SABLE ENABLES

Metabolic and Behavioral Measurement Systems

FLY TO MOUSE TO HUMAN

SABLE SYSTEMS INTERNATIONAL

SABLE ENABLES

Performance, Trust & Expertise

Superior Performance

Easy to use Sable high performance metabolic and behavioral measurement systems provide the highest resolution and deliver the most accurate results. Our systems set the standard that no other analyzers can match. You'll see every aspect of metabolism and behavior more clearly, with finer detail, quality and repeatability – giving you complete confidence in your data.

Trusted Results

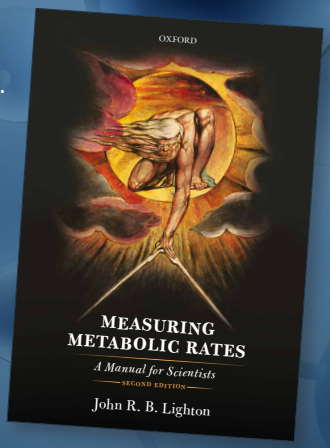
Our systems have been adopted by thousands of users worldwide, with results featured in thousands of peer-reviewed published studies. Our unique raw data storage protocol means there are no hidden algorithms or pre-conditioning of data – just fully traceable results that are available anytime for re-analysis. We make it easy for you to extract the parameters important to your research, such as energy expenditure, metabolic substrate selection, food and water uptake, meal and drinking patterns, position, total activity and wheel-running, and live body mass.

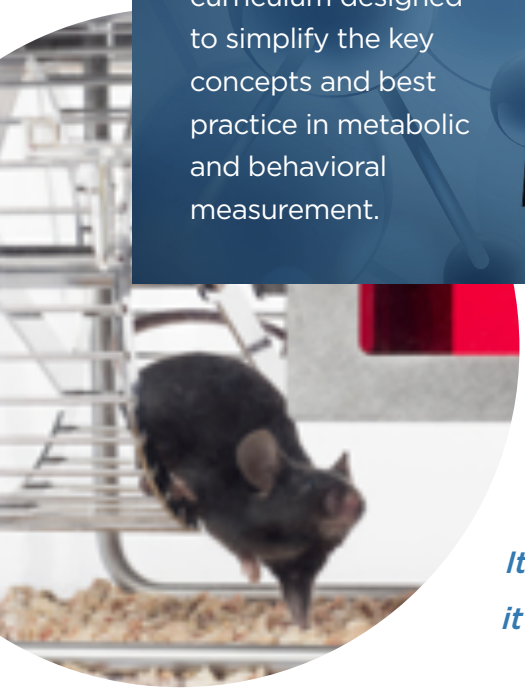
Expert Support

Our systems are designed by scientists, for scientists. Our knowledgeable staff assists you every step of the way, including experimental design, system configuration, setup, training and ongoing support.

Education

We are passionate about learning your application and sharing our expertise with you. Our founder and Chief Scientist, John R. B. Lighton, wrote the book "Measuring Metabolic Rates, A Manual for Scientists" – published by Oxford University Press and widely recognized as the world's most definitive text on metabolic measurement. We offer educational courses with hands-on curriculum designed to simplify the key concepts and best practice in metabolic and behavioral measurement.





"We love our system. It's constantly in use and it worked out beautifully! The support and help are very appreciated."

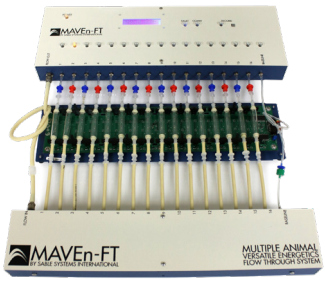
–Prof. Clifford J. Rosen, MD

By Scientists, For Scientists

1987	John Lighton founded Sable Systems International, encouraged by his advisor noted Biologist George A. Bartholomew
1993	First integrated hardware/software respirometry system to researchers at UC Irvine
1995	FC1 fuel cell oxygen analyzer vastly improves stability and accuracy of oxygen analysis
2000	Extended range CO_2 analyzers, with FlowKit mass flow generators for larger animals
2001	Oxzilla dual-channel differential oxygen analyzer, the Gold Standard for O_2 measurement
2004	FoxBox and Turbo Fox portable O_2, CO_2 and flow systems meet the rugged needs of field studies
2006	SSI holds the first of over 45 courses to date in metabolic measurement
2007	Sable respirometry goes into space on the Bigelow Aerospace Genesis II
2008	Oxford University Press publishes *Measuring Metabolic Rates - a Manual for Scientists*, by John Lighton
2010	FMS – the first portable and rugged Field Metabolic System
2010	Promethion™ - the first integrated digital system for metabolism and behavior monitoring
2012	Promethion Human Room Calorimetry system developed with St. Luke's Roosevelt Hospital, NY
2016	MAVEn™ - the first fully integrated energetics system for Drosophila metabolic phenotyping
2017	Promethion Core™ - the first large-scale, high-throughput metabolic/behavioral system for rodents
2019	Over 2,000 studies published in peer-reviewed journals citing Sable Systems instrumentation

SABLE ENABLES FLY SMALL ANIMALS

Metabolic and Behavioral Measurement, from FLY TO MOUSE TO HUMAN



MAVEn System

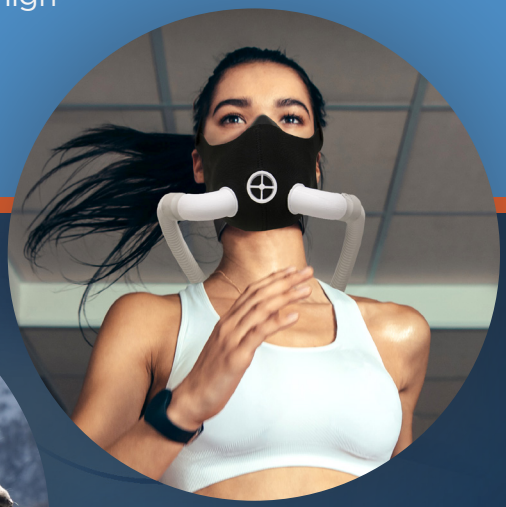
Classic Line Systems

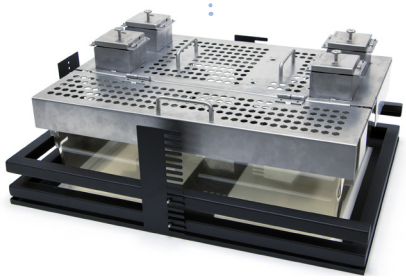
Promethion Core System

RODENT LARGE ANIMALS HUMAN

The Possibilities Are Limitless

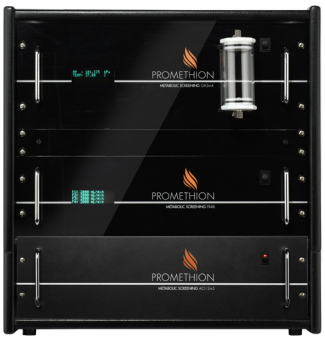
Sable metabolic and behavioral measurement systems span the full spectrum of animal species—from drosophila, to small rodents, to larger animals and mammals—including humans. Hundreds of published studies in peer-reviewed journals are proof of our systems' high performance in a broad range of applications.





GRID System

FMS: Field Metabolic System



Promethion Room Calorimetry System

SABLE ENABLES FLY SMALL ANIMALS

Insect & Small Animal Studies

Sable specializes in the study on all insects and small animals, from common fruit fly—*Drosophila melanogaster*—up to larger invertebrates, birds and mammals. Insects are cost effective models for therapeutic discovery that includes central nervous system disorders, inflammatory disorders, cardiovascular disease, cancer, and diabetes. Invertebrate energetics and other small animal research are constant drivers to the innovators of Sable's instrumentation, where the smallest signal from the animal demands that it be measured with acute resolution.

Applications

Disease • Aging & Health • Physiology • Metabolic Phenotyping • Behavior • Energetics

Sable Classic Line Systems

Flexibility and Performance – Our small animal systems enable the highest performance in measurement and control of gas, flow, humidity, temperature and barometric pressure.

Ease of Use – Broad range of proven, easy-to-use instruments can be stand-alone or custom configured into a system.

Raw Data Storage – All data is transparent and fully traceable, with no hidden algorithms or preconditioning. The parameters important for your research can be extracted any way you like.

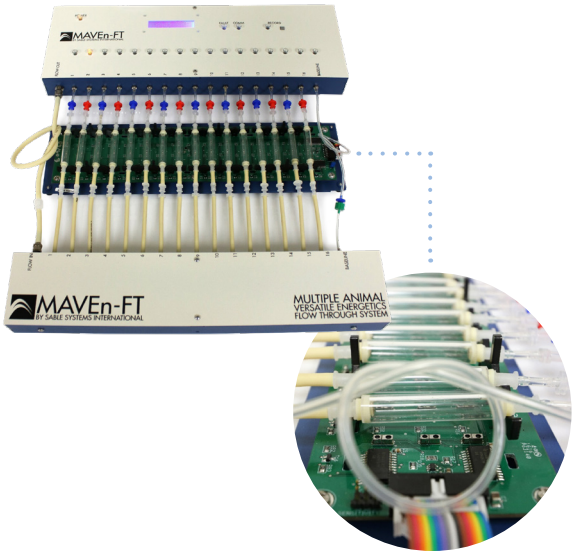
Data Analysis – Each instrument can be configured to work with a computer for both direct data acquisition and subsequent data analysis using Sable's ExpeData™ software.

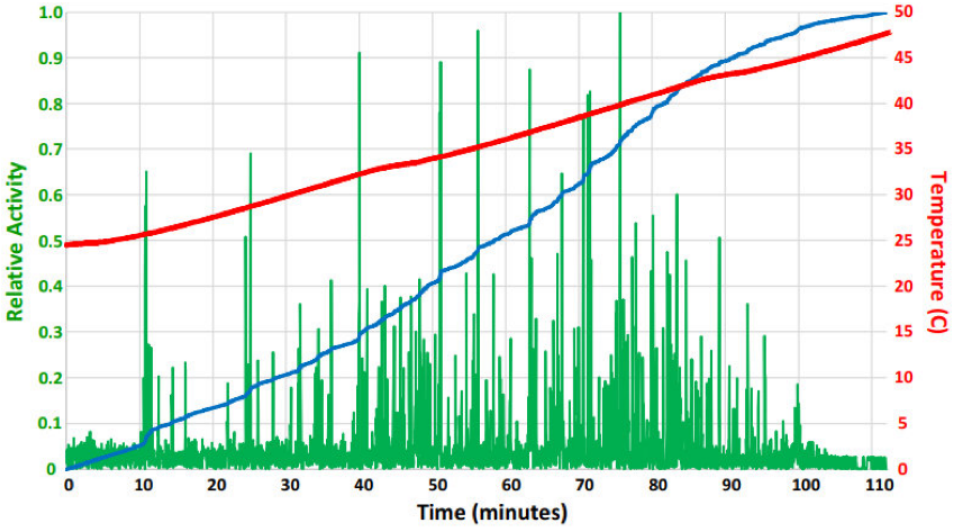
MAVEn™ Insect Respirometry System

High Throughput – Flow-through respirometry for up to 16 insects with individual air flows from 5 mL/min to 200 mL/min.

Automated Air Flow – Air flow is automatically directed from each chamber, in succession, to external gas analyzers.

Fully Programmable – System can be used under computer control or as a stand-alone instrument.



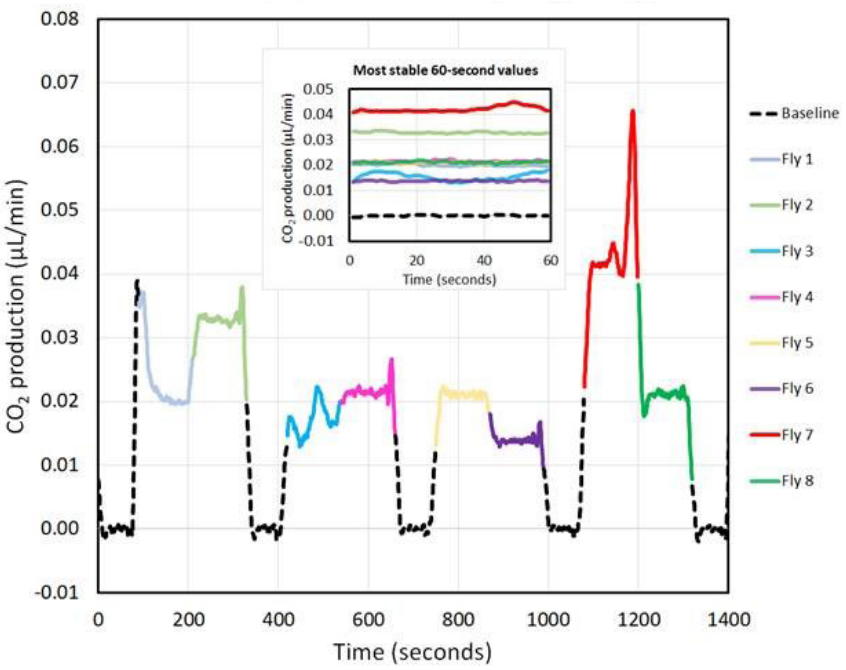


Spontaneous Activity with Increased Temperature

The instantaneous (green) and cumulative (blue) activity of a single dung beetle undergoing a thermal ramping treatment (red). Note the magnitude and frequency of spontaneous activity increased with temperature, peaking around 40C. Thereafter activity levels tend to decrease.

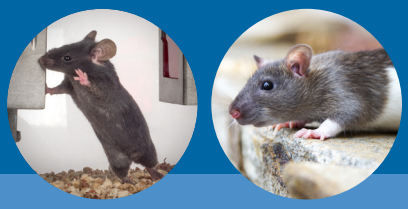
Metabolic Rates of *Drosophila* (~0.7mg)

Each chamber contains a single drosophila. The data is captured for 120 seconds per chamber and interleaved between chambers. The graph displays data for each chamber through one complete cycle through the control (empty) and 8 chambers with flies.



FLIC Drosophila Behavior System	FoxBox Field Respirometry System	AD-2 Small Animal Activity Detector	Oxzilla Differential Oxygen Analyzer
			

Mouse & Rat Studies



Metabolic and behavioral measurement of rodents plays a critical role in health and aging research. Metabolic phenotyping helps understand the physiological trade-offs of energy balance, food preference, environmental factors and animal behavior. In neuroscience and toxicology, metabolic assays and ethographic profiling of behavior are primary methods of evaluating efficacy. And in ingestive behavior studies, we learn the influences of genotype, phenotype, environment, and gastrointestinal microbiome on morbidities such as obesity and diabetes.

Applications

Aging & Health • Neuroscience • Toxicology • Ingestive Behavior • Metabolic Phenotyping

Promethion® Mouse and Rat Systems

Application-Specific Systems – Each system is configured for the unique requirements of your study.

Accurate and Trustworthy Results – Behavioral events are synchronized with metabolic events in fine detail. SableHD® high definition technology provides truest, most data-rich results. And only Sable preserves all raw data for QC or retrospective analysis.

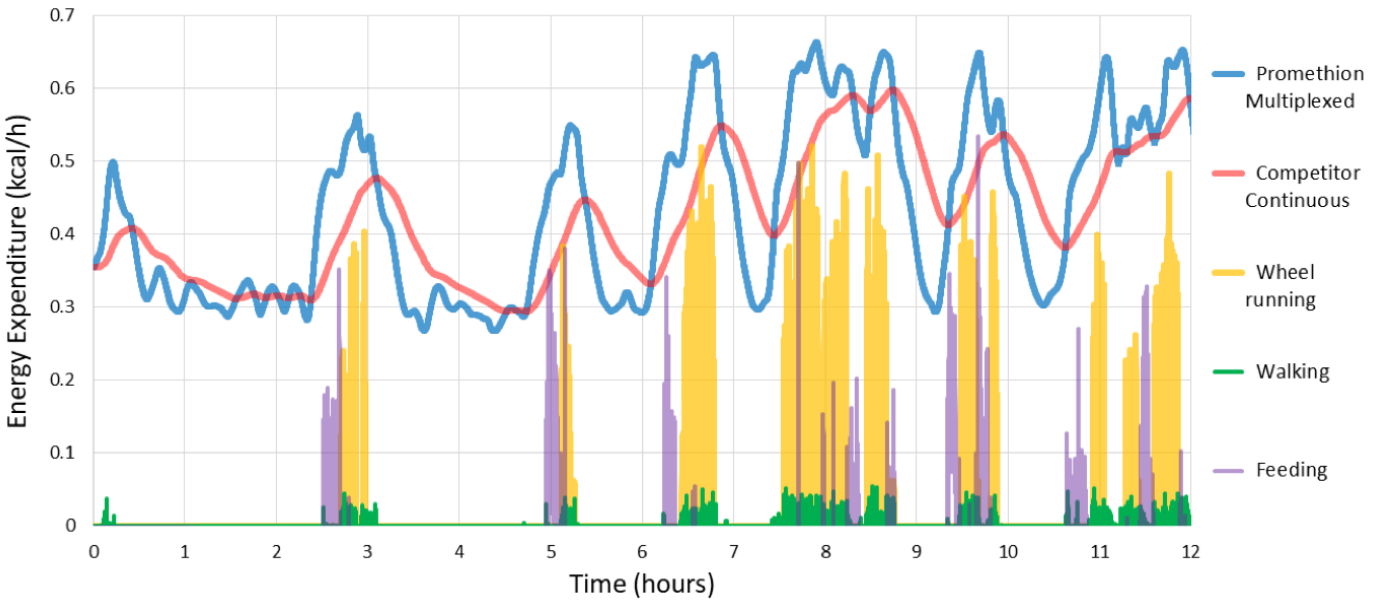
High Throughput and Workflow – Multiple systems can be networked together for unmatched parallel processing, highest reproducibility, and simultaneous study power. Home cage and near-ambient CO_2 levels eliminate cage acclimation time. Data and reports are securely accessed through remote computers, tablets and mobile devices.

Reliable Platform – Robust architecture, hot-swappable components and battery back-up provide you with maximum uptime.

Animal Safety – Sable pull-mode respirometry provides a low-stress environment for your animal, safeguarded in the event of a power failure. Only Sable meets the IACUC cage air-exchange standard.

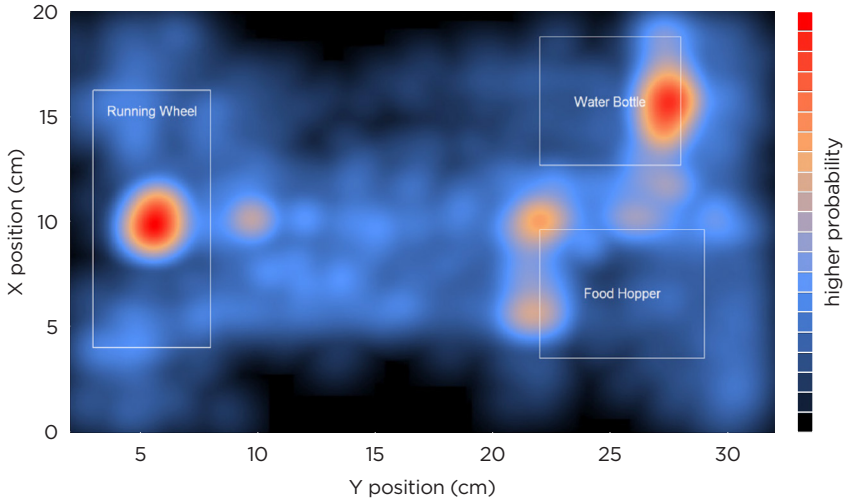
Fewer Animals – SableHD® allows more statistical power using fewer animals, for testing more hypotheses.

Real-time data and reports can be securely accessed via authorized desktop or mobile devices.



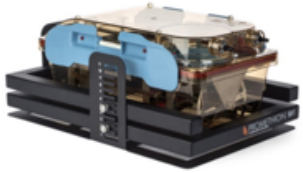
Comparing Metabolic Measurement Resolution of Promethion Multiplexed System vs. Legacy Continuous Systems

The Promethion Core Multiplexed system (blue line above), with high flow rates > 2000ml/min, reveals rapid metabolic changes tightly correlated with behavioral activity. Legacy continuous systems (represented by the red line) are limited by flow rates < 400ml/min – thereby producing attenuated resolution, time-lagged responses, and inaccurate quantification of resting and active states.

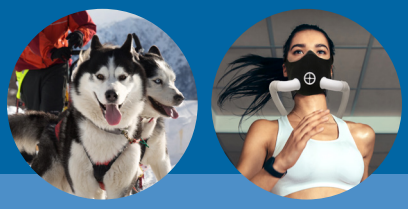


Position Probability Heat Map

Position Probability map of a single mouse over several days of data collection.

Multiplexed Metabolic Mouse Cage System	Gnotobiotic Pathogen-Free Isolation Cage	Temperature Cabinet	Rat Cage with Running Wheel
			

Large Animal & Human Studies



The measurement of energy expenditure is used to assess metabolic needs, fuel utilization, and the relative thermic effect of different food, drink, activities and pharmaceuticals. Recent integrated research from large animals and humans has applied indirect calorimetry to better understand the relationship of cardiovascular disease, insulin resistance, metabolic syndrome and diabetes to health and aging. These studies can be a critical component for resource management assessments.

Applications

Room Calorimetry • Aging, Health & Lifespan • Exercise Physiology • Livestock • Marine Mammal

Sable Promethion® and Classic Systems

Accuracy – Exclusive SableHD™ high definition digital technology provides industry-leading accuracy, sampling rate and resolution for O_2, CO_2, CH_4 and H_2O.

Resolution – Energy expenditure can be monitored with excellent temporal resolution, so that the metabolic consequences of different activities can be precisely evaluated including the relative utilization of differing metabolic substrates such as fats or carbohydrates.

Animal Size Range – Flow rates of 10 – 30,000 L/min for large animals and humans.

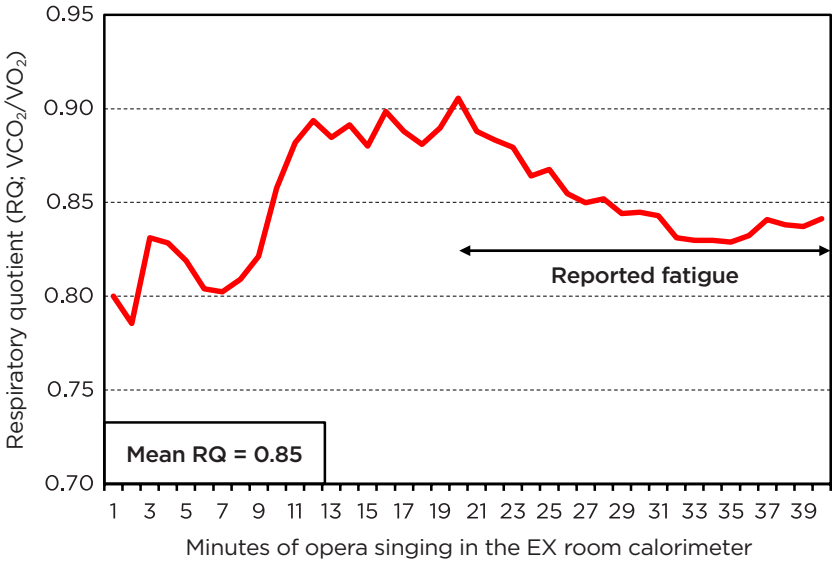
Traceable – All raw data are synchronously recorded and stored to allow the user to apply the latest algorithms for data analysis. No data are ever lost or compromised.

Versatile – Each system is configured for the unique requirements of your study. The systems can easily be adapted to rooms, smaller chambers or masks.

Environmental Sensors – Additional environmental sensors can be integrated into the system data stream including humidity, barometric pressure, temperature, light, occupancy and sound.

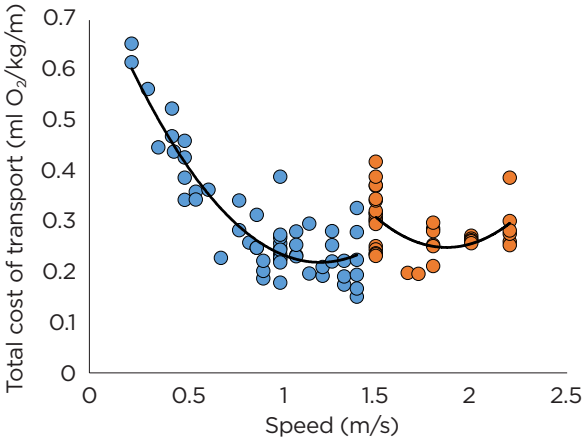
Promethion room calorimetry measures human energy expenditure in an unrestrained setting.

Sable benchtop and portable field systems can be configured for just about any large animal study



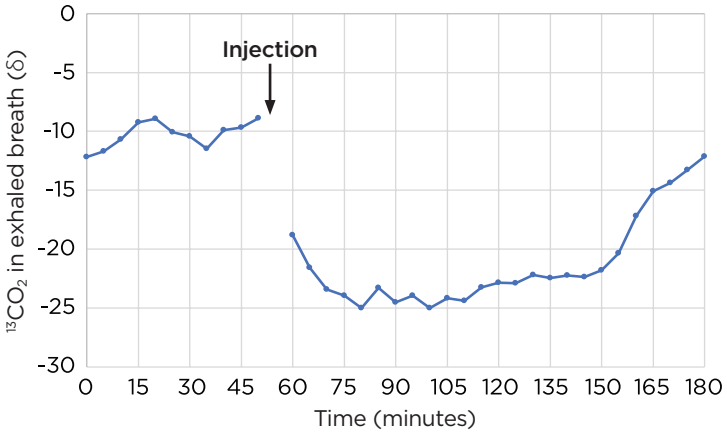
Metabolic results for a 40-minute opera singing performance using Promethion Whole Room Indirect Calorimetry

Drop in RQ correlates with reported fatigue during opera performance.



Mass-specific total cost of transport (COTtot) in relation to locomotor speed in polar bears and grizzly bears

Data are for polar bears and grizzly bears walking at <1.5 m s_{-1} (blue circles) and polar bears walking at ≥1.5 m s_{-1} (orange circles).



^{13}C-leucine-enriched Tennec Injected with Norepinephrine

^{13}C-leucine tracers illustrate a shift away from endogenous protein oxidation following an injection of norepinephrine. Prior to injection the 800g animal consumed a diet spiked with the tracer. Data collected in 2019 by Sable Systems International.

Fox Box	ESA (Environmental Monitor)	FMS with Flow Kit	Stable Isotope Analyzer
			

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By Scientists, for Scientists

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