The BSL System provides extensive recording and analysis options for signal processing curriculum, including bioelectric and biomechanical studies. The data acquisition unit includes four universal, software-programmable amplifiers to record biopotential and transducer signals. The BSL hardware/software combination can be tailored for a wide range of measurements with analysis tools for digital filtering, integration, differentiation, FFT, convolution, correlation, and a host of signal processing options. Students build and test real circuits and then use the software to compare real results to simulation.

**Signal Analysis & Processing**

The BSL software has an extensive library of signal processing functions permitting graphical insight to analytical methods. The software can demonstrate the procedure and consequences associated with simple to complex signal processing methodologies. For example, students can view data before and after IIR or FIR filter processing, build a complex waveform from periodic signals (i.e., create a square wave from multiple sine waves) and decompose the result, or apply non-linear processing methods to data. Use the XY display mode to generate Lissajous patterns and investigate chaotic phenomena and demonstrate phase relationships between two variables. Signals can be correlated and convolved. Use the histogram function to focus on distribution of specific signal measures.

**Transducers & Calibration**

The BSL System employs a wide array of transducers that transform physical measures into electrical signals. The generic input design of the MP36 acquisition unit allows it to interface a huge variety of third-party or completely unique transducers. Students can use the BSL software to linearize and calibrate transducers and then compare results to expected values. Relate fundamental physical standards to more complicated measures. For example, calibrate the Airflow Transducer with a syringe, and then use the Airflow Transducer to calibrate a respiration sensor designed to monitor thoracic circumference.

**Human & Animal Physiology**

The wide range of human and animal physiology experiments provide a powerful tool for teaching students the best technique and methodology for making a measurement. Each experiment demonstrates fundamental physiological concepts and educates students in the setup, recording and analysis process. Physiology basics are clearly explained. See pages 10-13 for details.
Programming Options

Students can create their own programs to control the MP36 hardware with the BHAPI hardware application program interface. Students can also develop their own analysis programs to read the BIOPAC file format with the ACKAPI software application program interface. See page 24 for details.

Physiological Control Systems & Compartmental Analysis

Implement simple experiments illustrating physiological control systems and compartmental analysis with the BSL System. The students can observe signal changes and then effect a change to observe a particular response. Investigate linear and nonlinear control paradigms. Create simple to intricate feedback loops where students perform a specific role in the loop operation. For instance, students can explore Westheimer's saccadic eye movement model which represents the eye as a 2nd order system — then record eye motion via EOG set up, and then compare the real results to the modeled results to validate or adjust the model.

Biomechanics

The Student Lab System has a comprehensive ability to monitor gait and other mechanical responses. The system works with Goniometers, Accelerometers, Heel-Toe Strike transducers and Tri-Axial Accelerometers. Biopotential signals such as EMG can be synchronously recorded. Use the Hand Dynamometer and Tri-Axial Accelerometer to measure isometric and isometric performance. Goniometers are available for evaluating one or two degrees of freedom from the same joint (e.g. wrist flexion/extension and radial/ulnar deviations). Use the XY display mode to monitor motion resulting from two degrees of freedom. Model mechanical systems, demonstrate principles of biomechanical resonance or inertial navigation (acceleration, velocity and position), or convert gravity vectors (from Tri-Axial Accelerometers) into associated “tilt” angles for use in ergonomic evaluations. See page 16 for details.

Instrumentation Design

The new signal processing breadboard allows students to build and test real-world signal processing circuit modules and then verify their performance against mathematical simulation using graphical comparisons. Students can combine circuit modules, collect physiological signals and then analyze the results. Each circuit module constitutes an important subset of circuit design when recording and processing physiological signals. The BSL system is used like an oscilloscope to make measurements for circuit module evaluation.

Interface with Existing Equipment

The BSL System offers over 60 industry-standard transducers. Further, the BSL System interfaces with other major amplifier and transducer manufacturers encompassing the most commonly used biomedical engineering instruments and sensors by using a wide variety of interface connectors and cables. Choose from 18 ready-made interface connectors, or build your own with the custom interface kit.

Perform 29 or more lessons with this core package:

Muscular

- BSL1 Standard & Integrated EMG
- BSL2 Motor Unit Recruitment & Fatigue
- H07 EMG Contractions—Active Learning
- H27 Facial EMG
- H34 EGG Electrogastrogram
- H36 Muscular Biofeedback

Cardiovascular

- BSL5 Components of the ECG (Lead II)
- BSL6 Leads I, II, III & Einthoven's Law
- BSL7 ECG & Pulse
- BSL16 Blood Pressure & Korotkoff Sounds
- BSL17 Heart Sounds & Cardiac Events
- H08 Dive Reflex—Active Learning
- H23 Signal Averaged ECG
- H32 Heart Rate Variability

Pulmonary Function

- BSL12 Pulmonary Function: Vol. & Capacities
- BSL13 Pulmonary Flow Rates: FEV and MVV

Neurophysiology

- BSL3 EEG Relaxation & Brain Rhythms
- BSL4 Alpha Rhythms in the Occipital Lobe
- BSL10 EOG Eye Movement, Saccades & Fixation
- BSL11 Reaction Time
- H10 EEG & Hemispheric Asymmetry
- H12 EEG Saccades & Displacement
- H13 EEG Visual Tracking vs. Imagination
- H14 Ocular Fixation while reading
- H15 Ocular Fixation while viewing an image
- H16 Reflexes & Reaction Time - Active Learning

Bioengineering

- H02 Compartmental Modeling
- H20 BME Filtering
- H25 BME Signal Processing (8 modules)
- H26 ECG R-wave Detector
- H33 FFT Fast Fourier Transformation

See page 44-44 for a description of all available lessons.

Increase your lab options with...

- Cardiac Output Sensor
- O₂ & CO₂ Analysis Module
- Finger Twitch Transducer
- Heel/Toe Strike Transducer
- Stimulator
- Tri-Axial Accelerometer
- Transducer Accessory Pack