

## NEULOG OXYGEN LOGGER SENSOR GUIDE



### NeuLog oxygen logger sensor NUL-205

The NeuLog oxygen sensor can be used for any science experiment where oxygen levels, dissolved or gaseous, are required. It is used in the fields of Chemistry, Physiology, Exercise Science, Biochemistry, Biology, Earth Science, Environmental Science, etc.

The sensor comes pre-calibrated so you can start experimentation right out of the box using this guide.

Among hundreds of possible experiments that can be performed with the NUL-205 sensor are: monitoring of ecological systems, combustion reactions, oxygen consumption rates, studying photosynthesis, testing chemical solutions and hydrogen peroxide decomposition, and oxygen solubility.

This sensor is practical for testing in school laboratories as well as in the field and has two modes of operation: open air mode to test gaseous oxygen concentration (percentage of oxygen in the air), and dissolved oxygen mode for the testing of liquids (mg/L and percentage of dissolved oxygen in a liquid).

The measurement units for this sensor are:

Oxygen % in air: The concentration of gaseous oxygen present in the sample.

mg/L: Total mass of dissolved oxygen per liter of a given liquid sample.

Oxygen % in water: The percentage of dissolved oxygen present versus the maximum level of oxygen saturation.

### Sensor's usage and offset:

#### Prior to use:

1. Remove the blue rubber cap from the NeuLog oxygen probe.
2. Unscrew the tip-end membrane cap of the probe, inside you will see a metal electrode.
3. Add 1 mL (half of the cap) of the "DO Filling Solution" directly into the tip-end which was just unscrewed.
4. Carefully reattach the tip-end of the probe by screwing it back into the probe (do not over tighten).
5. Do not replace the blue rubber cap until after testing.

Although the NeuLog oxygen sensor does not need to be calibrated prior to each use, it is recommended to offset its probe.

#### Open air mode:

Offset of the probe assumes a standard atmospheric oxygen concentration of 20.9% (assuming stable levels in the Earth's atmosphere at sea level).

1. Connect the oxygen sensor to a voltage source (USB-200, BAT-200, WIFI-201).
2. Wait about 5 minutes after connecting the sensor to the voltage source before you offset the sensor. For a more accurate measurement, look at the module window and wait for the reading to stabilize (it could take a little longer).
3. Press and hold the oxygen sensor's push button for 3 seconds.

#### Dissolved oxygen mode:

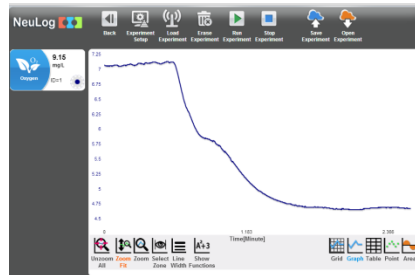
Inserting air into water with an air pump or a 50 ml syringe will saturate the water to 100% of its capacity in the specific temperature of water you are working in (using an air pump will get more accurate readings).

1. Connect the oxygen sensor to a voltage source (USB-200, BAT-200, WIFI-201).
2. Submerge the sensor in water. Make sure that the internal metal thermistor that is 4.5 cm above the oxygen probe's tip is also submerged in the water. Use water with the same temperature for offsetting and for further readings (oxygen is less soluble in high temperatures).
3. Wait about 5 minutes after connecting the sensor to the voltage source before you offset the sensor. For a more accurate measurement, look at the module window and wait for the reading to stabilize (it could take a little longer).
4. Saturate the water with oxygen using an air pump or a 50 ml syringe.
5. If you are in the "mg/L" mode, wait until you do not see any change in the oxygen concentration. This means that you pumped the maximum amount of air into the water (in the specific temperature you are working in).
6. Press and hold the oxygen sensor's push button for 3 seconds. You will see that the oxygen concentration that appears on the module window changes to the concentration that correlates to the water temperature.
7. If you are in the "% in air" mode, wait until you do not see any change in the oxygen percentage. This means that you pumped the maximum amount of air into the water (in the specific temperature you are working in).
8. Press and hold the oxygen sensor's push button for 3 seconds. You will see that the oxygen percentage that appears on the module window changes to 100%.

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9. When the oxygen concentration/percentage has stabilized, it means that all excess oxygen has come out of the water (as shown in the following graph).



### Quick start procedure:

#### PC or Mac Computer

##### Materials needed:

- NUL-205 Oxygen Sensor
- USB-200 USB Module
- USB to mini USB cable (included with the USB-200 module)

Your oxygen sensor needs to be connected to a USB-200 module. The USB-200 module then connects to a computer via a USB to mini-USB cable. Please note that you cannot plug the oxygen sensor directly into the computer.

The browser based application can be downloaded for free at [www.NeuLog.com](http://www.NeuLog.com) as well as a full application user guide. Choose "Downloads" on the main menu and then choose "Software and Application".

##### Procedure:

1. Install the NeuLog application.
2. Connect the USB-200 module to the PC or Mac.
3. Connect the oxygen sensor to the USB-200 module (they directly plug together). Please note that no calibration is required for this sensor.
4. Open the NeuLog application by clicking on the shortcut on the screen.
5. Once the oxygen sensor module box appears on the left side of the screen, the probe has been automatically identified and you can begin experimentation.
6. If the oxygen sensor is not automatically identified, click the "Search for sensors" icon to find the sensor.

7. Click on the "On-line experiment" icon; this will open a graph below.
8. Click on the "Module setup" button located in the oxygen sensor module box to change the sensor's settings if need be (open air or dissolved oxygen mode for example).
9. Remove the blue rubber cap on the end of the oxygen probe. Unscrew the membrane cap, fill half of it with the filling solution and screw it back.
10. Prior to initial use, the NeuLog oxygen sensor needs to be offset; please review the "Sensor Offset" section above.
11. Click on the "experiment setup" icon to change the experiment settings if need be (experiment duration for example).
12. The oxygen sensor will give a live reading in its module box when running.
13. To run an experiment and collect data, click the "Run experiment" icon.
14. To end data collection early, click the "Stop experiment" icon.

#### Tablet, smart phone device

##### Materials needed:

- NUL-205 Oxygen Sensor
- WIFI-201 WiFi Module
- BAT-200 Battery Module

Your oxygen sensor needs to be connected to a WIFI-201 module. The WIFI-201 module will create a closed NeuLog WiFi network which will stream the NeuLog data to the device of your choosing. Once your device is wirelessly connected to the NeuLog network, you can run experiments and collect data through a browser of your choosing.

##### Procedure:

1. Connect the oxygen sensor directly to the left side of a WIFI-201 module (no wires required).
2. Connect a BAT-200 module to the right side of the WIFI-201 module.
3. Although not required, we recommend plugging the BAT-200 to an outlet using a USB to mini USB charger (such as a typical cell phone charger). The WIFI-201 module will run for 60-90 minutes (depending on the sensor) without being plugged in.
4. The WIFI-201 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 WIFI-201 modules with the USB icon on the cover.

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- For further WIFI-201 instructions or the WIFI-201 quick start guide please visit: [www.NeuLog.com](http://www.NeuLog.com); Choose "Products" on the main menu, then choose "WiFi Communication module".
- The WIFI-201 indicator lights will flash; take no action until the LED to the far left turns blue; this can take up to one minute.
- Take your tablet or smart phone, go to the WiFi settings and select the NeuLog network (NeuLog0184 for example) which matches the ID found on the back of the WIFI-201 module (0184 for example).
- Give your device about 20 seconds to connect to the WIFI-201 module.
- 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.
- You will see a "Control mode" icon in the application, click on it.
- The application 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.)
- If the application does not auto detect the sensor(s), select "Search for sensors".
- Once the sensor is found, you will see a module box on the left side of the screen for the oxygen sensor. In this box, real time data will be displayed.
- To set the oxygen probe settings, click on the "Module setup" button located in the oxygen sensor module box (open air or dissolved oxygen mode for example).
- Remove the blue rubber cap on the end of the oxygen probe. Unscrew the membrane cap, fill half of it with the filling solution and screw it back.
- Prior to initial use, the NeuLog oxygen sensor needs to be offset, please review the "Sensor Offset" section above.
- Click on the experiment set up button to change the experiment settings if need be (Experiment duration for example).
- To run an experiment and collect data, click on the "On-Line" experiment icon, then click the "Run experiment" icon.
- If you have a newer generation WIFI-201 module (with the USB icon on the cover) this can be used as a USB-200, meaning you can tether the probes directly to the computer using the WIFI-201. To engage operation in this fashion, press 3 times on the panel button. Repeating this operation will return the unit to WiFi mode.

### Operation with NeuLog Graphic Display Module (viewer)

#### Materials needed:

- NUL-205 Oxygen Sensor
- VIEW-101 Graphic Display Module
- BAT-200 Battery Module

#### Procedure:

- Connect the oxygen sensor to the left side of the viewer.
- Connect the BAT-200 module to the right side of the viewer.
- The VIEW-101 will auto detect the sensor and you will see it appear on the left side of the screen.
- Once the sensor appears, it will be monitoring data in real time.
- Remove the blue rubber cap on the end of the oxygen probe. Unscrew the membrane cap, fill half of it with the filling solution and screw it back.
- Prior to initial use, the NeuLog oxygen sensor needs to be offset, please review the "Sensor Offset" section above.
- To run an experiment and collect data press the run icon (little green person).

#### Off-line experiments

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

#### Materials needed:

- NUL-205 Oxygen Sensor
- BAT-200 Battery Module

#### Materials needed to configure your offline experiment:

- USB-200 Module, WiFi-201 module or VIEW-101 Module
- USB to mini USB cable (included with the USB-200 module)

#### Procedure:

- To determine the experiment settings, first connect to your chosen device (PC, Mac, tablet, smart device) and click on the "Off-line experiment" icon after the sensor search has ended. (For more information on how to change the experiment settings, view the quick start procedure section for your chosen device in this document.)
- Connect the oxygen sensor directly to the left side of a charged BAT-200 module.
- Remove the blue rubber cap on the end of the oxygen probe. Unscrew the membrane cap, fill half of it with the filling solution and screw it back.
- Prior to initial use, the NeuLog oxygen sensor needs to be offset; please review the "Sensor Offset" section above.
- When ready to collect data, press the "Start/Stop" button on the oxygen sensor; a red light will turn on for the duration of the experiment.

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6. After the experiment has concluded (the "Start/Stop" button is pressed again or the data collection period ends) connect the sensor to your chosen device (you can find full instructions in each device's quick start procedure section).
7. Open the NeuLog application.
8. Click the "Off-line experiment" icon.
9. Click the "Load data from sensors" icon.
10. Select which experimental data to upload (5 experimental runs can be stored at one time on the NUL-205 oxygen sensor).

### Restoring sensor's factory default settings:

#### Procedure:

1. Connect the USB-200 to a PC, Mac, tablet, or smart device.
2. Connect the oxygen sensor to a USB-200 module (they directly plug together).
3. Open the NeuLog application.
4. Click the "Tools" icon.
5. Click the "Restore sensor's factory defaults" on the menu.

### Included with the sensor:

- NeuLog NUL-205 Oxygen Sensor Guide (this document)
- NeuLog oxygen sensor probe attached to the sensor's body by a durable rubber-coated wire
- 30 mL oxygen sensor filling solution (1 M KCl)
- Replacement membrane cap for the oxygen sensor

Sensor specifications			
	In air	Dissolved (%)	Dissolved (mg/L)
<b>Range and operation modes</b>	0 to 25%	0 to 125%	0 to 12.5 mg/L
<b>ADC resolution</b>	13 bit		
<b>Resolution</b>	0.1%	0.1%	0.01 mg/L
<b>Max sample rate (S/sec)</b>	100		

**Experiment Duration:** 1 second to 31 days.

### Sensor's 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
- Thermistor for temperature compensation.

Note: NeuLog products are intended for educational use.

### Videos and experiment examples:

- Videos, literature and other probes can be found at [www.NeuLog.com](http://www.NeuLog.com).
- In order to access the oxygen sensor's page, choose "Products" on the main menu and then "Oxygen logger sensor".
- In order to find the science experiments, choose "Experiments" on the main menu of the NeuLog website, then choose "Physics", "Chemistry", "Biology" or "Environmental Science".
- Biology Experiment:
  - Respiration (B-3)
- Chemistry Experiments:
  - Combustion (C-5)
  - Gas Solubility (C-6)

### Technical background:

The philosophy behind NeuLog'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 NeuLog 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).

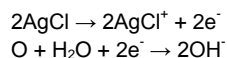
The sensor is pre-calibrated at the factory. The built-in software in the logger can be upgraded for free at any time using the provided firmware update. In spite of that, the probe needs to be offset prior to initial use. Please review the "Sensor offset" guide at the beginning of this document for detailed instructions.

The sensor is based on a Clark type probe that includes a platinum electrode and an AgCl electrode placed in a KCl electrolyte; all is covered by a Teflon membrane.

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Oxygen molecules diffuse through the membrane oxidizing the AgCl electrode; this accepts positive potential while the electrolyte accepts negative potential according to the following equations:



The potential difference of the electrodes is converted into an oxygen measurement by the sensor's controller using the temperature compensation calculation.

The sensor offset process also depends on the internal temperature readings.

### Maintenance and storage:

#### Short-term storage:

(Less than 24 hours)

For short term storage, fill a beaker with enough distilled water to cover the membrane cap of the oxygen probe. With the membrane cap still attached to the probe, place its tip side down in the distilled water. This easy method is ideal for short term storage, between trials for up to 24 hours.

#### Long-term storage:

(More than 24 hours)

1. Unscrew the membrane cap from the oxygen probe.
2. Discard the DO filling solution from the membrane cap.
3. Rinse the cap with distilled water and gently shake to air dry.
4. Rinse and dry the exposed metal electrode with distilled water; it can be dried with lab wipes.
5. For storage purposes: Loosely reattach the membrane cap to the oxygen probe.

### Maintenance:

- Never submerge the NeuLog sensor's plastic body in any liquid.
- Do not allow liquid into the NeuLog plastic body.
- After using the probe, wipe off all excess material, liquid or residue from the oxygen probe body. Do not leave the membrane cap with filling solution for more than two days.
- Store in a box at room temperature out of direct sunlight.
- Do not put the plastic case or cord of the oxygen probe in an acid or base.
- Store the oxygen 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. The warranty is for a period of 3 years from the date of purchase and does not cover damage of the product caused by improper use, abuse, or incorrect storage. Sensors with a shelf life such as ion selective probes 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 NeuLog!



Flexible, simple, fast, forward thinking.

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V11042014