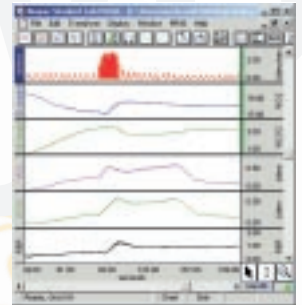


exercise physiology & biomechanics

With the Biopac Student Lab, it's simple to combine a wide range of respiratory system & pulmonary function signals with biomechanical data. Use the new Gas Analysis Module for online analysis of expired O_2 and CO_2 levels. Simultaneously record continuous, noninvasive blood pressure and cardiac output (bioimpedance method). BIOPAC offers transducers for angle of limb movement, acceleration, heel-toe strike, etc. for gait analysis, range of motion and other related studies. The system easily interfaces with force plates, motion analysis equipment and other instrumentation.

Respiratory & Pulmonary Function

The BSL includes a range of experiments for pulmonary function and Gas Analysis studies. Detailed lessons guide students through the classical pulmonary function tests, including tidal volume, inspiratory capacity, expiratory capacity, functional residual capacity, vital capacity, total lung capacity, forced vital capacity, forced expiratory volume ($FEV_{1, 2, 3}$) and Maximal Voluntary Ventilation (MVV).



Respiratory exchange ratio

Gas Analysis

Use the new Gas Analysis Module to create a powerful metabolic analyzer (cart) for students to measure expired O_2 and CO_2 and use lessons for VO_2 , Respiratory Exchange Ratio, and Basal or Resting Metabolic Rate. Combine metabolic and cardiac output measurements to give students a detailed view of a variety of cardiopulmonary responses. If your protocol examines CO_2 above 5% or requires high-speed response, contact BIOPAC to discuss the full range of gas analyzers.



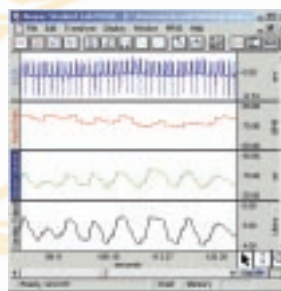
Airflow Pressure/Volume loop

features

- 27 lessons targeted for Exercise Phys. & Biomechanics
- ECG, EEG, EMG, EOG & EGG
- Respiration
- Temperature
- Airflow & Lung Volume
- Gas Analysis (CO_2 & O_2) — Metabolic Cart
- Cardiac Output (via bioimpedance)
- Respiratory Exchange Ratio
- Basal or Resting Metabolic Rate
- Motor Unit Recruitment
- 12-Lead ECG
- Heart Sounds
- Blood Pressure
- Stroke Volume
- Gait Analysis (including Heel-Toe Strike)
- Range of Motion
- Acceleration, Velocity, Distance

Suitable for inquiry-based, active learning in 2-yr. & 4-yr. programs, medical schools, and nursing programs

Cardiovascular



Cardiac output data

The BSL System includes many ECG lessons, including 12-lead ECG, cardiac output, and continuous blood pressure lessons. A Heart Sounds lesson allows students to listen to and record heart sounds, while comparing them to the ECG complex. There are also lessons for the Wingate test and Blood Pressure Response to Isometric Straining Exercise. Record cardiac output from human subjects—connect the bioimpedance electrodes to a subject and record stroke volume and cardiac output in real time pre- and post-exercise. There is also an option for continuous blood pressure monitoring, during exercise.

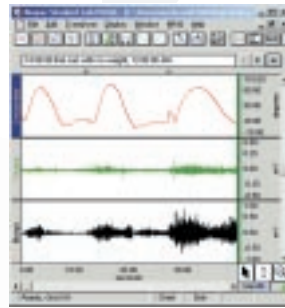
Biomechanics

Students can use the new Reflex Hammer in conjunction with EMG recordings to compare responses and reflex actions. For advanced studies,

I purchased the MP30 Advanced System and have found the student labs helpful in explaining and demonstrating physiological concepts and current technology. Personally, I have been using the *PRO* software for my own research purposes. I have instrumented an old cybex isokinetic ergometer with a force transducer to measure force and a potentiometer to measure joint angle. Data acquisition has been going very smoothly. I have been quite impressed with the *PRO* software and its abilities. I have set up a calculation channel that accounts for gravity's affect on limb weight at all joint angles throughout a range of motion. This allows me to accurately estimate muscular resistance. Our area rep took the time to come down to see us and has been helpful with questions.

—Dain LaRoche, Johnson State College, Environmental and Health Sciences

add angle of limb movement as a subject performs a variety of tasks. The system has transducers for recording heel and toe strike and acceleration for gait analysis studies. Use the Hand Dynamometer and Tri-Axial Accelerometer to measure isotonic 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). Record Sit & Reach tests and analyze range of motion. Use the *XY* display mode to monitor motion resulting from two degrees of freedom. The BSL software will determine velocity of motion and calculate acceleration.



Goniometry data

Nerve Conduction

Combine the human-safe stimulating electrode with the stimulator to record nerve conduction experiments. Stimulate the ulnar nerve and record nerve conduction time (Lesson H03). The procedure allows students to stimulate a subject at three different points along the ulnar nerve. The distance between the stimulation and recording points is measured and the velocity of signal propagation along the nerve is calculated.

Muscular

Students can measure EMG and Integrated EMG, including force and angle of limb movement. Students can listen to the sound of the electrical activity coming from muscle as they squeeze a hand dynamometer and equate changes in sound with changes in force. Add the BSL Stimulator and human-safe stimulation electrode for a variety of muscle stimulation experiments. Include visual and auditory feedback with touch for Muscular Biofeedback studies.



Ergometer modified to record WAnT using BIOPAC

Photo courtesy A. Zidermanis, PhD, formerly at Parker College of Chiropractic

Interface with Existing Equipment

The BSL System offers over 60 industry-standard transducers. Further, the system easily interfaces with other major amplifier and transducer manufacturers encompassing the most commonly used exercise physiology lab products such as force plates, ergometers, motion analysis systems, and metabolic carts. The BSL System can trigger or receive trigger information from other equipment. For interfacing, choose from a variety of ready-made connectors and

cables, or use the custom connector kit (page 39). BIOPAC support staff can help determine the appropriate interface for any complete system.

The following hardware suggestions will enable you to perform a wide variety of applications targeted for **exercise physiology & biomechanics**. Use BIOPAC lessons or easily create your own experiments with the BSL *PRO* software included with each system. Order the core package or select items à la carte.

See **BSL Hardware** (page 23) for all available transducers, electrodes and accessories.

Exercise Physiology Core

BSLEXP-W (Win) or BSLEXP-M (Mac)

Basic BSL System	BSLBSC, p. 8
Airflow Filters (10/pk)	AFT1, p. 34
Airflow Mouthpieces (10/pk)	AFT2, p. 34
Airflow Nose Clips (10/pk)	AFT3, p. 34
Airflow Transducer	SS11LA, p. 27
BP Cuff Transducer	SS19L, p. 27
Calibration Syringe (600 ml)	AFT6, p. 34
Electronic Stethoscope Transducer	SS30L, p. 28
Hand Dynamometer	SS25LA, p. 27
Hand Switch	SS10L, p. 26
Headphones	OUT1, p. 26
Pulse Transducer	SS4LA, p. 26
Respiratory Effort Transducer	SS5LB, p. 26
Temperature Transducer	SS6L, p. 26
Surgical Tape	TAPE1, p. 36

Perform 27 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	EKG Electrogastragram
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
H05	WAnT Wingate Test
H08	Dive Reflex - Active Learning
H23	Signal Averaged ECG
H32	Heart Rate Variability

Pulmonary Function

BSL8	Respiratory Cycle
BSL12	Pulmonary Function: Vol. & Capacities
BSL13	Pulmonary Flow Rates: FEV and MVV
BSL15	Aerobic Exercise Physiology

Neurophysiology

BSL3	EEG Relaxation & Brain Rhythms
BSL4	Alpha Rhythms in the Occipital Lobe
BSL11	Reaction Time
H10	EEG & Hemispheric Asymmetry
H16	Reflexes & Reaction Time - Active Learning

Biomedical Engineering

H02	Compartmental Modeling
H20	BME Filtering
H33	FFT Fast Fourier Transform

See page 43-45 for a description of all available lessons.

Increase your lab options with...

Airflow Transducer for Ex. Phys.	SS52L, p. 33
Calibration Syringe (2 L)	AFT26, p. 35
Cardiac Output Sensor	SS31L, p. 29
O ₂ & CO ₂ Analysis Module	GAS-SYSTEM2-EA, p. 34
Finger Twitch Transducer	SS61L, p. 30
Goniometer	SS21L, p. 29
Reflex Hammer	SS36L, p. 30
Stimulator	BSLSTM, p. 25
Transducer Accessory Pack	BSLEXP-TA, p. 42