Globisens

Labdisc K-12

Science Solution

Table of Contents

Contents

What K-12 Science Students Learn

Manual science experiments

Most K-12 students perform science by recording data "manually" - a very different thing from experiencing science "hands-on". Take chemistry - acids and bases – where litmus paper is used which changes color when immersed in acidic or basic liquids. The paper must be removed immediately, kept in good conditions and the color scale read accurately. Any number of mistakes can be made, so ruining the outcome of the experiment.

When studying Newton's laws of motion, to calculate complex concepts such as velocity and acceleration. Yet students often only have a marble, stopwatch, measuring tape and graph paper to achieve it. It's the same story when studying a pendulum where the sophisticated concept behind the experiment shows the earth completes one rotation a day, proving the mass of the earth and acceleration due to gravity. However, by the time students have repeatedly collected and recorded data manually, there's not much of the 45 minute lesson left to understand the real science behind the experiment.

Above we've described some typical experiments where data can be collected manually. But what about all the exciting science concepts that can only be explored with digital data collection, such as recording a sound wave, or a transient response in an electrical circuit. These experiments are beyond the reach of most K-12 school science experiments, simply because in order to measure such fast changing phenomena, students would need to collect thousands of samples per second. Equally very slow acting phenomena which require data collection over an extended period of time are not feasible for manual data collection. A typical example of this would be changes in temperature, humidity, light and sound over a 24 or 48 hour period.

Students find collecting data manually boring

The challenge for teachers to engage science students go beyond the limitations of which activities they can explore, the inconvenient, time consuming and tedious experiment processes and disorganized methods for a typical class of 30+ students, not to mention how inaccurate and imprecise experiment results often are.

The biggest problem is that K-12 science students are bored and convinced that science has no relevance in their lives.

Many schools find time and budget limitations have focused education on a narrower set of learning outcomes and as a result most children are dropping out science and math. Research shows the number one reason students drop out is because they're bored. The Bill and Melinda Gates Foundation's study supported this and showed students feel classes are not relevant to their lives or career aspirations.

The fact is, these same students are very technologically savvy and this can be used to science and math learning's advantage, helping to cultivate in students the desire to learn. Hand-held technology tools help science students make real-world connections so they understand how science and math concepts are relevant to their lives and futures.

Data Logging Technology Revolution

Twenty five years ago data logging technology began to enter school systems, offering educators ways to make science experiments easier and cheaper to do. Today, data loggers and sensors are highly featured and able to take thousands of measurements per second, critical in performing simple or complex experiments within the parameters of a 45 minute science lesson. Data logging technology has made a huge contribution to science education. Students have been saved from the tedious and time consuming tasks involved in manual data collection. Instead science educators have been able to focus on the two elements which hold the greatest pedagogic value for any science activity: Experiment design and data analysis.

However, "time constraints" have limited how widely data loggers are used by school science teachers. Typically one data logger is used by a pair of students. On average every data logger connects to two sensors, with two sensor cables and one communication cable to each pair's computer. So a typical class uses: 15 data loggers + 30 sensors + 45 cables.

On average it takes teachers 1.5 hours to test, calibrate and position a total of 90 items before every Lab lesson, then collect and put everything away afterwards.

Rejecting hands-on teaching practices

The pressure of standardized governmental tests, together with technology setup and maintenance means they don't have time to use data loggers. That's even assuming the teacher feels confident to use complicated technology successfully in the classroom. These factors all contribute to perfectly good teaching tools wasting away in Lab closets, far from the hands of science students.

In today's science learning environment the critical features in data logging are: IMMEDIACY CONNECTIVITY and EASE OF USE.

Labdisc - it's time for something new!

Globisens has listened to educator needs with the Labdisc - applying latest 21st Century technology to resolve the limitations of current data logging solutions for K-12 students, right up to university level science. Five models, with up to 15 built-in sensors, enable science investigation in various fields including environmental science, physics, biology and chemistry.

Globisens has packed a complete laboratory into a single small disc

The Labdisc replaces a big box of more than 20 individual items - data loggers, sensors, sensor cables and communication cables with a single device. Since all built-in sensors are automatically tested and calibrated, the Labdisc saves teachers hours of setup and calibration time every week.

The Labdisc is a truly plug n' play solution as it:

- ✓ Delivers a complete Lab on a disc with up to 15 sensors built-in
- ✓ Offers very high accuracy, high sampling resolution and fast recording – essential for K-12 science studies
- ✓ Saves teachers lab setup time – requiring only 15 Labdisc units to be handed out
  Ensures lessons run smoothly and calmly as teachers don't need to manage between 60 and 100 different items on the Lab table
- ✓ Saves precious school resources being wasted on multiple small items (like sensors and cables) which inevitably get mislaid and lost during the lab learning session.

Configurations for Every Science

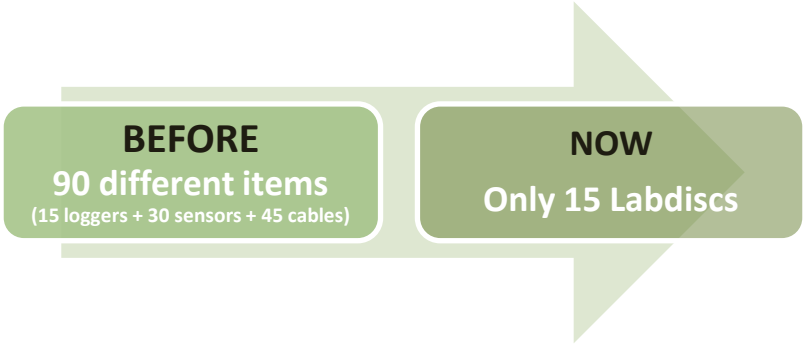
The Labdisc K-12 line includes **5 unique models** dedicated to the broadest range of school science, with **7 to 15 built-in sensor** configurations.

	Labdisc for **elementary school science** built-in sensors include: Ambient Temperature, Distance (motion), External Temperature, GPS, Heart Rate, Light, Microphone (sound level) **Typical activities include:** Temperature around us, day and night temperature, microclimate, distance, speed and time, heart rate before and after exercise.
	Labdisc for **environmental studies** built-in sensors include: Ambient Temperature, Barometer, Colorimeter, Dissolved Oxygen, External Temperature, GPS, IR Temperature, pH, Relative Humidity, Sound Level, Turbidity, Universal Input and UV. **Typical activities include:** Temp/light over 24 hours, acid rain, turbidity, water quality, temp./RH in urban areas using GPS, altitude and air pressure, heat absorption and cloud warming effects.
	Labdisc for **general science** built-in sensors include: Air Pressure, Ambient Temperature, Current, Distance (Motion), External Temperature, GPS, Light, Microphone, pH, Relative Humidity, Sound, Universal Input, Voltage. **Typical activities include:** Travelling speed with GPS, Newton's Laws, sound waves, electrical currents, pH titration, endothermic and exothermic reactions Boyle's Law, specific heat and microclimate.
	Labdisc for **biochemistry, biology and chemistry** built-in sensors include: Air Pressure, Ambient Temperature, Barometric Pressure, Colorimeter, Conductivity, Dissolved Oxygen, External Temperature, GPS, Heart Rate, Light, pH, Relative Humidity, Thermocouple, Turbidity and Universal Input. **Typical activities include:** Skin temperature, pulse rates before and after activity, sweat production and photosynthesis, solid, liquid and gas phase changes and pH titration.
	Labdisc for **physics** built-in sensors include: Accelerometer, Air Pressure, Ambient Temperature, Current, Distance (Motion), External Temperature, Light, Microphone, Universal Input, Voltage. **Typical activities include:** Lenz and Boyle's Laws, resistor networks, light source efficiency, light vs. distance, sound beat and wave superposition, Newton's Second Law and free fall acceleration.

Labdisc features and benefits

All-in-one disc

Teachers' preparation time for a Lab work is dramatically reduced, no longer having to deal with cables and sensors etc. Preparing for class couldn't be more convenient.

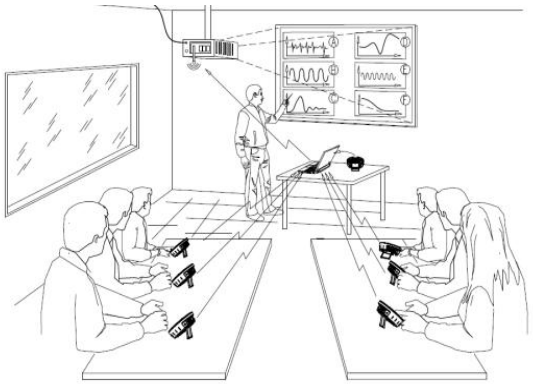


Wireless

The hand-sized Labdisc data logger is a single, cable-free device that acts as a complete Lab with up to 15 built-in wireless sensors. Bluetooth wireless communication fully integrates with all key school technologies and appliances. Connecting to computers, netbooks, interactive white boards, and tablets, the system delivers increased mobility in a cable-free Lab environment.

Technology consolidation

For so many schools with interactive board technology already a part of the classroom, up to 8 Labdiscs, measuring real scientific reactions, can wirelessly communicate with class interactive board via a single teacher's computer. This opens the door to collaboration, hands-on and inquiry-based learning, while saving the cost of many computers.

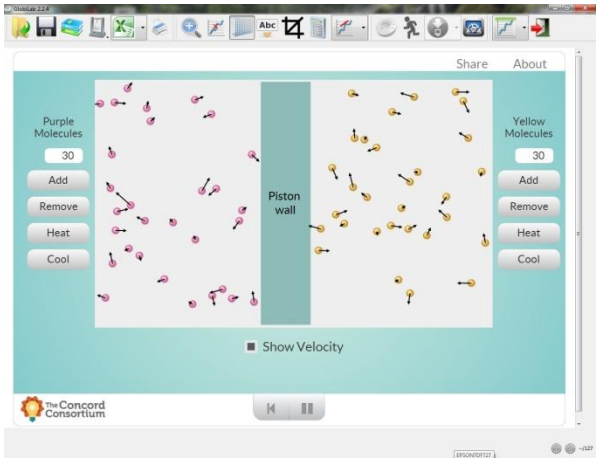


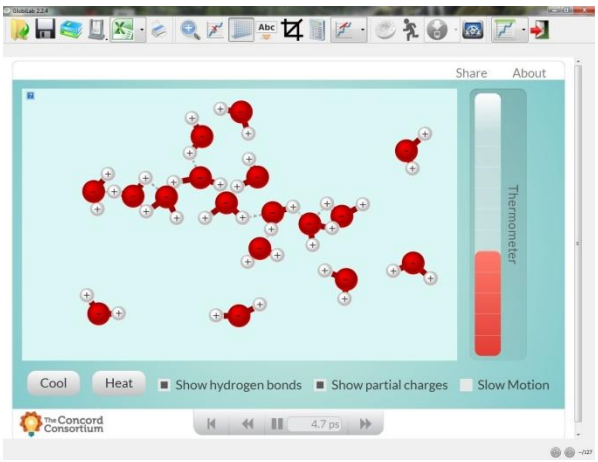
High resolution accurate data recordings

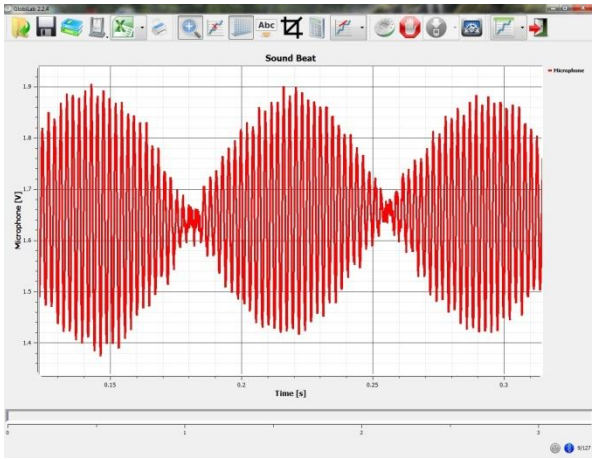
Measuring data at a very high resolution of 12-bit enables a wealth of experiment experience previously unavailable to students. K-12 students can digitally perform classic experiments in sound waves, electricity, mechanics collisions and more. The Labdisc also has high sensor accuracy at ±2% on most sensors, many of them digital sensor, which are much more accurate than analog.

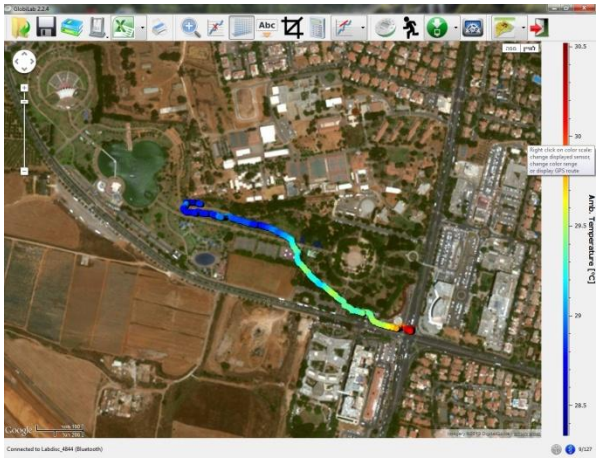
Unique analysis software

The Labdisc data analysis software carries all standard features including: Multiple displays, Labdisc setup, functions for mathematic manipulations and Export to Spreadsheets, as well as some unique features including integration with Google Maps, markers, data annotation tools and sophisticated data analysis features. Using the software simulation module, students can compare mathematical simulation to real measurements done by the Labdisc sensors









Broadening the Labdisc Offering

Globisens strongly believes in delivering an all-in-one wireless science laboratory. However, some key sensors require large casing and to maintain the compact and portable nature of the Labdisc, they cannot be included in the Labdisc housing. As a result, Globisens have completed the Labdisc built-in sensor range with some carefully selected external sensors to broaden the range of possible experiments for inquiry-based learning. Among the new and high accuracy, quality sensors are Force, Magnetic Field, Respiration, CO2, Voltage and Heart Rate.

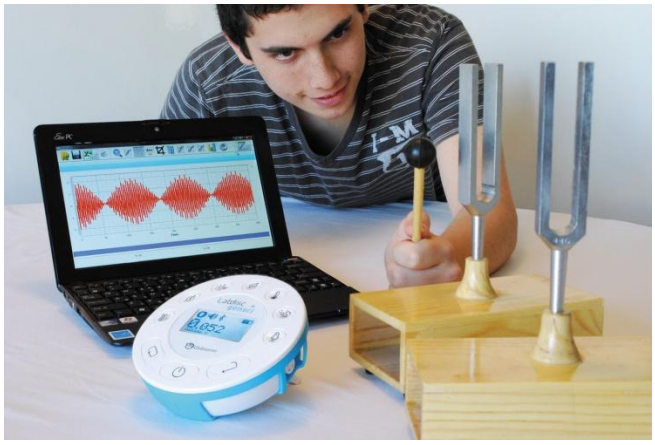
Force is one of the key sensors required for experiments in physics. For many sensors wireless communication is an important feature for enabling mobility. However, for a Force and Acceleration sensor, wireless is a “must”: It allows students to connect to moving objects without the need to connect a cable to the sensor which can interfere with the object motion

By incorporating the Force sensor as a stand-alone unit, wirelessly sending data measurements directly to the GlobiLab software, Globisens has made a world of experiments possible in mechanics and physics. The sensor measures force at a range of ±50N, 3-axis acceleration at a range of ±8g and has a sampling rate fixed at 500 samples per second. Whether exploring simple harmonic motion, friction, collision, impact and momentum or centripetal force, students can easily attach the Dymo to portable Lab trolleys and dynamic carts.

The additional external sensors ensure any curriculum requirement can be satisfied by combining the Labdisc models with a wireless external sensor. It also maintains the unmatchable Globisens price-point per sensor. The Labdisc automatically identifies external sensors, displaying data measurements in the relevant sensor units both on the LCD display and in the GlobiLab data analysis software.

Experiment Materials and Kits

As a single multi-meter device, the Labdisc replaces all traditional meters and sensors in the Lab. Yet, the Labdisc does not replace experiment materials and accessories such as glassware, chemicals, tuning forks, weights etc.

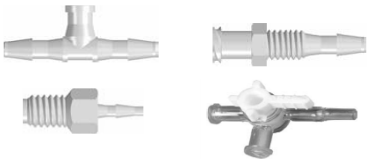


As part of the Globisens mission to provide complete science solutions to schools, a series of science kits have been created. These science kits contain all the experiment materials needed to cover the K to 12 science curriculums. Using our experiment cookbooks, students are able to conduct experiments, connect the Labdisc to the experiment materials and measure parameters such as temperature, air pressure, speed, light level and sound waves, to name just a few.

Physics Science Kit

P/N	Picture	Description
PH-KIT-GENERAL	  Picture for illustration purposes only	**Includes all below material for 1 to 2 students covering electricity, waves, magnetism and Newton mechanics.** • Set of two tuning forks with wooden resonance box • Electricity board with: 0.47 uF,100 uF, 1000 uF capacitors, 100 Ω, 1000 Ω, 10,000 Ω resistors, diode, SPST switch • Set of 6 x 10 cm black banana cables • Set of 6 x 10 cm red banana cables • 3 x 1.5 V, D type battery holder • Electric coil with 1600 turns and max current of 100 mA. Equipped with 2 banana sockets • Air core solenoid has an inner diameter > 3 cm and a length of 15 cm, equipped with 2 banana sockets • Bar magnet length 100 mm • Set of 3 metal springs with springs ranging from 4 N/m to 14 N/m • 10 x 1 N slotted mass set • Ping pong ball • Rectangle lab stand with aluminum rod 12 mm diameter x 500 mm length • Aluminum rod 12 mm diameter x 200 mm length • Right angle holder clamp • 2 x 60 mL syringe with luer lock
PH-KIT-01		**Laboratory power supply, having the following minimum specifications:** • Input voltage: 110-220 VAC • Output voltage: variable 0-30 VDC, Current 0-3 ADC • Digital display of both current and voltage, Current limitation 0 to 3A

Chemistry and Biology Science Kit

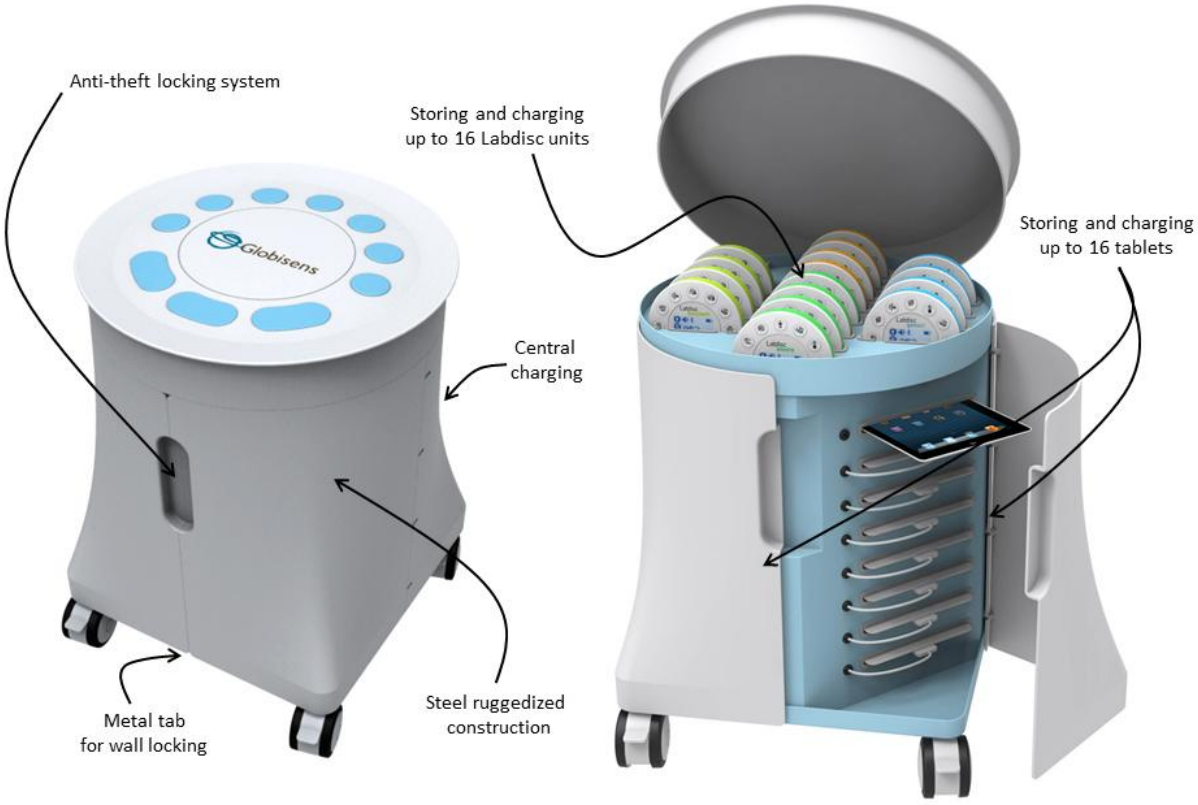
P/N	Picture	Description
BC-KIT-GENERAL		**Includes all glassware and non-consumables for one student or a team of two students to perform the high school chemistry and biology experiments.**
		• Beakers (10 mL & 30 mL & 150 mL)
		• Erlenmeyer flasks (10 mL & 25 mL)
		• Hirsch funnel
		• Filter flasks (25 mL)
		• Test tubes (6 x 50 mm)
		• Wintrobe tube
		• Wire mesh with ceramic center
		• Pipette, with tips
		• Volumetric flasks (10 mL & 25 mL), with stopper
		• Funnel
		• Watch glass
		• Rubber tubing
		• Pipette bulb
		• Periodic chart
		• 2 x 60 mL syringe with luer lock
		• Test tube holder (clear Perspex)
		• Pack of straws
		• Alcohol burner, 3.5 oz/100 mL (P/N
		• Tripod, burner, 15 cm x 9 cm x 4 cm (P/N 6346800)
		• Candles & matches
BC-KIT-01		**Valves and tubing set for conducting experiments with air pressure.**
		• 2 x NPT thread with 5/16" hex to 200 series barb, 3/32" (2.4 mm) ID tubing
		• 3 meter clear PVC tube inner diameter 2.3 mm (P/N UR00-2047C)
		• 2 x rubber cork for test-tubes
BC-KIT-02		**Consumables set including:**
		• Distilled water, 1 L bottle
		• Alcohol for burners
		• Hydrochloric acid, solution, 0.5 M, 500 mL bottle
		• NaOH solution 0.5 M, 500 mL bottle
		• Gloves

A Complete Mobile and Modern Science Laboratory

Globisens has expanded the concept of a condensed wireless science laboratory to introduce the Science Mobile Cart – mobilizing science to K-12 students wherever they are in school.

Now schools can develop ICT skills and bring real inquiry-led experimentation to students: Delivering a complete, consolidated and clean digital science learning environment to every class throughout the school.

The mobile cart solves the limitations on science learning in school. Teachers no longer need to be dependent on mobilizing students to congested and cluttered science labs, outfitted with thousands of dollars worth of equipment. Storing and charging up to 16 Labdiscs and 16 tablets; this mobile laboratory delivers digital inquiry-based science to every class.



Appendix 1: K-12 Science Experiment Table

Subject	Field	Lesson hours	Grade level	Labdisc	Sensors
"Light intensity" Measuring and comparing the luminosity of a candle, a flashlight and natural day-light.	Physics	2	Middle school	Physio, Gensci	Light
"Day and Night" Recording the variations of temperature and light during a period of 24 hours to establish relations between them.	Environment/ Biology	2	Elementary/ Middle school	Gensci, BioChem, Physio, Primo	Light, Temperature
"What Do We Drink?" Measuring the pH of different soft drinks.	Chemistry	2	Middle school	Gensci, BioChem, Enviro	pH
"Water Bodies" Measuring temperature and humidity near rivers or other water bodies to determine their effect on temperature and humidity.	Environment/ Biology	5	Middle school	Enviro, Gensci, BioChem	Temperature, Humidity
"How Loud is Sound" Measuring the decay of sound level over distance	Environment/ Physics	2	Elementary	Gensci, Physio, Primo	Microphone
"Walk in the Park" Measuring temperature changes at a busy city junction, and in a nearby park or garden	Environment	2	Elementary	Gensci, Primo, Enviro	Temperature, GPS
"Travelling Speed" Using the GPS sensor to measure walking speed, running speed and/or biking speed – a great activity for creating a contest between students.	Physics	5	Middle school	Gensci, Enviro, BioChem	GPS
"Our Heart Rate" Measuring the heart rate before and after exercise and recording useful information to determine physiological parameters.	Biology	2	Middle school	BioChem (or Gensci with external heart rate)	Pulse
"The Laws of Motion" Determining the relationship between speed time and distance as part of understanding Newton's mechanic principles.	Physics	2	Middle school	Gensci, Physio	Distance

"Altitude and Air Pressure" Using the Barometer and GPS sensors to travel from high to low places, measuring the change in air pressure and altitude.	Environment	5	Middle school	Enviro	GPS, Barometer
"What is Distance" Examine the relationship between speed time and distance. Explore graphs of distance versus time	Physics	2	Elementary	Primo, Gensci, Physio	Distance
"The Temperature Around Us" Recording the temperature of different substances	Physics	2	Elementary	All	Temperature
"Absorption of Heat" Measuring and comparing the internal temperature of different colored containers full of water after being exposed to sunlight.	Physics	2	Middle school	All	Temperature
"Lenz Law" The connection between electric and magnetic fields.	Physics	2	High school	Physio, Gensci	Voltage
"The Principle of Resistor Networks" Measuring the current and voltage of two simple electric circuits (in series and parallel) and determining the differences between them	Physics	3	High school	Physio (or Gensci with external Voltage)	Voltage, current
"Light Versus Distance" Recording light intensity while moving away from the light source.	Physics	2	High school	Physio, Gensci	Light
"Acid Rain" Collecting rain in different area and verifying the acidity of the rain as it relates to pollution.	Environment/ Biology	2	High school	Gensci, BioChem, Enviro	pH
"Sweat Production" Covering our hand with a plastic bag, while measuring temperature and relative humidity to explain the principle of the body's cooling system – sweat**.**	Biology	2	High school	Enviro, Gensci, BioChem	Temperature, Humidity
"Boyle's Law" Measuring the connection between volume and pressure: PV=NRT, by using a syringe to show the linear relation between volume and air pressure.	Chemistry	2	High school	Gensci, BioChem, Physio	Air Pressure

"Photosynthesis" Recording air pressure and light level, while using an Elodea water plant sealed in a test-tube - to measure the effect of photosynthesis and the relation between light intensity and oxygen production by the plant.	Biology	3	High school	Gensci, BioChem, Physio	Air Pressure
"City Micro Climate" Measuring the changes in noise, temperature (and humidity) in different urban areas.	Environment/ Biology	4	High school	Enviro, Gensci, BioChem	GPS, Temperature, Humidity
"Lambert-Beer law" Determining the relationship between a solution concentration and its light absorbance.	Chemistry	3	High school	Enviro, BioChem	Colorimeter
"Free Fall" measuring the free fall acceleration using a ping-pong ball.	Physics	2	High school	Gensci, Physio	Distance
"Sound Level Versus Distance" Measuring the sound level decay over distance.	Physics	2	High school	Gensci, BioChem, Enviro	Distance, Microphone
"Sound Waves" Recording sound waves and sound wave interference.	Physics	3	High school	Gensci, Physio	Microphone
"Cloud Effect on a Winter's Day" Measuring the sky's temperature on a clear sky day and on a cloudy day and explaining how clouds keep ground heat from radiating into the atmosphere.	Environment	3	High school	Enviro	IR Temperature
"Candle flame" Exploring the temperature zones of a candle flame.	Chemistry	2	High school	BioChem	Thermocouple
"Photosynthesis" Using a DO2 sensor to check the Photosynthesis rate of an Elodea plat in different light intensities.	Biology	3	High school	BioChem	Dissolved Oxygen
"Phase Changes: Solid, Liquid and Gas" A classic activity measuring the freezing and boiling point of water.	Chemistry	3	Middle school	All	Temperature

"Impact and momentum" Using the distance sensor to measure the speed of two carts before and after a plastic collision.	Physics	3	High school	Physio, Gensci	Distance
"UV & Sun Block" Measuring and comparing the level of ultraviolet radiation, resulting from the intervention of a beam of sunlight through different types of filters such as sunglasses and sun blocks.	Environment/ Chemistry	3	Middle school	Enviro	UV
"Hooks Law" Using a metal spring to investigate the spring coefficient K and the equation F = -kx.	Physics	2	High school	Dymo	Force
"Newton 2nd law" - Using a cart pulled by a constant weight to prove Newton law of motion - F = ma.	Physics	3	High school	Dymo	Force, Acceleration
"Water Quality" Comparing drinking water turbidity to other water taken from lakes and ponds.	Environment/ Biology	4	High school	Enviro, BioChem	Turbidity
"Friction" investigating the static and dynamic friction of a body moving on different surfaces.	Physics	3	High school	Dymo	Force
"Harmonic motion" Investigating the motion of a mass on a spring.	Physics	3	High school	Dymo	Force
"Endothermic and Exothermic Reactions" Performing different measurements to examine which reactions release or consume heat.	Chemistry	3	High school	All	Temperature
"pH Titration" Classic Acid and Base titration - measuring pH and temperature change (Also using an external temperature sensor).	Chemistry	3	High school	Gensci, BioChem, Enviro	pH, Temperature
"Specific Heat" Heating different liquids to the same temperature (70˚C) and comparing the cooling curves of these liquids to explain which has the higher specific heat.	Chemistry	3	High school	All	Temperature

"CO2 production during respiration" Investigating bean seeds respiration, using the CO2 sensor.	Biology	2	Middle school	All with External CO2	CO2
"Earth Magnetic field" Using the Magnetic Field sensor to check the magnetic field of the Earth poles.	Physics	2	Middle school	All with external Magnetic Field	Magnetic Field
"Magnetic field of a coil" Using the magnetic field sensor to check the magnetic field inside a long coil.	Physics	2	High school	All with external Magnetic Field	Magnetic Field
"Mammal effect" decreasing the heart rate when seeming in cold water to preserve body heat.	Biology	3	Middle school	Primo, BioChem	Temperature, heart rate
"Doppler effect" what happens to a sound harmonic while in motion.	Physics	4	High school	Gensci	Microphone