



Edu-logger CO₂
Logger Sensor Guide
900-230



Edu-logger CO₂ logger sensor

900-230

The CO₂ Sensor can be used for any science experiment or activity where CO₂ levels are required. Some fields of study include Chemistry, Physiology, Exercise Science, Biochemistry, Biology, Earth Science, Environmental Science, etc.

This sensor is practical for testing CO₂ levels both in laboratories and in the field. An electromechanical cell in the sensor reacts with carbon dioxide to produce a voltage which is directly interpreted to give a CO₂ concentration reading.

Hundreds of possible experiments that can be done with the 900-230 sensor are: Monitoring of ecological systems, combustion reactions, CO₂ consumption rates, studying photosynthesis, testing chemical solutions, hydrogen peroxide decomposition, and many more.

The Edu-logger CO₂ sensor collects data in the following units of measurement:

- Parts per million (ppm): The total number of carbon dioxide molecules per million molecules sampled.

Sensor offset:

Prior to each use the CO₂ needs to warm up for roughly half an hour. To do this, plug the CO₂ sensor into a USB module or a battery pack and allow the sensor to sit for half an hour prior to collecting data for the best results.

Open air mode:

The CO₂ sensor needs to be calibrated before use. Calibration of the probe assumes a standard atmospheric CO₂ concentration of 20.9% (assuming stable levels in the Earth's atmosphere at sea level).

Materials Needed:

- 900-230 CO2 sensor
- One of the following (depending on experiment type):
 - 900-213 USB Module (For On-line experiments)
 - 900-215 Battery (For Off-line experiments)
 - 900-272 Viewing Module and 900-215 Battery (For use with Edu-logger Viewer)

Procedure:

1. The CO₂ sensor needs a power supply to properly calibrate so connect the CO₂ sensor to:
For On-line experiments: 900-213 USB Module.
For Off-line experiments: 900-215 Battery
For use with the Edu-logger Viewer: 900-272 Viewing Module and 900-215 Battery.
2. The sensor now needs to be calibrated:
Connect the CO₂ sensor to the left side of a 900-213 Module (which is connected to a computer via the USB or mini USB cable).

Open the Edu-logger software.

Once the CO₂ sensor is detected click the “Module setup” button.

Hold the probe vertically so the opening is facing the ground.

Press and hold the blue “Start/Stop” button the faceplate of the sensor for 3 seconds.

3. The CO₂ Sensor is now calibrated for use.

Quick start procedure:

PC or Mac Computer

Materials needed:

- 900-230 CO₂ Sensor
- 900-213 USB Module
- A USB to mini USB cable (which comes with the 900-213)

Prior to initial use the Edu-logger CO₂ sensor needs to be offset. Please review the “Sensor calibration” section of this document on beginning on page 2 for detailed instructions.

Your CO₂ sensor needs to be connected to a 900-213 module. The 900-213 module then connects to a computer via a USB to mini-USB cable. Please note that you cannot plug the CO₂ sensor directly into the computer.

Resident PC software and browser based application can be downloaded for free at www.edulab.com as well as a full software user guide.

Note: Make sure not to download and install both types of software they will conflict on the computer.

Procedure:

1. Follow the ‘Sensor Offset’ guide in this document.
2. Install the Edu-logger software
3. Connect the 900-213 module to the PC or Mac
4. Connect the CO₂ sensor to the 900-213 module (they directly plug together).
5. Open the Edu-logger software.

6. Once a CO₂ sensor logo appears on the left side of the screen the probe has been automatically identified and you can begin experimentation.
7. If the CO₂ sensor is not automatically identified then click the “Search for sensors” icon to find the sensor.
8. Select the “On-line experiment” button; this will open a graph below.
9. Click on the “Module setup” button located on the CO₂ sensor icon in the module window to change the sensor settings if need be.
10. Click on the "experiment set up" button to change the experiment settings if need be (experiment duration for example).
11. The CO₂ sensor will give a live reading in the box to the left of the screen while plugged in.
12. To run an experiment and collect data click “Run experiment”.
13. To end data collection early, click “Stop experiment”.

Tablet, smart phone device

Materials needed:

- 900-230 CO₂ Sensor
- 900-268 WIFI module
- 900-215 Battery

Prior to initial use the Edu-logger CO₂ sensor needs to be offset. Please review the “Sensor offset” section of this document on beginning on page 2 for detailed instructions.

Your CO₂ sensor needs to be connected to a 900-268 module. The 900-268 module will create a closed Edu-logger wifi network which will stream the Edu-logger data to a device of your choosing. Once your device is wirelessly connected to the Edu-logger network you can run experiments and collect data through a browser of your choosing.

Procedure:

1. Follow the ‘Sensor Offset’ guide in this document.
2. Connect the CO₂ sensor directly to the left side 900-268 (no wires required).
3. Connect a 900-215 module to the right side of the 900-268 module.
4. Although not required, we recommend plugging the 900-215 to an outlet using a USB to mini USB charger (such as a typical cell phone charger). The 900-268 module will run for 15-75 minutes (depending on the sensor) without being plugged in.
5. The 900-268 can be powered directly using a mini to USB cord and plugging it into your computer or a wall charger. Please note this

function is only available on 900-268 units with the USB icon on the cover.

6. For further 900-268 instructions or the 900-268 quick start guide please visit: www.edulab.com

7. The 900-268 indicator lights will flash; take no action until the LED to the far left turns blue; this can take up to one minute.
8. Take your tablet or smart phone, go to the WiFi settings and select the Edu-logger network which matches the 900-268 Module ID found on the back of the 900-268 device. (Edu-loggerXXXX for example).
9. Give your device about 20 seconds to connect to the 900-268.
10. Once the device is connected, go to your browser and type the website **wifi201.com** into the URL bar, then wait for 30-60 seconds.
11. You will see a “Control mode” icon in the browser, click on this icon.
12. The browser will then load a new screen and begin to auto detect the sensor(s); this can take a minute. (You can stop the search when the sensor is found.)
13. If the browser does not auto detect the sensor(s), select “Search for sensors”.
14. Once the sensor is found you will see an icon on the left side of the screen for the CO₂ sensor. The icon will display real time data.
15. Click on the “Module setup” button located on the CO₂ sensor icon in the module window to change the CO₂ probe settings if need be.
16. Click on the experiment set up button to change the experiment settings if need be (Experiment duration for example).
17. To run an experiment and collect data, select “On-Line” experiment, then select "Run".

18. If you have a newer generation 900-268 (with the USB icon on the cover) this can be used as a 900-213, meaning you can tether the probes directly to the computer using the 900-268. To engage operation in this fashion, press 3 times on the panel key. Repeating this operation will return the unit to WiFi mode.

Operation with Edu-logger viewer

Materials needed:

- 900-230 CO2 Sensor
- 900-272 Viewing Module
- 900-215 Battery

Procedure:

1. Follow the ‘Sensor Offset’ guide in this document.
2. Connect the CO2 sensor to the left side of the viewer.
3. Connect the 900-215 module to the right side of the viewer.
4. The 900-272 will auto detect the sensor and you will see it appear on the left side of the screen.
5. Once the sensor appears it will be monitoring data in real time.
6. To run an experiment and collect data click the run button (little green person).

Off-line experiments

(Off-line experiments are for when you do not have a sensor connected directly to a computer, tablet, smartphone, or Edu-logger viewer).

Materials needed:

- 900-230 CO₂ Sensor
- 900-215 Battery

Materials needed to configure your offline experiment:

- 900-213 Module or 900-268 module or 900-272 Module
- USB to mini USB cable (included with the 900-213 module).

Procedure:

1. Follow the ‘Sensor Offset’ guide in this document.
2. Connect the CO₂ sensor directly to the left side of a charged 900-215 module.
3. When ready to collect data press the “Start/Stop” button on the CO₂ sensor, a red light will turn on for the duration of the experiment.
4. To change the experiment settings first connect to your chosen device (PC, Mac, tablet, smart device) and select the “Module setup” button. (For more information on how to change the experiment settings view quick start procedure section for your chosen device in this document.)
5. After the experiment has concluded (when the “Start/Stop” button is pressed again or the data collection period ends) connect the sensor to your chosen device. (full instructions in each device’s quick start procedure section)
6. Open Edu-logger software.
7. Click the “Off-line experiment” button.

8. Click the “Load data from sensors” button.
9. Select which experimental data to upload. (5 experimental runs can be stored at one time on the 900-230 CO₂ sensor)

Restoring sensor’s factory default settings:

Procedure:

1. Connect the 900-213 to a PC, Mac, tablet, or smart device.
2. Connect the CO₂ sensor to a 900-213 module (they directly plug together).
3. Open the Edu-logger software.
4. Click the “Tools” icon.
5. Click the “Restore sensor’s factory defaults” on the menu.
6. If prompted to clear the graph, click either the “Off-line experiment” or “On-line experiment” (whichever you are using).
7. Click “Clear experiment results”.
8. Resume from step 4.

Included with sensor:

- Edu-logger CO₂ sensor probe which is attached to the sensor body by a durable rubber-coated wire.
- Edu-logger 900-230 CO₂ Sensor Guide (This Document)

Sensor specifications:

Range and operation modes	350-10,000 ppm
ADC resolution	14 bit
Resolution	1 ppm
Max sample rate (S/sec)	100

Sensor features:

- Fully digital data
 - Rugged plastic ergonomic case
 - Push button switch for Start/Stop experiments in off line mode
 - LED indicator of experiment status (blinks while collecting data)
 - Attached probe cased in durable plastic
- Note:** Edu-logger products are intended for educational use.

Videos and experiment examples:

- Videos, literature and other probes can be found at www.edulab.com

Technical background:

The philosophy behind Edu-logger's plug and play technology is based on each sensor's ability to store its own data due to an internal flash memory chip and micro-controller in each plastic Edu-logger body.

This technology allows the sensor to collect and then store the digital data in the correct scientific units ($^{\circ}\text{C}$, $^{\circ}\text{F}$, Lux, %, ppm, for example).

The sensor is pre-calibrated at the factory. The built-in software in the logger can be upgraded for free at any time using the provided firmware update.

In spite of that, the probe needs to be offset prior to initial use. Please review the "Sensor offset" guide at the beginning of this document for detailed instructions.

The CO₂ sensing element consists of a cation (Na⁺) solid electrolyte formed between two electrodes together with a printed heater (RuO₂) substrate.

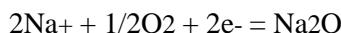
The cathode (sensing element) consists of lithium carbonate and gold, while the anode (counter electrode) is made of gold.

When the sensor is exposed to CO₂ gas , the following electrochemical reaction occurs:

Cathodic reaction:



Anodic reaction:



Overall chemical reaction:



As a result of the electrochemical reaction, electro-motive force (EMF) would be generated according to Nernst's equation:

$$\text{EMF} = \text{Ec} - (R \times T) / (2F) \ln(P(\text{CO}_2))$$

where

P(CO₂) : Partial pressure of CO₂,

Ec : Constant value R : Gas constant

T : Temperature (K) F : Faraday constant

By monitoring the electromotive force (EMF) generated between the two electrodes, it is possible to measure CO₂.

Maintenance and storage:

- Never submerge the Edu-logger sensor's plastic body in any liquid.
- Do not allow liquid into the Edu-logger sensor's plastic body.
- After using the probe wipe off all excess material, liquid or residue from the CO₂ probe body.
- Store in a box at room temperature out of direct sunlight.
- Do not put the plastic case, or cord of the CO₂ probe in an acids or bases.
- Store the CO₂ sensor's probe upright with the blue rubber tip pointing downward.
- Do not use the sensor in acid or alkaline solutions with a molarity greater than 1.0.

Warranty:

We promise to deliver our sensor free of defects in materials and workmanship for a period of 3 years from the date of purchase. Our warranty does not cover damage of the product caused by improper use, abuse, or incorrect storage. Sensors with a shelf life such as ion selective proves have a warranty of 1 year. Should you need to act upon the warranty please contact your distributor. Your sensor will be repaired or replaced.

Thank you for using Edu-logger!



Flexible, simple, fast, forward thinking.

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