Columbus Instruments, LLC
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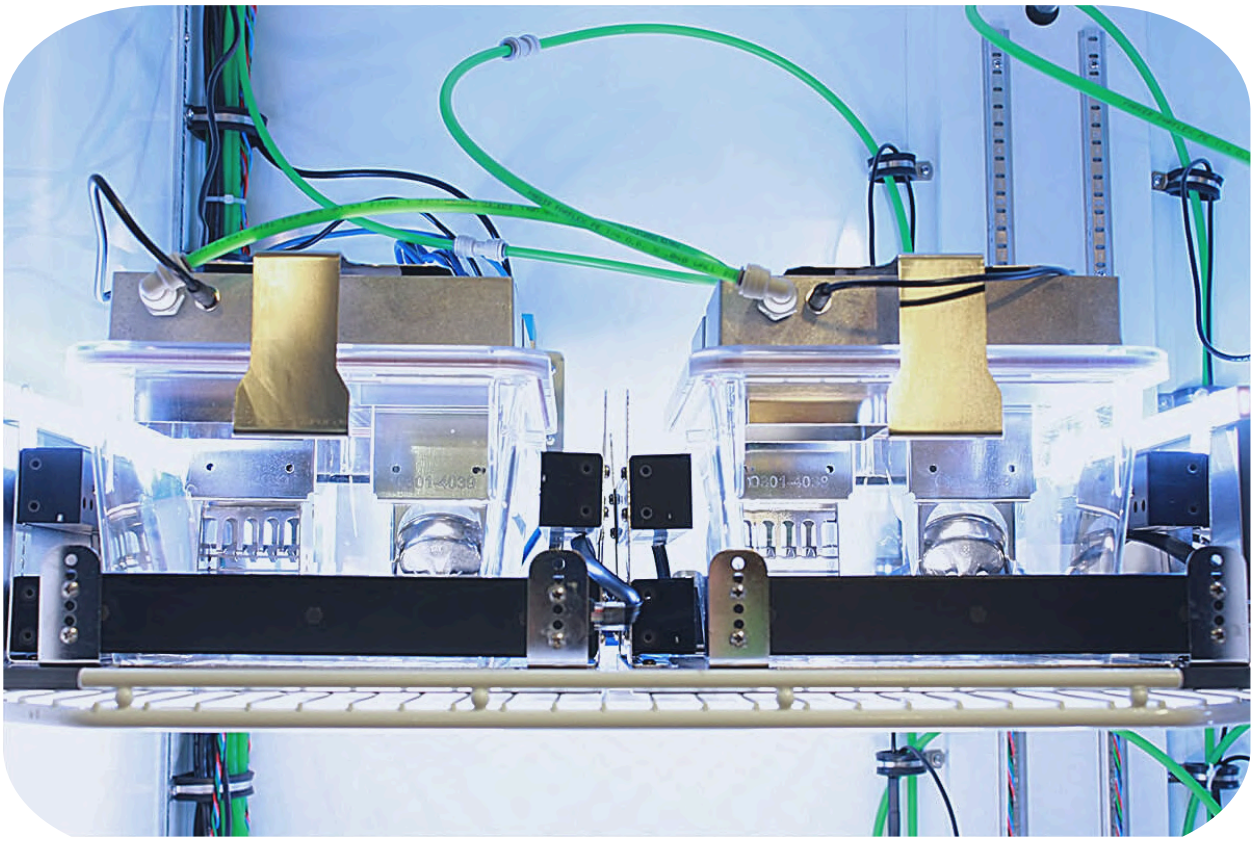
Oxymax-CLAMS

Comprehensive Lab Animal Monitoring System



Metabolic Phenotyping in Rats and Mice

The Comprehensive Lab Animal Monitoring System (CLAMS) is an all-in-one system for monitoring up to 32 test animals, offering detailed measurements for various parameters, including indirect calorimetry, activity, body mass, feeding, and more. Each system can be customized for various research needs.

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In broad terms, the assessment of the exchange between carbon dioxide and oxygen is commonly referred to as indirect calorimetry. This exchange ratio fluctuates depending on whether the subject is metabolizing fat, carbohydrates, proteins, or a combination of these substrates.

The process involves placing the subject within a sealed chamber and finely controlling the airflow to generate minute differences in oxygen and carbon dioxide levels between the incoming fresh air and the sampled air inside the chamber. Several advanced gas sensing technologies are available for quantifying these variations. Thanks to the adaptability and versatility of our systems, we provide a range of sensors, each uniquely suited to specific applications.

Oxymax Sensor Technologies

Paramagnetic Oxygen Sensor Included as standard, measurement range is 0-100% with a response time of 50 seconds per cage. Using paramagnetic technology allows for the highest level of precision and accuracy.

Zirconia Oxygen Sensor Part of the "High Speed Sensing Option", measurement range is 0-100% and when coupled with our dual tube High Speed Gas Dryer, response time is 20 seconds per cage. Multiple High Speed Sensor sets can be connected to the system to allow 2 or more cages to be measured simultaneously.

Electrochemical Oxygen Sensor An economically efficient solution for monitoring oxygen consumption, this method necessitates occasional sensor replacement and is most effectively employed in scenarios involving small-scale systems or continuous sampling systems.

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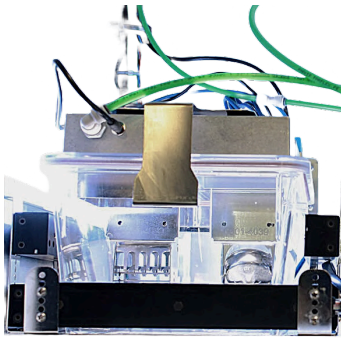
CLAMS has maintained its position as the leading metabolic monitoring system since 1999. The extensive and esteemed customer network actively contributes to ongoing enhancements and breakthroughs, ensuring that the system remains at the vanguard of both metabolic and behavioral research.

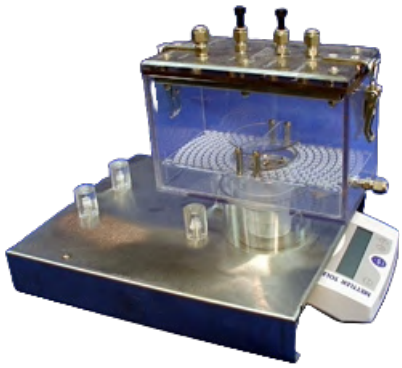
Each system is meticulously crafted on a semi-custom basis, accommodating precisely the required options to meet experimental needs and financial constraints. Customers have the flexibility to select the parameters for measurement and can choose from a range of cage environments suitable for a wide spectrum of applications. In every research scenario, a tailored solution is offered to address the specific challenge at hand.

CLAMS-HC
Home Cage



The most popular offering closely resembles the typical IVC cage, reducing stress and aiding acclimation. The cage and its components are compatible with cage-washing systems, ensuring robustness, reliability, and ease of use for daily applications.

CLAMS-CF
Center-Feeder



This cage design is optimal for obese models and experiments demanding precise food intake measurements. It presents powdered food from the base, features a spacious spill cup, and incorporates a feeder designed to prevent food caching and foraging.

CLAMS-WC
Waste Cage

Urine and feces collection require a novel cage design, with a funnel beneath a wire floor that allows waste material to fall through for collection. The CLAMS sensors have been mechanically adapted to seamlessly fit these specialized metabolic cages.

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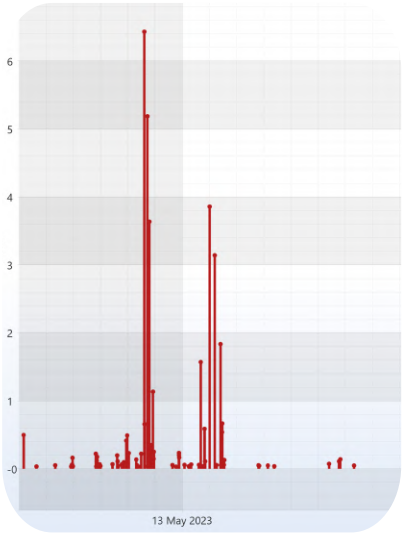
Food Intake

Monitoring food consumption in rodents is essential for understanding the complex relationship between diet, metabolism, and metabolic phenotypes. It allows researchers to draw meaningful conclusions about energy balance, nutrient utilization, and the effects of various interventions on metabolic processes.

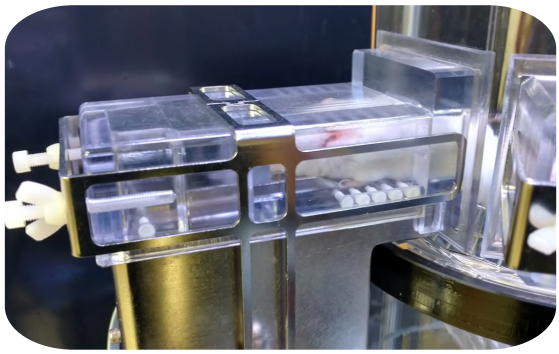
Diverse cage types affect food presentation, influencing feeding behavior and food intake. Data is recorded in high-resolution and event-driven bout files.



CLAMS-HC The overhead feeder replicates the IVC cage's pellet-based food presentation and includes a spillage catchment to account for crumbs. Animals can also access and consume these crumbs, causing minor spillage.

Automated Food Access This feature lets researchers schedule food access through a servo-driven door, using various programming options like time, mass, time and mass, "energy value," or yoked and pair feeding.

CLAMS-CF The center feeder, originally devised for Ob/Ob mice, dispenses powdered food and can be conveniently customized for various mouse strains. This system, known for its precision in monitoring food intake, ensures accurate data collection following a short acclimation period, making it a versatile choice for metabolic studies.



CLAMS-WC The most restrictive, this feeder is designed to prevent food crumbs from entering the urine funnel. Animals access powdered food through a tunnel equipped with fur-fluffing ribs. The length of the tunnel is carefully designed to be maximized for preventing crumbs but not so long that the animal can urinate in it.

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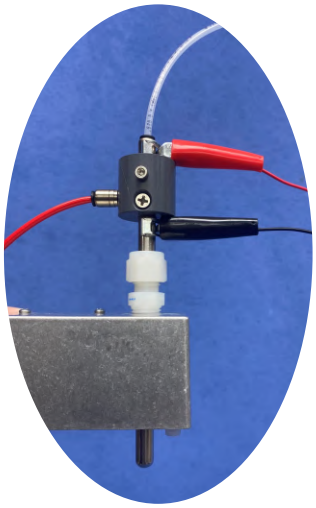
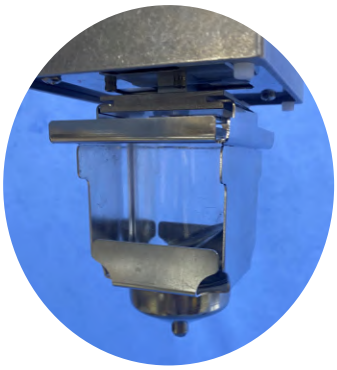
Drink Intake

Drinking can be monitored either by mass or with our patented Volumetric Drinking Monitor. Similar to the food intake data, drinking data is reported synchronously with the calorimetry data file. Data is recorded in high-resolution and event-driven bout files.



Volumetric Drinking Monitor (VDM) This patented technology uses a small dosing pump hidden within a standard sipper tube to deliver water. A water level detection circuit signals the pump when the animal drinks. Lick detection operates on conductivity principles, where each contact with the sipper tube counts as one pump of 20 microliters, rendering the VDM highly precise compared to common lick counters.

Home Cage Sipper Bottle A water bottle is suspended from a precision load cell and the weight of the bottle is constantly monitored. Access to water can also be controlled in a similar fashion as the automated food access option.



Body Mass

The subjects' body mass can be periodically measured by suspending a red translucent enrichment cubby from a precision load cell. Although entry into the cubby is entirely voluntary, it is worth noting that most subjects tend to sleep in it. It's important to mention that this particular option is not available for the CLAMS-WC system.

The body mass monitoring feature in CLAMS-HC offers additional flexibility. The cubby, feeders, and drinkers come equipped with a universal clip that allows them to be easily attached to the load cells. These components can be reconfigured and combined in various ways to suit specific experimental needs. Most frequently, researchers choose to replace the body mass cubby with a second feeder or drinker for conducting studies related to diet or drink preferences.

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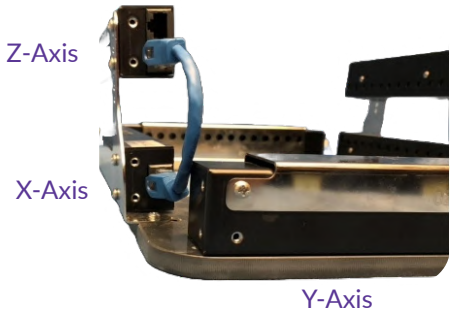
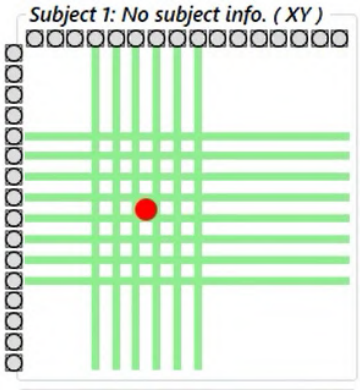
Activity

Monitoring activity in rodents is essential in metabolic phenotyping to assess energy balance, metabolic rate, the effects of interventions, and the relationship between metabolic health and behavior, providing crucial insights into metabolic disorders and the impact of genetic, environmental, and therapeutic factors on rodent metabolism.

Infrared (IR) Photo Beams Activity is monitored using IR photo beams encircling the cage. Interrupted beams signify movement, with frequent interruptions indicating repetitive actions like grooming. The grid arrangement enables continuous XY position tracking, and with a Z-axis sensor, rearing events are detectable. Photo beam activity monitoring has a long history in behavioral research, with various activity data files available for analysis.





Running Wheels Free spinning running wheels record the number of revolutions which reports the counts in bins. A magnet located at the perimeter of the wheel provides a field that is sensed as it passes a detector that, in turn, conveys rotation information.

Ergometric Running Wheel The Ergometric Running Wheel features an open axle design for improved animal access, attaching magnetically to a low-friction, ultra-smooth ergonometric engine. This engine provides programmable torque and monitors wheel rotations, allowing Work calculation with known resistance and distance.

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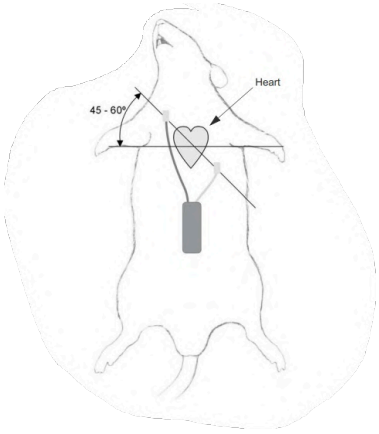
Telemetry

Oxymax-CLAMS offers core body temperature and heart rate monitoring through advanced radio telemetry. The transmitters are efficiently powered through the inductive antenna encircling the cage. These transmitters, being battery-free, are not only more compact compared to traditional models but also boast an extended operational lifespan. The telemetry option is available in both the CLAMS-HC and CLAMS-CF systems.

Temperature Transmitter
15.5 x 6.5 mm, 1.1 grams



Heart Rate Lead Placement

Temperature & Heart Rate
Transmitter
26 x 6.5 mm, 1.5 grams

Temperature and Light Control Enclosure

Ambient temperature exerts a significant influence on metabolic activity. The environmental enclosures empower researchers with meticulous control over both temperature and the light/dark cycle. The temperature is adjustable within a range of 5° to 32°C, complemented by an internal air circulation system ensuring precise temperature uniformity, even in cold conditions.

Lighting is achieved through programmable LED strips, offering fine-tuned control over timing, intensity, and even color. Within the experiment setup menu, advanced options permit intricate adjustments to temperature and light patterns, allowing for precise and tailored research conditions.

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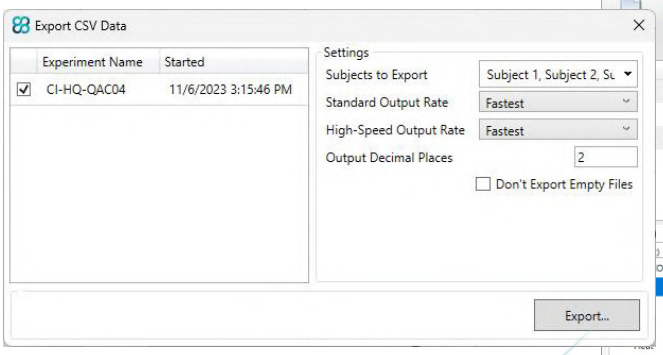
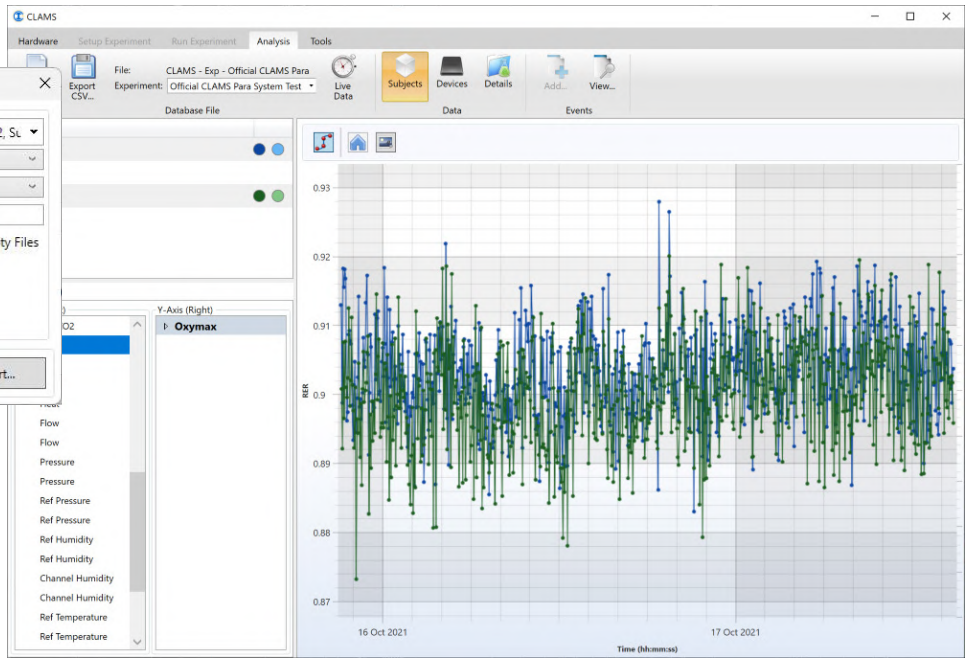
Data Collection & Export





Choose Your Data Density

Maximum Export Settings:

- 10 Readings per Second
- 0.01 PPM CO_2 Resolution
- 0.003 PPM O_2 Resolution
- 1 Milligram Mass Resolution

ANCOVA Analysis - Fast, Standardized, Transparent

Amir I Mina, Raymond A LeClair, Katherine B LeClair, David E Cohen, Louise Lantier, Alexander S Banks

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CalR — A Web Application for Indirect Calorimetry Analysis

CalR quickly generates customizable time, bar and regression plots.