The Biopac Student Lab provides a wide range of options for animal and tissue experiments. Lessons allow students to study animal and human species for comparative physiology programs. Use the new Gas Analysis Module for human and animal experiments for the analysis of expired O₂ and CO₂. The new Dissolved Oxygen probe allows students to monitor the oxygen consumption of a goldfish. Perform intracellular recording and membrane transport studies.

See Human Physiology on pages 10-11 for more details.

- ECG, EEG, EMG, EOG & EGG
- Temperature
- Gas Analysis CO₂ & O₂
- pO₂
- pH
- Bioimpedance & Cardiac Output
- Force
- Neurophysiology
- Hemodynamics
- Respiratory & Pulmonary Function
- Reaction Time
- Nerve Recordings & Compound Action Potentials
- Membrane Transport (drug delivery)
- Tissue Baths
- Stimulation & Response
- Isolated Heart, Lung, Muscle
- Auditory, Somatosensory & Visual Evoked Response
- Compatible with Cawdad Lab Manual

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

**Cardiovascular Hemodynamics**

Lessons cover ECG (1-12 lead) and allow students to isolate components of the ECG complex and use the averaging features in the software for further ECG analysis. Use the electronic stethoscope to examine heart sounds and then overlap the data to correlate the sounds with the mechanical and electrical events of the cardiac cycle. Record arterial blood pressure and record systolic, diastolic, mean, dp/dt max and min, and use the noninvasive Cardiac Output Sensor to record stroke volume and cardiac output. If flow signals are available, record them simultaneously with pressure to examine vascular resistance and compliance. Plot pressure versus flow to obtain P/V Loops. See the Frog Heart and Turtle Heart lessons on page 45 for refractory heartblock and vagal escape.

**Muscular**

Record EMG to investigate the properties of skeletal muscle. Record and display raw and integrated EMG signals; overlap the signals for better correlation of the data. Measure strength and repeat trials for motor unit recruitment/summation and fatigue. Demonstrate the treppe (staircase) phenomenon. Study the contractility of skeletal muscle with the force transducer and stimulator. The Frog Gastrocnemius lesson records threshold, maximal response, summation, tetanus, and fatigue.

**Compound Action Potential**

Use the new Nerve Chamber (or an existing chamber) with the Low Voltage Stimulator (SS58L, page 25) to record the compound action potential and nerve conduction from the frog sciatic nerve. Record action potentials from cockroaches, crawfish and earthworms. Add a range of drugs and determine the effect they have on the nerve. The new Nerve Chamber includes a drug delivery chamber (agent well) with lid to maximize the quality of the results and improve experimental repeatability.
Lessons to study software included with each (page 23) for all available transducers, and lung experiments. Use the BSL Stimulator to perform research-quality experiments with the cable for ion transport studies. Record and analyze data from isolated heart tissue preparations, including field stimulation, with the BSL Stimulator. Interface with through the entire recording and analysis process. Students can also electrically stimulate modular, flexible configuration. The Visceral Smooth Muscle lesson guides students. The new Tissue Bath Stations provide students with research-quality equipment in a

In vitro Applications

in vivo Applications

The following hardware suggestions will enable you to perform a wide variety of applications targeted for animal physiology. 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.

Animal Physiology Core

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

Basic BSL System (with BSLCLB8

substituted for SS2L)

Dissolved O2 Probe Interface

Force Transducer (200 g)

Lead (unshielded) x 2

Leads (shielded) x 2

Low Voltage Stimulation

Needle Electrodes x 3

Nerve Chamber

Recording Nerve Cable

Stim. Electrodes for animals

Stimulator Nerve Cable

Perform 32 or more lessons with this core package:

Muscular

A08

Frog Nerve

A02

Frog Action potentials

A10

Visceral Smooth Muscle

A11

Resting Potential from Crawdad

A12

Membrane Potential (muscle)

A15

Earthworm Smooth Muscle

BSL1

Standard & Integrated EMG

H07

EMG Contractions - Active Learning

H27

Facial EMG

H34

EGG Electrogastrogram

Cardiovascular

A04

Frog Heart

A09

Turtle Heart

BSL5

Components of the ECG (Lead II)

BSL6

Leads I, II, III & Einthoven’s Law

H08

Dive Reflex - Active Learning

H23

Signal Averaged ECG

H32

Heart Rate Variability

Pulmonary Function

A07

Dissolved O2 (goldfish)—with your probe

Neurophysiology

A01

Frog Pith & Prep

A03

Frog Nerve

A06

Cockroach Nerve

A08

Action Potential

A14

CPG Worm

BSL3

EEG Relaxation & Brain Rhythms

BSL4

Alpha Rhythms in the Occipital Lobe

BSL10

Eye Movement, Saccades & Fixation

H10

EEG & Hemispheric Asymmetry

H12

EOG Saccades & Displacement

H13

EOG Visual Tracking vs. Imagination

H14

Ocular Fixation while reading

H15

Ocular Fixation while viewing an image

Biomedical Engineering

H20

BME Filtering

H33

FFT Fast Fourier Transform

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

Increase your lab options with…

Cardiac Output Sensor

Dissolved O2 Probe

pH Probe

O2 & CO2 Analysis Module

Tissue Bath Station

Temperature Transducer

Transducer Accessory Pack

Neurophysiology

Study EEG under a variety of conditions to explore relaxation and brain rhythms—the software can filter and display each rhythm separately: Alpha, Beta, Delta and Theta. Select from a variety of PRO Lessons to study Alpha rhythms in the occipital lobe, reaction times, and hemispheric asymmetry. Add the EOG (ocular signal) to study eye movement, saccades, tracking, angular displacement, or ocular fixations. Use the stimulator to study evoked response — auditory, visual, or somatosensory. The new high-speed MP35 hardware allows the recording of spontaneous nerve activity, continuously, at speeds of 100,000 samples a second. Add the SuperLab stimulus presentation package to perform stimulus response studies investigating higher order neuronal function in humans. Conduct intracellular and extracellular recordings with glass microelectrodes and Ag-AgCl wire electrodes to study action potentials from a variety of subjects.

Respiratory & Pulmonary Function

The BSL System provides an excellent introduction to respiratory system and pulmonary function volumes and capacities, respiratory rates, breathing, and ventilation. Display and/or print a clinical grid on the data for effective interpretation and training. A complete range of airflow and pressure transducers is suitable for small, medium and large animals as well as humans.

Gas Analysis

Use the new gas analysis system for detailed metabolic studies in small and medium sized animals. Chambers, couplers, facemasks, and tubing options provide setup options for any protocol. The system can provide online measures of O2 and CO2 for RER, VO2 and BMR/RMR. Use the Dissolved O2 probe and lesson to measure the oxygen consumption of a goldfish.

Intracellular & Membrane Transport

Use the Voltage Drive & Current Monitor Cable (BSLCBL10, page 38) to perform ion transport studies. The cable uses the output from the BSL hardware to drive a set of stimulation electrodes and also monitors stimulation current. Use the new High-Impedance Cable (BSLCBL8/9, page 36) to record from the cockroach ventral nerve and for a variety of applications investigating higher order neuronal function in humans. Conduct intracellular and extracellular recordings with glass microelectrodes and Ag-AgCl wire electrodes to study action potentials from a variety of subjects.