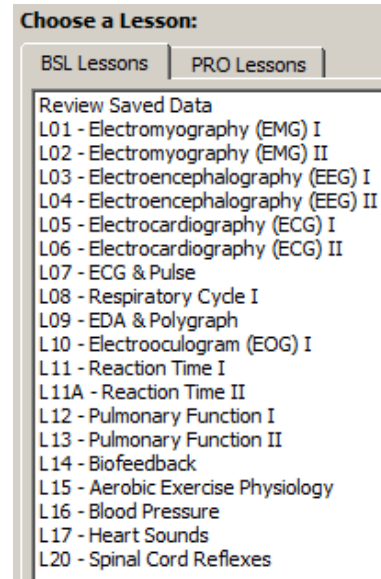1. Launch the Biopac Student Lab program.

   If the MP unit is not connected or not turned ON, a message similar to the following will appear:

Since the Review Saved Data mode does not require hardware, simply click the "**Analyze Only**" button.

2. The Choose a lesson menu shown at right will appear.

3. Scroll down to select **Review Saved Data** and click **OK**.

NOTE For BSL for MP46/45 hardware, only a subset of the lessons is supported. Lessons 7, 8, 9, 11, 11A, 14, 15 & 20 are not used in MP46/45.

Choose a Lesson:

| BSL Lessons | PRO Lessons |

Review Saved Data
L01 - Electromyography (EMG) I
L02 - Electromyography (EMG) II
L03 - Electroencephalography (EEG) I
L04 - Electroencephalography (EEG) II
L05 - Electrocardiography (ECG) I
L06 - Electrocardiography (ECG) II
L07 - ECG & Pulse
L08 - Respiratory Cycle I
L09 - EDA & Polygraph
L10 - Electrooculogram (EOG) I
L11 - Reaction Time I
L11A - Reaction Time II
L12 - Pulmonary Function I
L13 - Pulmonary Function II
L14 - Biofeedback
L15 - Aerobic Exercise Physiology
L16 - Blood Pressure
L17 - Heart Sounds
L20 - Spinal Cord Reflexes

Choose a lesson prompt

Selecting a File to Review

Upon entering "Review Saved Data" mode, browse to the desired file and click "Open."

Note that the lesson number extension has been automatically added to the file name.

The BSL application will open the lesson file, with the Data Window and Journal displayed, as shown on the following page.
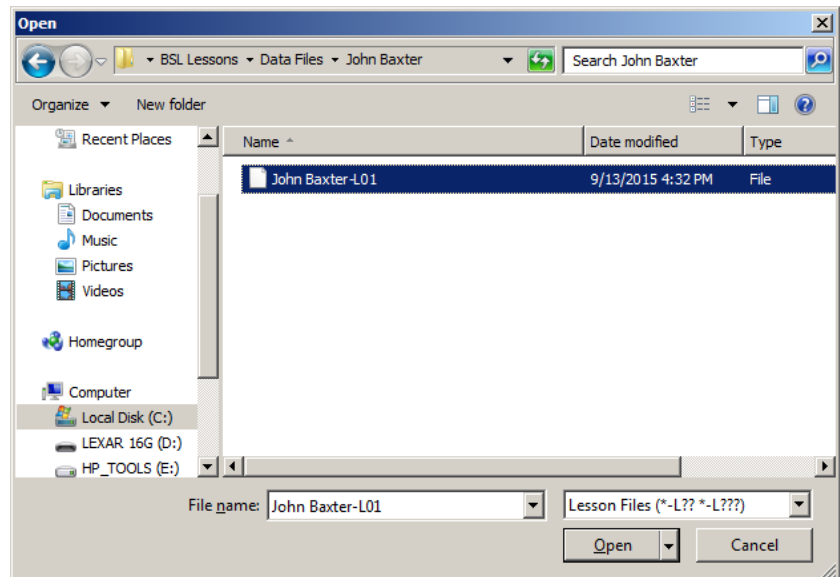
Sample Data File

There are many sample files included with the installation. To review a sample file:

1. Using File > Open, locate the **Biopac Student Lab** folder on the drive the program was installed to.

2. Open the **Biopac Student Lab** folder and select the **Data Files** folder.

3. Open the **Data Files** folder and select the **Sample Data** folder.

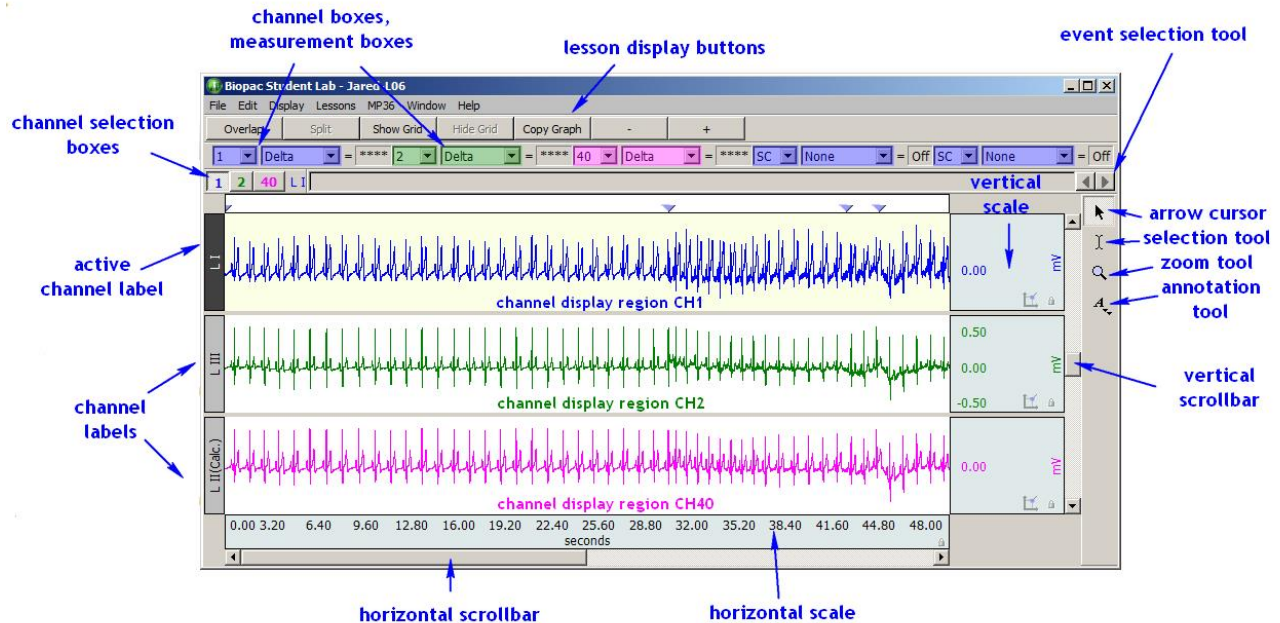4. Open the **Sample Data** folder and select a file (such as **Jared-L06**).
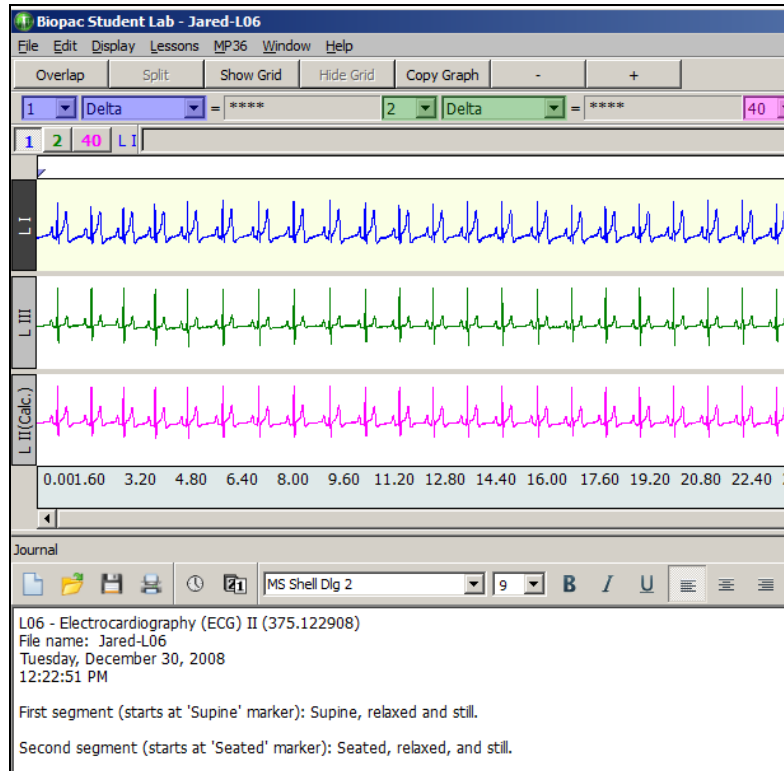
Screen display after opening a sample file in Review Saved Data mode

Software Tools Used for Analysis

Biopac Student Lab software includes a variety of Display Tools for modifying the data display by adjusting axis scales, hiding channels, zooming in, adding grids, etc. This can be very useful when studying just a portion of a record, or to help identify and isolate significant data for reporting and/or analysis.

Basic descriptions of the standard tools follow; for further explanation, see "Beyond Basics" on page 49.


Basic Display Tools for Analysis

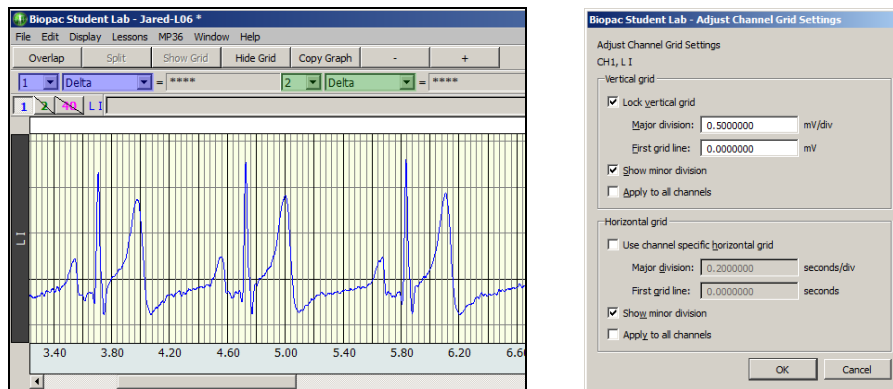| Viewing Tool	Overview
Selection	The **selection (arrow)** icon is a general-purpose cursor, used for selecting channels and scrolling through data.
I-Beam	The **I-beam** icon is used to select an area for measurement. To activate it, click it and move the mouse such that the cursor is positioned at the beginning of the region to be selected. The cursor must be positioned within the data window. Hold the mouse button down and move (drag) the cursor to the second position. Release the mouse button to complete the selection. The selected area will remain darkened. Measurements will apply to the selected area. For more details on selecting an area for measurement, see page 55.
Zoom	The **zoom** icon magnifies selected areas of data. Click the zoom icon and define an area of interest by click-hold-drag-releasing the mouse over the desired section. The horizontal (time) and vertical (amplitude) scales will expand to display just the selected section. For more details about the Zoom tool, see page 50.
Annotation	The **annotation** tool allows text to be added into any channel within the display window. Clicking a graph channel when this tool is active brings a field for entering text, along with font and formatting options. The text box can be repositioned as desired by selecting and dragging to the desired location. Existing text can be edited by double-clicking on the text box, which reopens the annotation dialog.

Show/Hide Channels

Another display feature of the Biopac Student Lab system is the ability to hide channels from view. The data is not lost, but simply hidden, so that the user can focus on a specific channel or channels. Hidden channels can be brought back into view at any time.

To hide a channel, click on the desired channel button while holding down the Alt (Option) key.

The hidden channel's button will contain a slash. To toggle the channel back into view (unhide), simply repeat the Alt click.
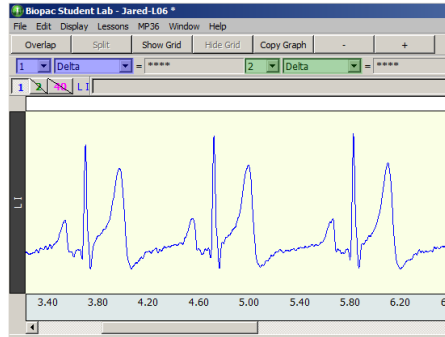
*Hide channels (Channel 2 and Channel 40 are hidden)*

Grids

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. Grids can be fixed or variable. A **fixed grid** has grid lines locked to the data. When fixed grids are on, the horizontal and vertical scale adjustments are locked out, but the user may still use the zoom options. In general, any lesson that records an ECG signal will use fixed grids, but there are exceptions to this.

Grids will appear in the recording mode of selected lessons, to assist the user in obtaining certain values (like the grip strengths required in Lesson 2 EMG II). Grids will only be displayed in the recording mode when they are absolutely needed, so that the waveform can be more clearly displayed.

IN BSL LESSONS: To show or hide the grid display in the Review Saved Data mode:

1. Open a data file.
2. Use the Show Grid Hide Grid buttons at the top of the display.

IN BSL PRO: Choose **Display > Show** and check/uncheck the **Grid** option.
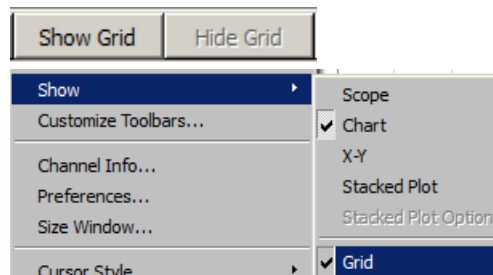
Overlap and *Split* buttons

The software defaults to a **Split** display, which functions like a chart recorder and keeps each waveform in a separate track. If an **Overlap** button is available, you can select it to switch to an oscilloscope style display that overlaps multiple waveforms in one track.

Measurement Tools

Extracting information from the data

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.
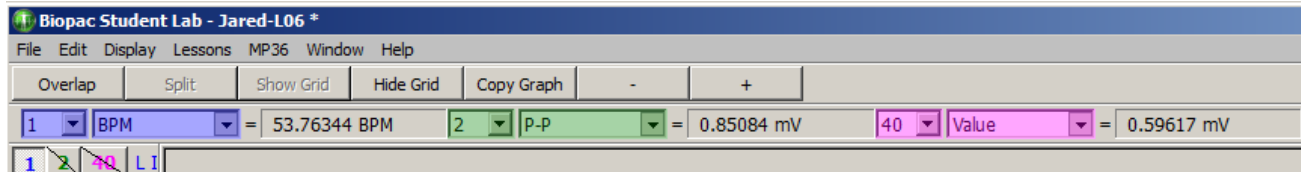

Measurement Tools for Analysis

Two important points regarding measurements:

1. The <u>measurement only applies to data in the selected area</u> of the waveform that the user specifies.

2. 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. Although the lessons will specify which measurements to use, the student may want to familiarize themselves with all the measurements, so they can explore the data beyond what the lesson requires.

For example, to extract the heart rate for the data shown below:

By counting the peaks (R-Waves) in the ECG waveform, it's possible to get a rough estimate of the average heart rate. Count the number of peaks within the first 10 seconds (9 in this example) and multiply by 6 to get the number of beats per minute (54 in this example).
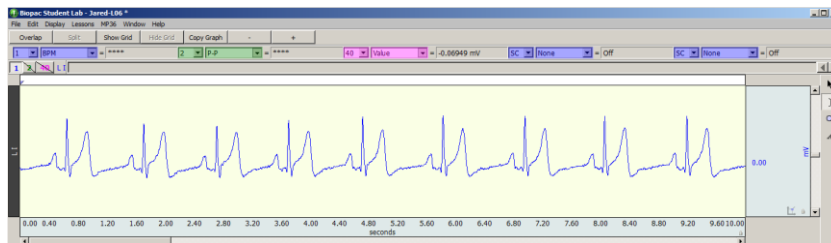
Sample ECG Data

An easier and more accurate way to obtain a Subject's precise heart rate is with the Biopac Student Lab measurement tools. In the figure below, the BPM is 55.76 for the selected beat-to-beat interval.

BPM Measurement for one beat-to-beat interval

Saving

As data is recorded, it is saved to the computer's internal memory. After recording, data is transferred and saved to an assigned location. The program automatically saves the data file, with a file name based on the username or I.D. given at the start of each lesson.

- BIOPAC recommends the original save location is on a local hard drive to minimize possible data loss due to network communication issues.

If students want to duplicate the data file when the lesson is finished, before they begin analysis, the "**Copy to another location**" option allows them to save a copy of the lesson data to the selected location (such as a centralized data folder on a school network).

Printing

The Biopac Student Lab software has powerful printing capabilities and will print graphs and journals to any inkjet or laser printer. Control the amount of data that is printed by adjusting the screen display <u>before</u> selecting **Print** from the File menu. Use the **Journal Toolbar controls** to modify the format of text, wave data, and/or measurements in the Journal before printing.
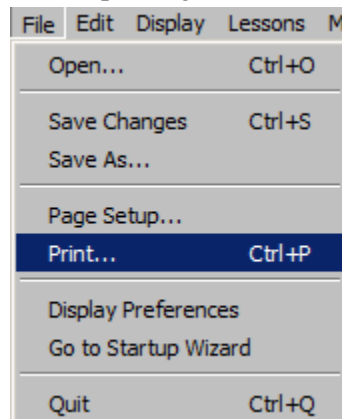
(The Journal is printed from the Print [icon] icon on the Journal toolbar).

Analysis: Beyond Basics

*At this point, you are encouraged to follow the **Tutorial** documentation. If that is not available, open up the sample data file and follow along on the computer if possible. To access the sample data file, follow the procedure outlined in the "Getting into the Review Saved Data mode" section on page 42. Open the "Sample Lesson Data" folder to select "Gail-L02". Have fun experimenting and don't worry — you can't lose or damage the Sample Data file.*

Changing the Scales

Horizontal Scale

Clicking within the numbers of the horizontal scale (x-axis) region of the graph generates the dialog shown to the right.

Adjust the settings in this window to precisely specify the horizontal scale for all channels. For a detailed explanation of the vertical scale settings, see the BSL Tutorial or BSL *PRO* Manual.

Note that any change you make to the Horizontal Scale only affects the waveform display and never alters the saved data.
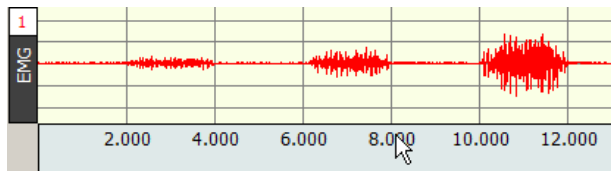
Horizontal Scale Adjustment

Vertical Scale

Clicking the vertical scale (y-axis) region of the graph generates a dialog for modifying the upper and lower ranges of the selected channel. For a detailed explanation of the vertical scale settings, see the BSL Tutorial or BSL *PRO* Manual.

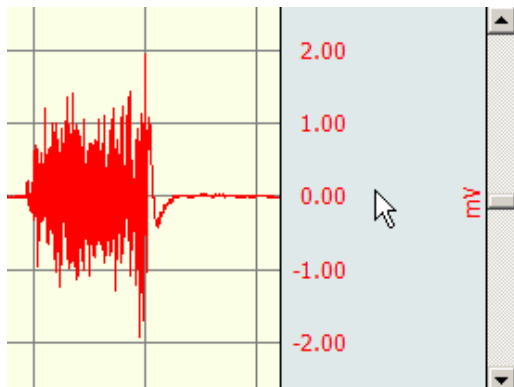Note that any change made to the vertical scale only affects the waveform display and never alters the saved data.
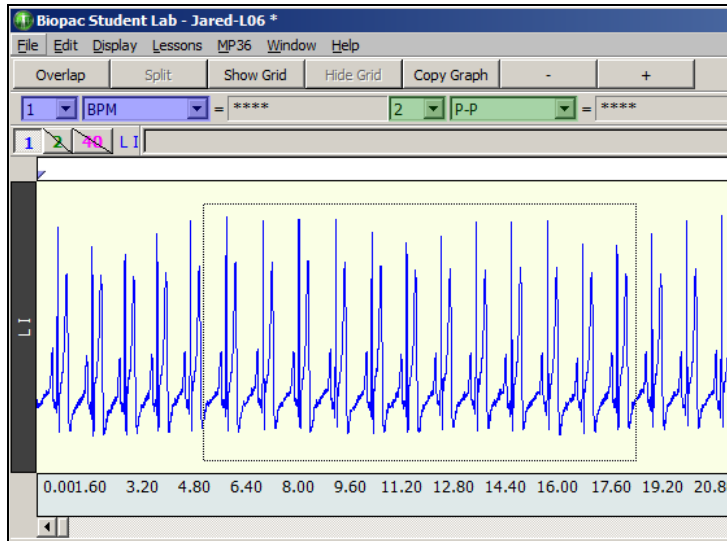

Vertical Scale Adjustment

Zoom

The zoom tool is very useful for expanding a specific section of a waveform in order to see more detail.

To use the zoom tool:

1. Click on the zoom tool icon [🔍] to select it.
2. Draw a box around the area you wish to zoom in on.

   * To draw the box, hold the mouse button and drag the cursor to the end of the desired region.

Zoom tool used to select a portion of ECG data

3. Release the mouse button.

   When the mouse button is released, the boundaries of the selected area become the new boundaries of the Data Window, as shown in the following figure.
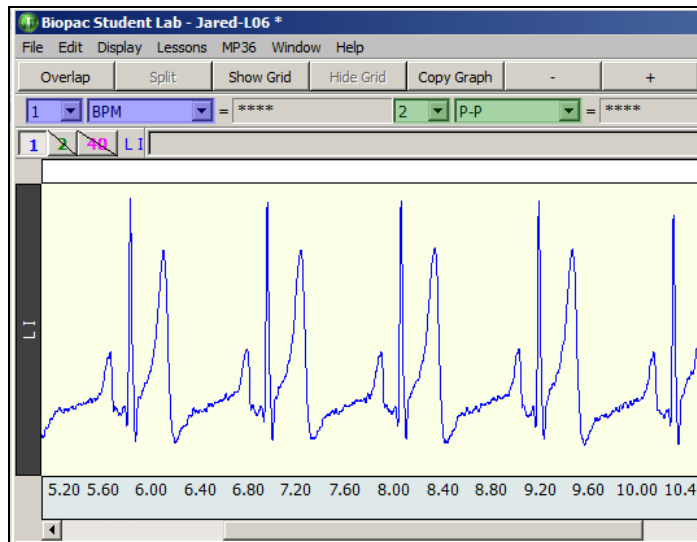
Result of using the zoom tool to select an area

Note that the vertical scale changes for the selected channel only, but the horizontal scale changes for all channels. This is because the horizontal (time) scale is the same for all channels.

How to undo the Zoom

To revert to the (horizontal and vertical) scale settings used prior to the last Zoom, click the Display menu, and scroll to select **Zoom Backward**. Note that you can "undo" up to five Zoom aspects.

Display Menu

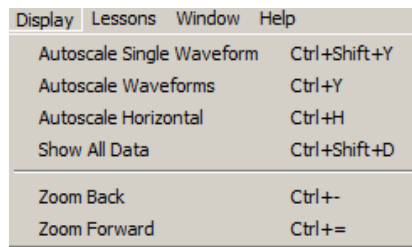The Display Menu contains even more tools for manipulating the data display. When you click Display and hold down the mouse, the menu options will be generated. To use any of these options, drag down to the desired selection, then release the mouse button.

Autoscale Waveforms

Autoscale Waveforms performs a "best fit" to each channel's **vertical** scale. That is, it adjusts the "Scale" and "Midpoint" of each channel's vertical scale, such that each waveform fills approximately two-thirds of its available track area.
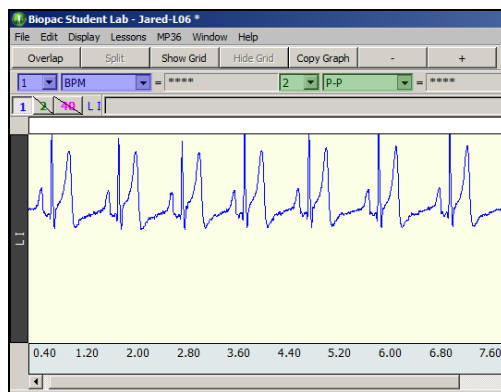
Before Autoscale waveforms   *After Autoscale waveforms*
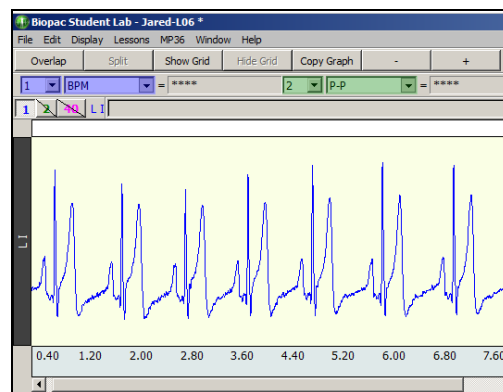
Autoscale Horizontal

Autoscale Horizontal fits the entire waveform (all the data you have collected) within the data window. That is, it will adjust the **horizontal** 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.
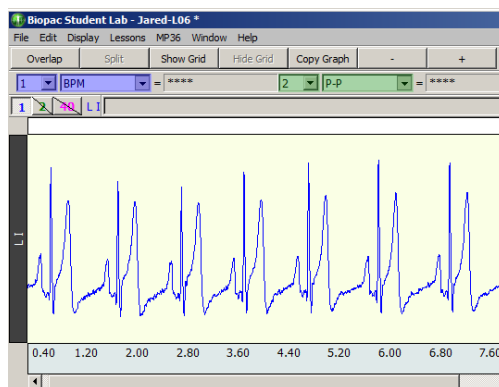
Before Autoscale horizontal   *After Autoscale horizontal*
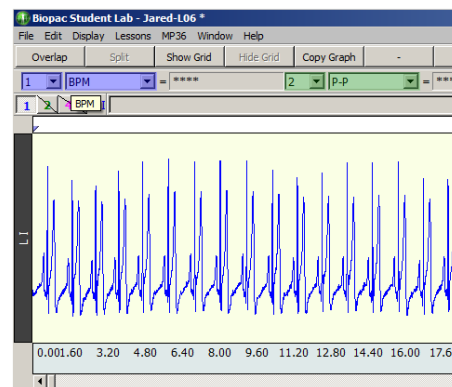
TIPS   The "Scale" or "Time-per-Division" setting will probably not be set to even numbers after an Autoscale function, so you may need to manually adjust the setting if even numbers are required.

One way to ensure the complete data file is displayed on the screen is to select **Show All Data**. This is very handy if you have lost track of where you are in the data due to manual scale changes, zooming, etc.

🌀 Biopac Student Lab

Event Markers

Event Markers are inverted triangles that are placed within the marker region at specific points to mark areas of interest or indicate the start of a new recording segment. Some lessons insert event markers automatically during the recording, and others require that event markers be entered manually. To insert an event marker, depress the **F9** key. You may then type in text linked to that marker, but which will be displayed in the left portion of the marker region.

The "active" marker appears darkened, and the marker text corresponds to the active marker
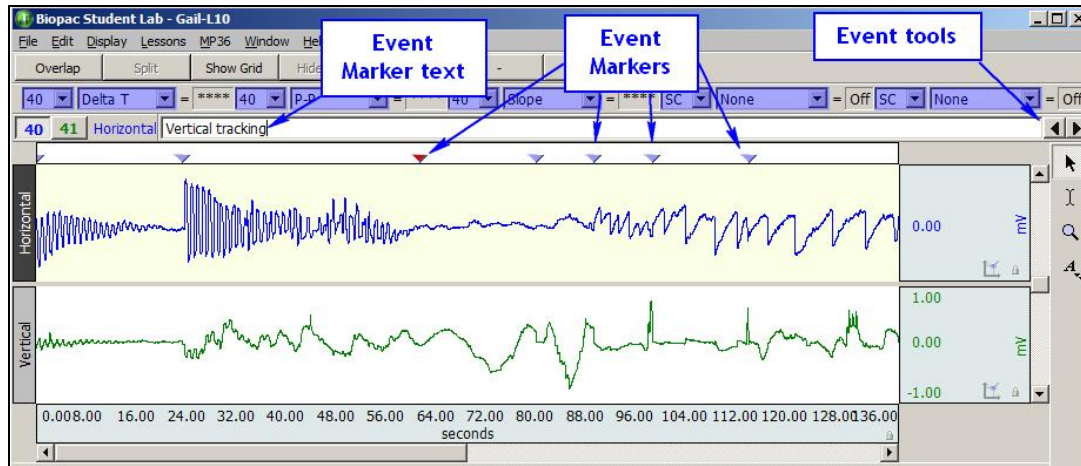
Event Marker elements

Event Marker Tools

You may change the active marker by using the "event marker tools" in the right portion of the marker region.

* Click the **left pointing event marker tool** to move to the event marker that was placed prior to the current active marker (if one exists).

* Click the **right pointing event marker tool** to move to the event marker that was placed after the current active marker (if one exists).

* Right click any event marker to generate a pop-up menu, as shown here:
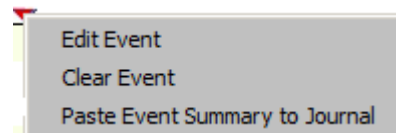
Clicking 'Edit Event' will open the Event Palette, which allows for editing, labeling or removal of Event Markers.

Event Palette

The Event Palette is a floating window that provides a quick summary of events for the topmost graph and can used to examine, search, and modify events. Events can be extracted in a time range for a specific event type and specific channels.

There is only one visible event palette for the entire application. The palette consists of four sections: event list, selected event, display, and event actions. Each section can be shown or hidden by toggling the disclosure button next to its title.
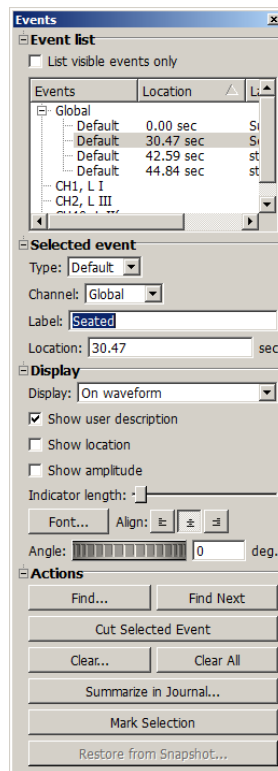
Event Palette

To choose an event marker menu item, simply scroll to the desired item in the event list and highlight it. The event Actions allows you to Find events, Find next event, Clear the active marker, Clear all events, Summarize in Journal, (inserts list of Event Markers into Journal), or mark Selection (places event markers at beginning and end of selected area).

Add or Edit Event Markers

You may add event markers to your data after it has been recorded by clicking within the event marker region with the Selection tool. The new marker will become the active marker, and you may type in the marker text. All event marker text is editable. Just position the cursor in the marker label region and make the desired changes.
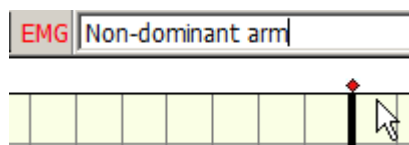
Event Marker Label Region

Printing Event Markers

When you print out the waveform(s) the marker text will appear above the appropriate marker, and a dashed vertical line will appear 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 and/or be hidden. Adjust the time scale to expand the marker display as necessary before selecting print.

Lesson Specific Display Buttons

Depending on the data you are viewing, lesson specific display buttons may appear when you are in the Review Saved Data mode. These include the Overlap, Split and Baseline buttons, discussed below. If other, more specialized buttons appear, their operation will be discussed in the lesson.

Overlap and Split

The "Overlap" and "Split" buttons allow you to toggle between an oscilloscope style display and a chart recorder style display. Simply click on the desired button to activate the display style you desire.

Overlap

The oscilloscope style interface allows the waveforms to "overlap" each other. This can be very useful when comparing different waveforms from one channel to each other.
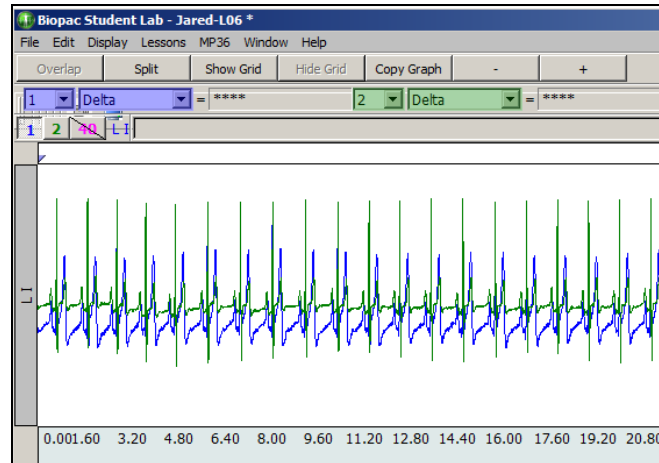
Overlap waveforms

Note that by alternating the active channel selection and using the vertical scroll bar, you can move each waveform with respect to the other(s) for precise alignment. If grids are shown, the display be based on the active channel.

In the preceding figure, Channel 1 ECG is the active channel (channel box appears depressed and channel label is ECG) and vertical scale adjustments would only move the ECG waveform. To move the Pulse waveform, it's necessary to activate Channel 40 Pulse prior to adjusting the vertical scale.

Split

The Split (chart recorder) display divides each channel's waveform to its own region. This is the default display mode for Biopac Student Lab. Only one channel can be active at a time. Adjusting the vertical scale or scrolling the vertical axis up or down affects only the active channel.

Split waveforms

<u>Adjust Baseline</u>

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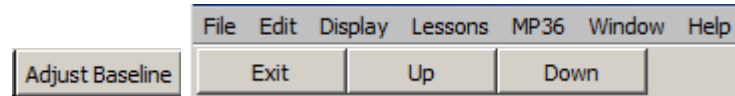
The Adjust Baseline button allows the waveform to be positioned up or down in small increments so that the baseline can be exactly zero. This is not necessary for obtaining accurate amplitude measurements, but may be desired before making a printout or when using grids.

Adjust Baseline button displays Up/Down buttons

After the **Adjust Baseline** button is pressed, **Up** and **Down** buttons will be displayed. 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.

Selecting an Area for Measurement

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 endpoint of the selected are, inclusive.

A **critical concept** for the measurement tools is that measurement results only apply to the area established by the "I-Beam" cursor. The measurement area can be a single point, an area, or the endpoints of a selected area. If no data point or area is highlighted on the screen, then the measurement results are meaningless. It is up to the student to select a point or an area with the I-Beam cursor, as the software will never do it automatically.

Selecting a single point

To select a single point:

1. Click on the **I-Beam** tool icon to activate it.
2. Move the cursor over a point on the data. Notice that whenever the cursor is over data it is displayed as an "I."
3. Release the mouse button.

When you have selected one point of data, a flashing line will appear at the cursor position, as shown in the figure below. 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.
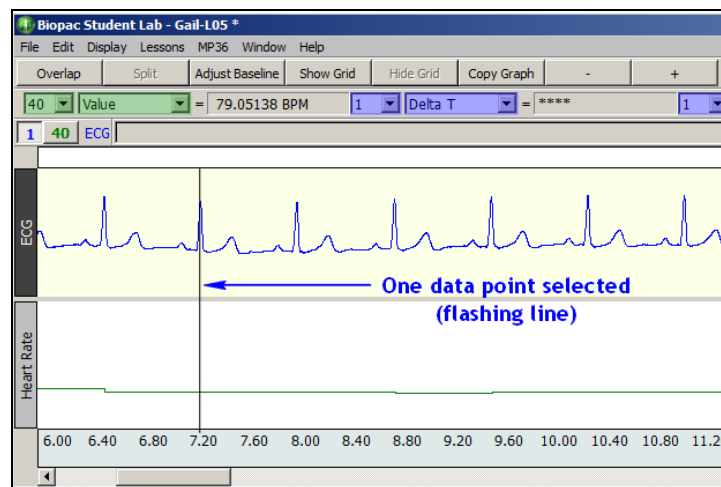
Single point measurement area

To deactivate a point when you are finished taking measurements, click on the **Selection tool** icon.

Selecting an Area with the I-Beam Tool

To select an area of data (several data points, including the endpoints):

1. Click on the I-Beam tool icon to activate it.
2. 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."
3. Drag the mouse while keeping the mouse button held down.
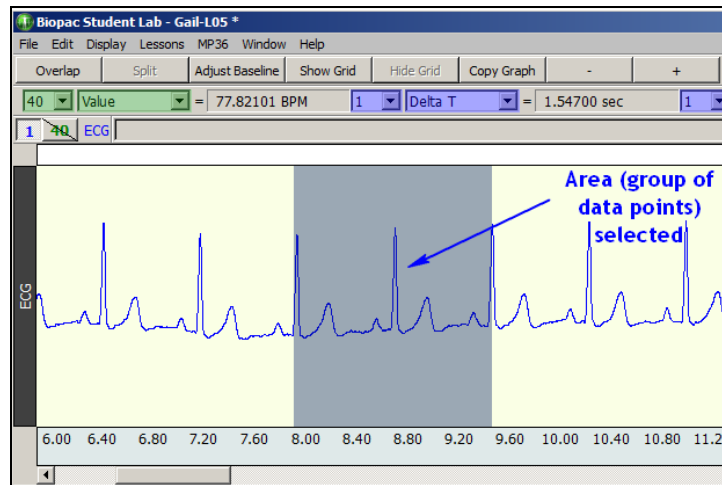4. Release the mouse button.

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

Selecting an area

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

Note: Since some measurement formulas (such as delta) use the start value and end value, the direction you "drag" to create the selected area will influence the polarity of some measurements.

Channel Measurement Box Regions
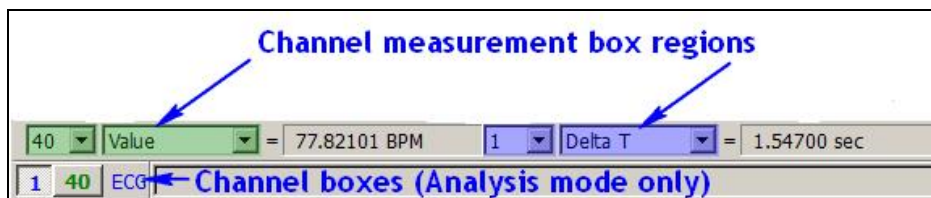
Elements of the Measurement Tool Region

Note that there are two channel measurement box regions shown in the above example. The channel measurement boxes can be set to correspond to any of the channels displayed on the screen. The preceding figure shows two channels of data displayed in the data window.

The number of channels displayed will vary, with up to eight different channels of data displayed on the screen at once (software-controlled, depending on the lesson). You may set more than one channel measurement box to the same channel. For instance, you may want to measure BPM and Time for Channel 1, so you would set two boxes to Channel 1.

|	
Channel number [CH] Pop-up menu	The channel number pop-up menu lets you set the channel number to apply the selected measurement to. To set a channel number, click and hold down the mouse button over the channel number box. A pop-up menu will appear allowing you to make a selection. The selections in the pop-up menu will contain the channels that were recorded ("1" and "40" in the figure above) plus the "SC" option. To "fix" the channel number for the region, choose the desired channel number. To determine which channel number refers to which waveform, look to the right of the box(es) for the active channel box label. To change to another channel, simply click its channel box, and note the new label.
SC - Selected Channel	"SC" stands for Selected Channel, and is an optional way to take measurements. When SC is selected, the channel the measurement region refers to is the one indicated by the depressed channel number box (below the channel measurement box region). The "SC" option allows for quick measurement comparisons between channels using one region. To take a measurement from another channel, simply click the desired channel box or click anywhere within the desired channel's data region using the selection tool.
Measurement type Pop-up menu	The measurement type box is a pop-up menu that allows you to choose any of the 34 Biopac Student Lab measurement functions, which are defined in the following Table of Measurement Definitions. Each measurement functions on a single point, an area, or the end points of a selected area, as established by the "I-Beam" tool. To remove a channel from displaying any measurement type, choose "None" from the popup menu.
Measurement Result	The measurement result is the value that the measurement calculates. If the correct region is not established for the measurement type, the result will be meaningless. See the Table of Measurements by Selected Area (on the next page) for a summary of tools for each region. The measurement units will not be shown — you must keep track of the units from the display window scale regions. The result will read "****" if there is no data selected or not enough data for the selected measurement.

Available Measurements for Analysis

None
Value
Delta
P-P
Max
Min
✔ Mean
Stddev
Integral
Area
Slope
Lin_reg
Median
Time
Delta T
Freq
BPM
Samples
Delta S
Median T
Max T
Min T
Calculate...
Correlate
Skew
Kurtosis
Moment...
Expression...
Evt_count...
Evt_loc...
Evt_ampl...
Sum
Rate_mean
Rate_median
Rate_stddev

Elements of the channel measurement box region

For measurement definitions and descriptions, please see your BSL Tutorial or BSL *PRO* Manual.

Data Window (Edit menu option)
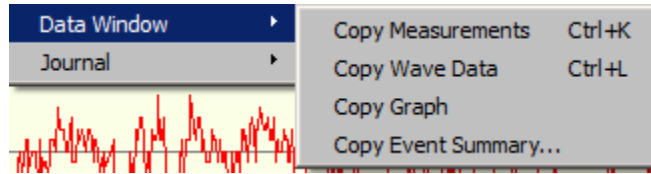
The **Edit** menu **Data Window** option includes three copy options that are to be used for measurements and waveforms in the Data Window (versus the Journal). The distinctions of each are detailed below.

Edit > Data Window option	Use
Copy measurement	Use to copy the measurement values from the data window.
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.
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 entire data file.
Copy Event Summary	Copies a summary of graph events to the clipboard, including event type, position on horizontal axis, channel and label information.

The Journal

In the Review Saved Data mode, the Journal feature is editable, so you can type notes or copy measurements from previously saved data. You can also copy data directly to the Journal. When in the Review Saved Data mode, click anywhere in the Journal window to activate it.
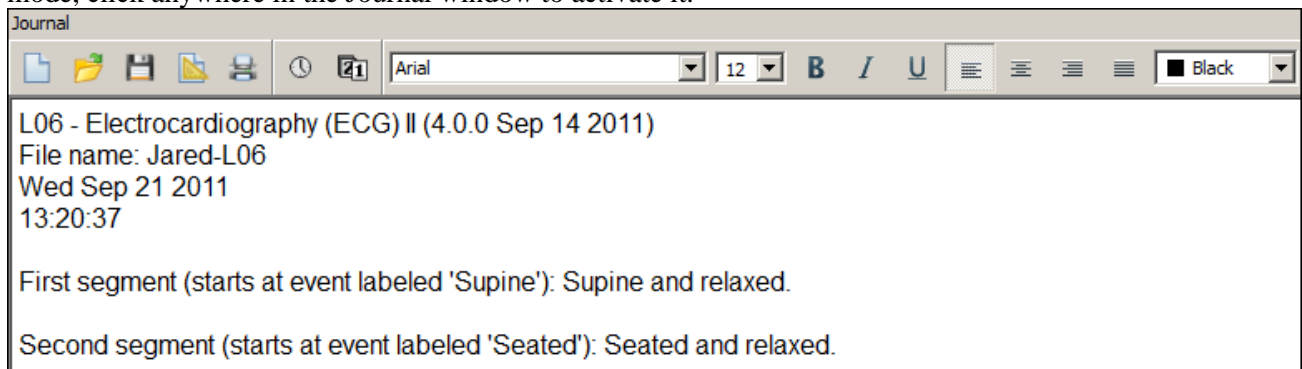
Journal Window

Format Journal Entries

Change the style and format of text, measurements, and waveform data pasted to the Journal by using the formatting tools above the Journal window. (Available in Lessons in Analysis mode only.)

Journal Paste Options (Edit menu)

Paste a pop-up measurement
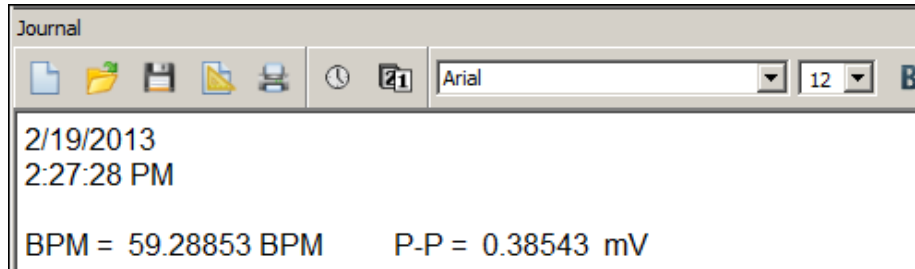
BPM and P-P measurements for Channel 1 pasted to Journal

When you use the Paste Measurement function, all the pop-up measurements showing a value will be written to the Journal. If you don't want these measurements, be sure to select the measurement option "None."

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 keyboard shortcut.

Paste wave data
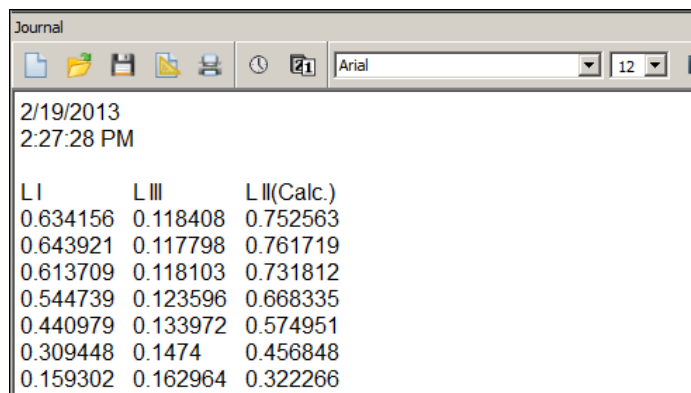
Wave data for Channel 1, Channel 2 and Channel 40 pasted to Journal

When you use the Paste Wave Data function, all the points that make up the data in the selected wave area will be written to the Journal. It's very easy to put a lot of data into the Journal using this command. If you select one second of a wave that was sampled at 200 Hz, you will get 200 numbers written into the Journal.

To paste wave data into the Journal:

1. 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.

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

3. Pull down the Edit menu and scroll down to Journal then scroll right to Paste Wave Data. Alternatively, you can use the Ctrl-W keyboard shortcut.

Remember — it's very easy to paste a lot of numbers to the Journal. Pasting just one second of a wave that was sampled at 1000 Hz will write 1000 numbers into the Journal.

Paste Graph

Use this option to paste a screenshot of the current graph into the Journal.

Paste Event Summary

Pastes a summary of graph events to the Journal, including event type, position on horizontal axis, channel and label information.

Time and Date Stamps in the Journal

The Journal is equipped with stamps for the time and date.

It's always a good idea to time and date stamp the Journal. The time stamp is the "clock" button at the top left of the Journal window. The date stamp is the "calendar" button to the right of the time stamp.

Journal Text entry

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. To return to the graph, click in the graph window.

Use the Edit > Copy option to copy Journal text to another program or to another section of the Journal.

Use the formatting tools in the Journal toolbar to customize the text style.
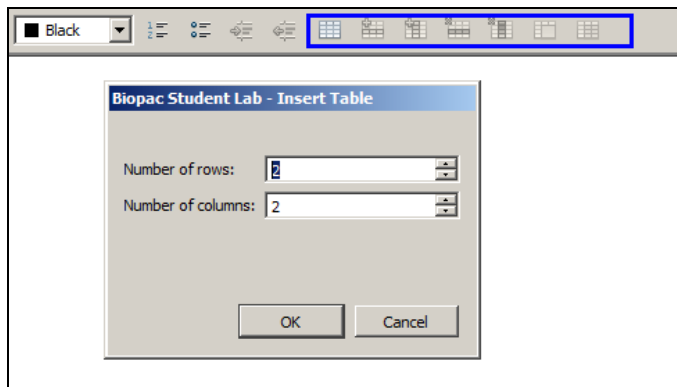
Journal tables can be added formatted and deleted using the table icons on the right side of the Journal toolbar.

Adding a hyperlink to the Journal

Add a live web link to the Journal using the hyperlink toolbar icon.

Click into the Journal where you want the link to appear.

Enter the URL (web address) and the desired link name into the Text field.

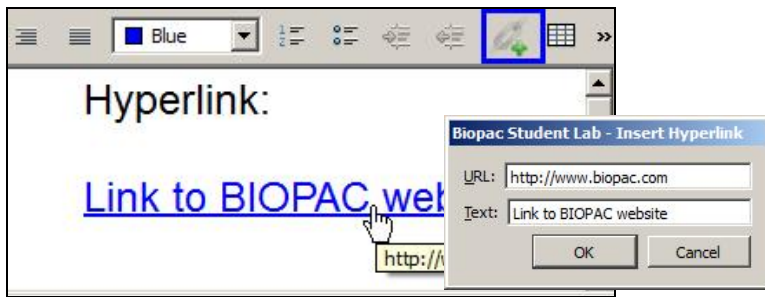Note: The http:// designation must be used for the link to be active.

Saving the Journal

To save a Journal, click the [disk icon] icon on the Journal toolbar. This will display a File >Save option for saving the Journal under a unique name to a *.jcq format

Lesson Save Options

In Recording Mode

When the **Done** button is pressed, data is <u>automatically</u> saved to the location assigned at startup.

The lesson Done dialog option "Copy to another location" allows students to create a copy of the currently opened file. To set the default location, use the lesson startup file (see Menu Customization on page 26).

Select the desired directory and drive and click **OK** to copy the lesson file(s). The "File name" entry is locked because the original name must be preserved when a file is copied.
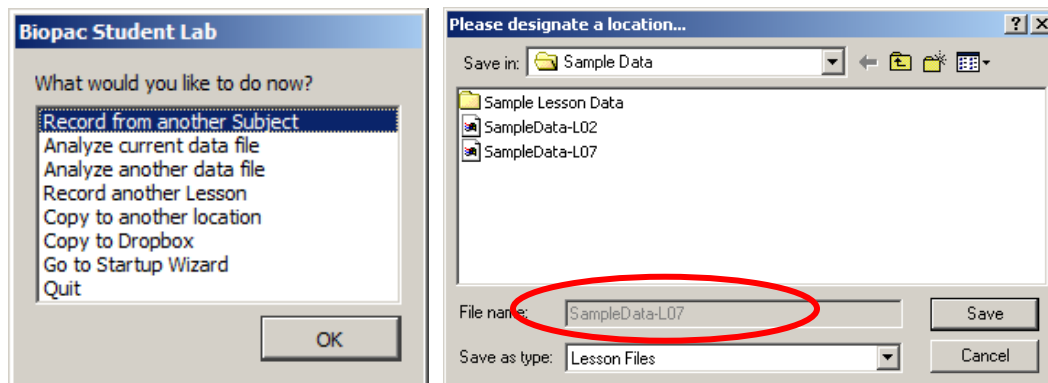
In Review Saved Data Mode

There are two ways to save a file after analysis in the Review Saved Data mode:

- **Save Changes** will ensure that the files are properly named and saved to the location the file was opened from.
- **Save As** allows students to save data to a different location.

Experimental Objectives by Lesson

Lesson 1   EMG I

- To observe and record skeletal muscle tonus as reflected by a basal level of electrical activity associated with the muscle in a resting state.
- To record maximum clench strength for right and left hands.
- To observe, record, and correlate motor unit recruitment with increased power of skeletal muscle contraction.
- To listen to EMG "sounds" and correlate sound intensity with motor unit recruitment.

Lesson 2   EMG II

- To determine the maximum clench strength for right and left hands and compare differences between male and female.
- To observe, record, and correlate motor unit recruitment with increased power of skeletal muscle contraction.
- To record the force produced by clench muscles, EMG, and integrated EMG when inducing fatigue.

Lesson 3   EEG I

- To record an EEG from an awake, resting subject with eyes open and eyes closed.
- To identify and examine alpha, beta, delta, and theta components of the EEG complex.

Lesson 4   EEG II

- To record an EEG from an awake, resting subject under the following conditions:
    - Relaxed with eyes closed.
    - Performing mental arithmetic with eyes closed.
    - Hyperventilating (breathing quickly and deeply) with eyes closed.
    - Relaxed with eyes open.
- To examine differences in the level of alpha rhythm activity during mental arithmetic and hyperventilation, compared to the control condition of eyes closed and relaxed.

Lesson 5   ECG I

- To become familiar with the electrocardiograph as a primary tool for evaluating electrical events within the heart.
- To correlate electrical events as displayed on the ECG with the mechanical events that occur during the cardiac cycle.
- To observe rate and rhythm changes in the ECG associated with body position and breathing.

Lesson 6   ECG II

- Record ECG from Leads I and III in the following conditions: supine, seated, and breathing deeply while seated.
- Compare the displayed calculated ECG Lead II to recorded ECG Leads I and III, and use the R wave amplitudes to confirm Einthoven's Law.
- Approximate the mean electrical axis of the ventricles on the frontal plane using vectors derived from the amplitude and polarity of the QRS complex in ECG Leads I and III.
- Approximate the mean electrical potential of the ventricles on the frontal plane using the resultant vector derived from the vectors of Leads I and III.

Lesson 7   ECG & Pulse

- To become familiar with the principle of plethysmography and its usefulness in qualitatively assessing peripheral changes in blood volume.
- To observe and record changes in peripheral blood volume and pressure pulse under a variety of both experimental and physiological conditions.
- To determine the approximate speed of the pressure pulse wave travelling between the heart and the finger.
- To illustrate the electrical activity associated with normal cardiac activity and how it relates to the flow of blood throughout the body.

Lesson 8   Respiratory I

- To record and measure ventilation utilizing pneumograph and air temperature transducers.
- To show how ventilation relates to temperature changes in airflow through one nostril.
- To observe and record chest expansion and contraction and modifications in the rate and depth of the breathing cycle due to cerebral influence and chemoreceptor influence on the medullary control centers.

Lesson 9   EDA & Polygraph

- To become familiar with procedures for recording electrodermal activity.
- To observe and record changes in respiratory rate, heart rate, and skin resistance associated with somatic and special sensory stimuli.
- To observe and record changes in respiratory rate, heart rate, and skin resistance associated with cognitive behavior and emotion.
- To analyze a 3-channel polygram recorded under various experimental conditions to gain a better understanding of polygraphy and its potential for use and misuse.

Lesson 10   EOG I

- Record EOG and compare eye movements during real and simulated tracking of a pendulum.
- Record EOG and compare eye movements during real and during simulated tracking of an object in the vertical plane.
- Record and compare the "saccadic" eye movements when reading three different ways; silently (easy), silently (challenging) and aloud (challenging).

Lesson 11   Reaction Time I (Auditory Reaction Time)

- Observe the effect of learning and the effect of anticipating the stimulus delivery on reaction time.
- Compare reaction times in four stimulus-response situations:
  - a) Fixed interval stimulus presentation using the dominant hand for the response.
  - b) Random interval stimulus presentation using the dominant hand for the response.
  - c) Fixed interval stimulus presentation using the nondominant hand for the response.
  - d) Random interval stimulus presentation using the nondominant hand for the response.
- Compare the reaction times for groups of subjects by calculating the statistics of group mean, variance, and standard deviation in each of the four stimulus-response situations.

Lesson 11A   Reaction Time II (Visual Reaction Time)

- Observe the effects of learning and anticipation of the stimulus delivery on reaction time.
- Compare reaction times in four stimulus-response situations:
    - e) Fixed interval stimulus presentation using the dominant hand for the response.
    - f) Random interval stimulus presentation using the dominant hand for the response.
    - g) Fixed interval stimulus presentation using the nondominant hand for the response.
    - h) Random interval stimulus presentation using the nondominant hand for the response.
- Compare the reaction times for groups of subjects by calculating the statistics of group mean, variance, and standard deviation in each of the four stimulus-response situations.
- Compare the visual stimulus reaction times to the auditory stimulus reaction times obtained in Lesson 11 (Reaction Time I).

Lesson 12   Pulmonary Function I

- To observe, record and/or calculate selected pulmonary volumes and capacities.
- To compare the observed values of volume and capacity with average values.
- To compare the normal values of pulmonary volumes and capacities of subjects differing in sex, age, weight, and height.

Lesson 13   Pulmonary Function II

- To observe experimentally, record, and/or calculate forced expiratory volume (FEV) and maximal voluntary ventilation (MVV).
- To compare observed values of FEV with predicted normals.
- To compare MVV values with others in your class.

Lesson 14   Biofeedback

- To introduce the concept of biofeedback training for relaxation.
- To measure levels of arousal via heart rate and electrodermal activity (EDA).

Lesson 15   Aerobic Exercise Physiology I

- Record and compare changes in pulmonary airflow before, during, and after a brief period of moderate exercise.
- Record and compare changes in respiratory rate and changes in heart rate before, during, and after the exercise period.
- Compare and note any changes in Lead II electrocardiogram recorded before, during, and after moderate exercise.
- Record and compare changes in skin temperature associated with the brief periods of moderate exercise and recovery.

Lesson 16   Blood Pressure

- To use an auscultatory method for an indirect determination of systemic arterial systolic and diastolic blood pressures and — To correlate the appearance and disappearance of vascular sound with systolic and diastolic pressures respectively.
- To measure, record, and compare systemic arterial blood pressure in the right arm and the left arm of the same Subject under identical conditions.
- To measure, record, and compare systemic arterial blood pressures in the same Subject under different experimental conditions of rest and exercise.
- To compute and compare pulse pressure and mean arterial pressure under different experimental conditions of rest and exercise.
- To compute the pulse pressure wave velocity by measuring the time between the R-wave of the ECG and the Korotkoff sounds.

Lesson 17 Heart Sounds

- To listen to human heart sounds and describe them qualitatively in terms of intensity or loudness, pitch, and duration.
- To correlate the human heart sounds with the opening and closing of cardiac valves during the cardiac cycle and with systole and diastole of the ventricles.
- To determine the nature of the change in the relationship between electrical and mechanical events of the cardiac cycle as heart rate increases.

Lesson 20 Spinal Cord Reflexes

- To become familiar with anatomical and physiological elements of simple spinal reflexes.
- To examine properties of some simple neuromuscular reflexes commonly tested in physical diagnosis.
- To measure and compare latent periods and reaction times of extensor and flexor reflexes.
- To elicit an extensor reflex and compare contractile force vs. stimulus strength.
- To apply the Jendrassik maneuver and observe exaggeration of an extensor reflex.
- To measure and compare reaction times of voluntary activation of skeletal muscle vs. involuntary (reflex) activation of skeletal muscle.

Biopac Student Lab PRO Features

For advanced studies and customized lessons, use the **Biopac Student Lab *PRO***. This powerful software option is included with the Biopac Student Lab, and detailed information is available in the digital *PRO* Manual under the BSL *PRO* Help menu or in the installed User Support folder.

Biopac Student Lab *PRO*	(BSL *PRO* is installed with the Biopac Student Lab)
Easy to use	The Biopac Student Lab *PRO* offers the same convenient and easy-to-use features that Windows® users are accustomed to. Since the Biopac Student Lab *PRO* software runs under these environments, you can run other applications while you are collecting data. In terms of hardware setup the Biopac Student Lab *PRO* uses simple plug-in connectors and standard interface cables. You don't need a degree in electronics to set up your system.
Flexible setup	The Biopac Student Lab *PRO* can be configured for a wide variety of applications, from single channel applications to multiple-device (up to 4 analog) measurements. Control the length of acquisition, the rate at which data is collected, how data is stored, and more.
Flexible acquisition rates	The Biopac Student Lab *PRO* can acquire data from 1 to 100,000 samples/sec. This allows recording of almost all physiological parameters from slow moving temperature data to fast response action potential data.
Flexible menu display	Easily customize menu displays to show only the functions you are using, thereby reducing the risk of error or confusion in the lab. This is particularly powerful for laboratories working to GLP guidelines and is also useful for teaching applications.
On-line calculations	Although the Biopac Student Lab *PRO* software provides an extensive array of measurements and transformations you can apply to collected data, sometimes you need to perform computations *while* data is being collected. The On-line Calculation functions allow you to calculate new channels based on incoming signals. This feature allows you to compute BPM, for instance, based on raw ECG data.
On-line filtering	Many times, it is preferable to filter data as it is being collected, rather than having to wait until after the fact, so now you can apply filters to incoming data and view the results in real time. That means on-line monitoring of data filtered to suit your needs.
On-line measurements	The Biopac Student Lab *PRO* software can instantly compute over a twenty measurements and computations for any given data point(s). These options are available from pull-down menus and include mean; peak-to-peak value; standard deviation; frequency; and BPM.
Grid options	You can apply several different grid styles to your data to help with analysis. UNLOCKED grids help you view the data display on the monitor whereas LOCKED grids help more with printing. You can set the Grid Options to create printouts that look similar to chart recorder output. Add minor grid lines if desired, and select the line width, color, and style for all grid lines.
Presets	There are over 80 factory-established "Presets" that allow the user to easily configure hardware parameters. These presets can be modified, and/or new presets can be created and saved for later use.

Graph templates	This powerful feature allows instructors to predefine experiments. Students simply open the template file and click "Start" to run the experiment. A sample graph template file (HeartTemplate.gtl) is included with the *PRO* installation.
Preview your data	Biopac Student Lab *PRO* allows you to change both the vertical scale and the horizontal scale. You can change the amplitude scale or the time scale to any value you wish, or you can have the Biopac Student Lab *PRO* software automatically scale them for you.
Simplified editing	Delete unimportant sections of your data with a keystroke. You can "paste" together sections from different waves, or edit out noise spikes from individual waves.
Append mode	For some applications, data only needs to be recorded during some portions of a long experiment. The Biopac Student Lab *PRO* software has an Append mode that lets you pause the acquisition for as long as you wish, and resume the acquisition as many times as needed. When data are acquired in this mode, you can start and stop a recording as you would with a chart recorder. This saves on storage space and processing time for transformations.
Digital filtering	All data contains measurement error and noise. Now you can reduce or eliminate that error by using the digital filters and smoothing transformations included in the Biopac Student Lab *PRO* software. You can smooth data or filter out noise from any frequency or bandwidth you wish.
X/Y plotting	You can view and acquire data in the form of an X/Y plot, with one channel on the horizontal axis and another on the vertical axis. This allows you to explore relationships between different channels and opens up a whole range of applications, from chaos plots to respiration analysis to vectorcardiograms.
Histogram function	You can easily examine the variability and the measures of central tendency of any waveform data with the histogram function. Set the plotting options to suit or let the software determine the "best fit" for graphing data.
Math functions	In many cases, simply collecting raw data is not enough. The BSL *PRO* software has an array of built-in mathematical functions ranging from simple absolute value functions to computation of integrals, derivatives, and operations involving multiple waveforms (such as subtracting one wave from another). You can even chain multiple functions together to form complex equations.
Media Capture	Connect a USB camera and capture audio/video of a subject during acquisition. This captured media can be viewed during acquisition and playback of the linked data file. (BSL 3.7.7 and later only)
Triggering	If you need to measure response times or start data collection only after some event has occurred, the Biopac Student Lab *PRO* software allows you to trigger an acquisition in a number of different ways. You can trigger on the level of a signal, or with an external synchronizing trigger.
Event markers	Many times, especially during a long acquisition or in a laboratory setting, it is useful to make a note of when specific events (such as manipulation) occur, so that any changes in the data can be noted. The marker function allows you to insert symbols in the record and add up to 80 characters of text for each marker. Markers can be added either while data is being collected or after the fact.

File compatibility	With the Biopac Student Lab *PRO* software, you can save data in a number of different formats. You can output data in either text or graphical form, and export or use the clipboard to place data in other programs. Use BSL *PRO* data in word processing programs like Microsoft Word®, spreadsheet programs like Microsoft Excel®, drawing programs like Aldus IntelliDraw®, or desktop publishing programs like Aldus PageMaker®. Biopac Student Lab *PRO* software will even read-in raw data from a text file.
Pattern recognition	Using an advanced pattern search/recognition algorithm, the Biopac Student Lab *PRO* software can automatically find a specific pattern within waveforms. This is useful for finding abnormal waveforms (such as irregular ECG waves) within a data file.
Peak detection	The Biopac Student Lab *PRO* software has a built in algorithm to find either positive or negative peaks from any size data file. You can even search for all the peaks with one command and automatically log statistics like peak time and area to the journal.
Printing options	The Biopac Student Lab *PRO* software provides a range of printing options, and allows you to fit data on one page or many. You can also print several graphs per page, even if you only have one-channel recordings.
Sample data files	The Biopac Studetnt Lab *PRO* installation disk includes sample data files from: a 4-channel recording, Blood Pressure, EEG, EMG with Force, Finger Twitch, and more.
User support	Whether you have a question about compatibility with existing equipment or need to develop a specialized measurement device, BIOPAC's Applications Department can address the problem. Plus, you can visit the BIOPAC website at **www.biopac.com** for answers to frequently asked questions, product information, and a wide array of Application Notes.

BSL Curriculum Management System

The **BSL Curriculum Management System** is available through optional licensing in BSL 4.1 and above only. The license must be authorized to use this lesson customization tool. To add a license to an existing Biopac Student Lab installation, please contact BIOPAC.

Overview

The BSL Curriculum Management System is a licensed feature that allows instructors to substitute customized lesson content and create user-defined onscreen lesson instructions for any existing BSL Lesson. It also has a built-in networking feature allowing instructors to easily broadcast customized content to student workstations over a local network. The level of control over lesson customization in the BSL Curriculum Management System goes well beyond the scope of standard BSL Lessons & *PRO* and is ideal for instructors wishing to create, edit, and modify content in a seamless, flexible fashion.

Use the BSL Curriculum Management System to:

- Associate custom recording procedures, analysis procedures, introductions and data reports with any existing BSL Lesson with a mouse-click. (Any user-defined PDF can be substituted for the default BSL Lesson PDFs.)

- Edit onscreen HTML Journal content to create custom onscreen instructions with the built-in BSL Visual editor.

- Configure Instructor (Host) and Student (Client) network settings for sharing lesson content. You don't need to be an I.T. expert! Simply select the Host and Client computers in the BSL *PRO* Preferences to connect automatically over your local network.

- Share *PRO* Lessons and Shared Lessons over your network.

  o BSL *PRO* Lessons - H01-H36 and A02-A17

  o **Shared Lessons** are custom lessons created by the instructor.

For more information on the BSL Curriculum Management System licensed feature, see Chapter 18 of your BSL *PRO* Manual or contact BIOPAC.
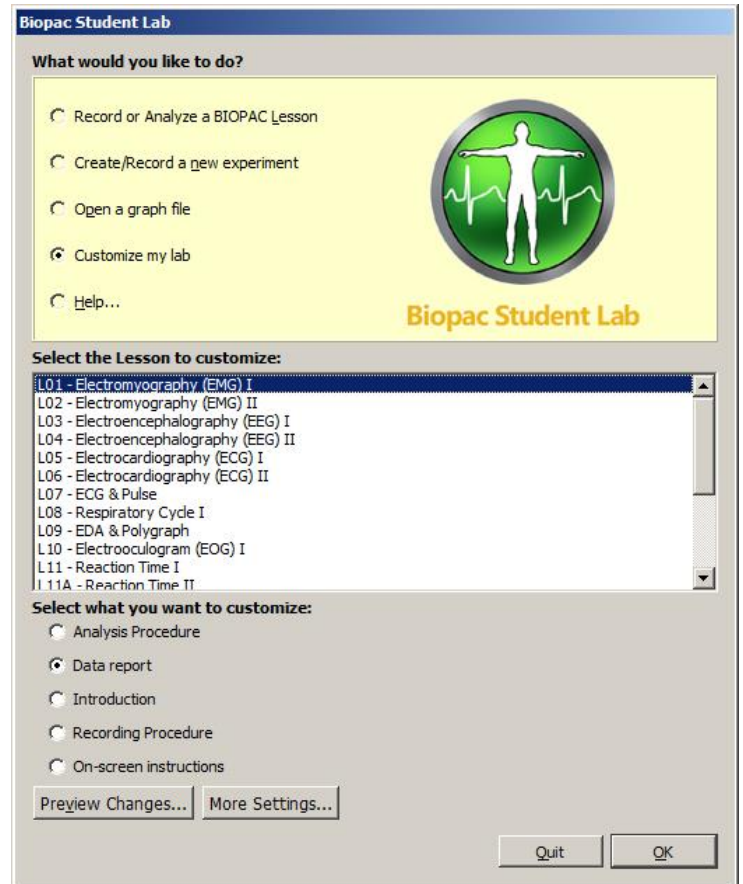
MP36/35 Data Acquisition Unit Technical Information

The MP Data Acquisition Unit is the heart of the Biopac Student Lab System. The MP Unit has an internal microprocessor to control data acquisition and communication with the computer. The MP Unit takes incoming signals and converts them into digital signals that can be processed with your computer. There are four analog input channels, one of which can be used as a trigger input. You will need to connect the MP Unit to your computer and connect electrodes, transducers, and I/O devices to the MP Unit. You are encouraged to take a few minutes to familiarize yourself with the MP Unit prior to making any connections.

The MP36/35 Data Acquisition Unit is a physiological data recorder designed for medical educational purposes. This system is used in medical education and research facilities. This system is not used for the mitigation, cure or diagnosis of disease. This device is NOT used in the home. Subject to IEC60601-1, the MP36/35 Data Acquisition System is CLASS II, type BF equipment.

Symbols — MP36, MP35, and MP46/45

Symbol	Description	Explanation
	Type BF Equipment	Classification
	Attention	Consult accompanying documents
	On (partial)	Turns MP35 on assuming AC300A power adapter is powered by the mains
	Off (partial)	Turns MP35 off if but AC300A power adapter remains powered by the mains
	Direct current	Direct current input
	USB	USB port
	Functional Earth Ground	Functional Earth Ground Connection
	Class II Equipment	Class II Medical Equipment, as established by IEC60601-1
	Fuse	Equipment Fuse

Compliance

Safety

The MP36/35 satisfies the Medical Safety Test Standards affiliated with IEC60601-1. The MP36/35 is designated as Class I Type BF medical equipment

EMC

The MP36/35 satisfies the Medical Electromagnetic Compatibility (EMC) Test Standards affiliated with IEC60601-1-2.

Types of Input Devices

There are three types of devices that connect to the MP UNIT: electrodes, transducers, and I/O devices.

Electrodes are relatively simple instruments that attach to the surface of the skin and pick up electrical signals in the body.

Transducers, on the other hand, convert a physical signal into a proportional electrical signal.

Input/Output devices (I/O for short) are specialized devices like pushbutton switches and headphones.

Simple Sensor Connectors

Regardless of the type of device connected, every sensor or I/O device connects to the MP UNIT using a "Simple Sensor" connector. Simple Sensor connectors are designed to plugs only one way into the MP UNIT, so you don't have to worry about plugging things in upside down or into the wrong socket.

Electrodes, transducers, and the pushbutton switch all connect to the channel input ports on the front panel of the MP UNIT.

Headphones and the stimulator connect to the "Analog out" port on the back panel of the MP UNIT.

MP36/35 only: A digital device may connect to the "I/O Port" on the back panel

MP36/35 only: A trigger device may be connected to the "Trigger" port on the back panel.

Front Panel

Front Panel, MP UNIT

The front panel of the MP UNIT has an electrode check port, four analog input ports, and two status indicators.

Electrode Check

[人] The Electrode Check port is a diagnostic tool used with the BSL *PRO* software to determine if the electrodes are properly attached to the subject.

Input ports: CH 1, CH 2, CH 3, and CH 4

[人] The inputs on the MP UNIT acquisition unit are referred to as Channels. There are four 9-pin female analog input ports on the front of the MP UNIT. The Biopac Student Lab Lessons software will always check to see that you have the proper sensors connected to the appropriate channel.

Status indicators

The Busy status indicator is activated when the MP UNIT is acquiring data and also during the first few seconds after the MP UNIT is powered on to indicate that a self-test is in progress. (When the MP UNIT passes the power-on test, the Busy light will turn off.)

The Power status indicator is illuminated when the MP UNIT is turned on.

Back Panel

Back Panel, MP36/35

The back panel of the MP36/35 has an analog output port, a USB port, an I/O Port, a Trigger Port, a DC input, a fuse holder, and a power switch, and the unit's serial number.

Analog Out port

There is one 9-pin male "D" analog output port on the back of the MP UNIT that allows signals to be amplified and sent out to devices such as headphones.

USB port (MP36/35 only)

The MP36/35 connects to the computer via a USB Port, located just below the word USB.

- Uses a standard USB connector.
- Should only be used to connect the MP36/35 to a PC or Mac.

Headphone Output (MP36/35 only)

- Accepts a standard (1/4" or 6.3 mm) stereo headphone jack.

I/O Port (MP36/35 only)

- Accepts a DB 25 Female connector.
- Input/Output port used to connect digital devices to the MP36/35.

Trigger Input (MP36/35 only)

- Accepts a male BNC connector.
- Input port used to send trigger signals from another device to the MP36/35.
- Used to synchronize MP36/35 units when more than one MP36/35 is used.

DC Input

Use the DC Input to connect an AC300A power adapter or BAT100 battery to the MP36/35.

The power supply requirements for the MP UNIT are 12 VDC @ 1 Amp. Only use the AC300A power adapter with the MP36/35. The AC300A is a 12 VDC @ 1.25 Amp power supply adapter that can connect to any mains rated as 100-250 VAC @ 50/60 Hz, 40VA.

The receptacle is configured to accept a "+" (positive) input in the center of the connector and a "-" (negative) input on the connector housing.

The functional earth ground on the AC300A Power Adapter is tied to Mains earth ground and accessible metal parts on the MP36/35 unit.

The AC300A power adapter is Class II and when it is used to power the MP36/35, the MP36/35-AC300A combination is Class II. The MP36/35 unit also incorporates an additional level of isolation between the AC300A power adapter and the Subject.

Fuse holder

The fuse holder contains a fast-blow fuse that helps protect the MP UNIT from shorts on its power, analog, and digital I/O lines. The MP36/35 uses a 1.0 A, 250 V, 3AG, fast-blow fuse and the MP30 uses a 2.0 A, 250 V, 3AG, fast-blow fuse.

To remove the fuse, use a screwdriver to remove the fuse cover located below the word Fuse.

Power switch

ON position — powers up the MP UNIT

OFF position — cuts the flow of power to the MP UNIT

Mains Power Disconnection

To completely disconnect the MP36/35 unit and the AC300A power adapter from all poles of the supply mains, extract the power cord plug from the mains outlet. Extract the plug by grasping the plastic shell of the plug and pull firmly away from the mains outlet in a direction perpendicular to the face of the mains outlet. Take care not to touch the metal blades associated with the plug. This procedure will fully power down (de-energize) the MP36/35 unit and AC300A power adapter. Please note that the power switch on the back of the MP36/35 unit turns power ON and OFF to the MP36/35 unit only.

Cleaning Procedures

Be sure to unplug the power supply from the MP UNIT before cleaning. To clean the MP UNIT, use a damp, soft cloth. Abrasive cleaners are not recommended as they might damage the housing. Do not immerse the MP UNIT or any of its components in water (or any other fluid) or expose to extreme temperatures as this can damage the unit.

Sterilization and Disinfection

Disposable, sterile, single-use-only, accessories are used with the MP UNIT for educational (teaching) applications. Non-disposable accessories can be disinfected, if required, with Cidex® or equivalent.

MP36/35 Input > Output Scaling

The MP36/35 hardware can pipe signals from any channel input to the output using the "CHX to Output" control panel in the BSL *PRO* software—due to the difference between the input and output range, there will be a change in signal level (scaling). The output range depends on the MP device and the output pin used as shown in the following table. Note that when using MP35 output pin 2, there is an additional baseline offset (2.048 V) applied.

Output Pin (Analog Out port)	Pin Description	Output Range (Volts)
Pin 1* - MP36/35	Headphones, A.C. Coupled	-2.048 to +2.048
Pin 2 - MP36	Low Voltage Stimulator, D.C. Coupled	-10 to +10
- MP35	CH Data, D.C. coupled	0 to +4.095 V (baseline offset of 2.048 V)

The input range is gain dependent. The table below shows the scaling (multiplying) factors to use for each gain setting.

Gain	Input Range +- millivolts	Output Scale***—*accurate to ±10%*	
		Factor 1 **Pin 1** (Headphone out) and Pin 2 (MP35 only)	*Factor 2* **Pin 2** (Low Voltage Stimulator) – MP36 only
x5**	± 2 V	1.024	5
x10	± 1 V	2.048	10
x20	± 500 mV	4.095	20
x50	± 200 mV	10.238	50
x100	± 100 mV	20.475	100
x200	± 50 mV	40.950	200
x500	± 20 mV	102.375	500
x1,000	± 10 mV	204.750	1,000
x2,000	± 5 mV	409.500	2,000
x5,000	± 2 mV	1023.750	5,000
x10.000	± 1 mV	2047.500	10,000
x20,000	± 0.5 mV	4095.000	20,000
x50,000	± 0.2 mV	10238.000	50,000

Notes

* 1: To properly measure the output signal you need at least a 2K Ohm load.

** 2: x5 only available on MP36 and MP46/45.

*** 3. Input to Output scaling is accurate to within 10%.

Example:

MP35, input signal level = ±10 mV (20 mV- pk to pk), input gain = x100, Output on pin 2.

Signal output level = 20 mV-pk to pk x 20.475 = 0.4095 V pk to pk.

However there is a baseline offset of 2.048 V, so actual signal output level is:

Lowest level = 2.048 V – (0.5 x 0.4095 V) = 1.843 V

Highest level = 2.048 V + (0.5 x 0.4095 V) = 2.253 V

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Limited Warranty

BIOPAC Systems, Inc. guarantees its equipment against all defects in materials and workmanship to the original purchaser for a period of 12 months from the date of shipment unless otherwise stated below; effective 1-1-2015, BIOPAC MP36 units are guaranteed against defects in materials and workmanship to the original purchaser for a period of 60 months (5 years) from the date of shipment.

If BIOPAC Systems, Inc. receives notice of such defects during the warranty period, BIOPAC Systems, Inc. will at its option, either repair or replace the hardware products that prove to be defective in materials or workmanship. 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., your BIOPAC Systems, Inc. product has been damaged by alteration, accident, abuse, misuse, neglect, improper packing, shipping, modification or servicing, by any party other than BIOPAC Systems, Inc. If a problem arises, please contact us for authorization before returning an item.

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 to accept delivery of any shipment containing any shipping carton which does not have the RMA number(s) displayed on the outside. The Buyer will prepay transportation charges to the BIOPAC Systems, Inc. designated site. The warranty period for repairs and for used equipment purchased from BIOPAC is 90 days.

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