



Lakeland University, Plymouth, Wisconsin  
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## Introduction

In a study we conducted at Lakeland University in Plymouth, Wisconsin, the main focus was to collect and analyze data from Aranet4 PRO sensors. These battery-powered stand-alone wireless sensors monitor carbon dioxide (CO<sub>2</sub>), temperature, relative humidity, atmospheric pressure, and RSSI (signal strength from base station to sensors).

During the pandemic it has been found that CO<sub>2</sub> monitoring is an important factor for returning students back to school. CO<sub>2</sub> is also important to monitor because indoor air which contains high levels of carbon dioxide (CO<sub>2</sub>) concentration can affect a person's cognitive ability and their productivity. Indoor CO<sub>2</sub> concentration can make people anxious, sleepy, and unable to concentrate, which results in a lower performance to complete tasks. Decreasing CO<sub>2</sub> levels can increase a person's productivity. Aranet products monitor indoor air quality, provide real-time data, and receive alerts when CO<sub>2</sub> levels have crossed thresholds and rooms need ventilation. When rooms are ventilated in a timely manner, concentration, and performance levels increase, improving productivity and overall contentment.

Aranet Pro base station and Aranet4 PRO sensors were used to collect the data at Lakeland University.



### Aranet PRO base station

- Gather readings from up to 100 Aranet4 devices.
- Centralized data collection.
- Independent local storage and Aranet Cloud.
- Analyze real-time data.

### Aranet4 PRO sensor

- Wireless plug-and-play with on-screen display.
- Monitors CO<sub>2</sub> (air quality indicator), temperature, relative humidity, atmospheric pressure, and RSSI (signal strength).
- Warns via color indicator and sound signal when action must be taken to increase airflow.





Figure 1: Lakeland University Aerial Map w/ Aranet4 PRO sensors & Aranet PRO base station.

**Summary:**

Figure1, each of the five sensors was assigned a different color. On the aerial map, the colored sensors are located in a different room on campus, and each measure a different distance to the base station. The base station was located in a different building and room than all of the Aranet4 sensors.

Sensor Color	Sensor Location	Sensor Floor Level	Distance to Base Station
Purple	Computer Lab	2 <sup>nd</sup>	0.09 mi
Red	Science Lab	1 <sup>st</sup>	0.08 mi
Green	Classroom	1 <sup>st</sup>	0.01 mi
Orange	Classroom	2 <sup>nd</sup>	0.01 mi
Blue	Classroom	2 <sup>nd</sup>	0.03 mi
<b>Base Station</b>	<b>Base Station Location</b>	<b>Base Station Floor Level</b>	<b>N/A</b>
Base Station	Server Room	1 <sup>st</sup>	N/A

Figure 2: Chart displaying the five sensors, and base station distance at Lakeland University.

**Summary:**

Figure 2, the chart displays what color each sensors were, the location of the sensors, what floor the sensors were on, and how far the sensors were from the base station.

After the data is collected by the wireless sensors it gets sent to the Aranet base station where the data collected can be viewed. The data is displayed on individual graphs that show CO<sub>2</sub>, temperature, relative humidity, atmospheric pressure, and RSSI. The data on these graphs are displayed in intervals of five minutes.

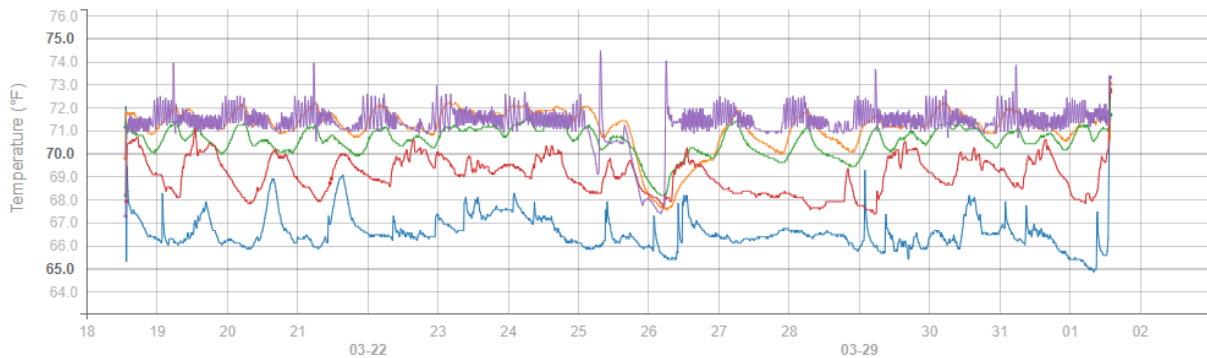
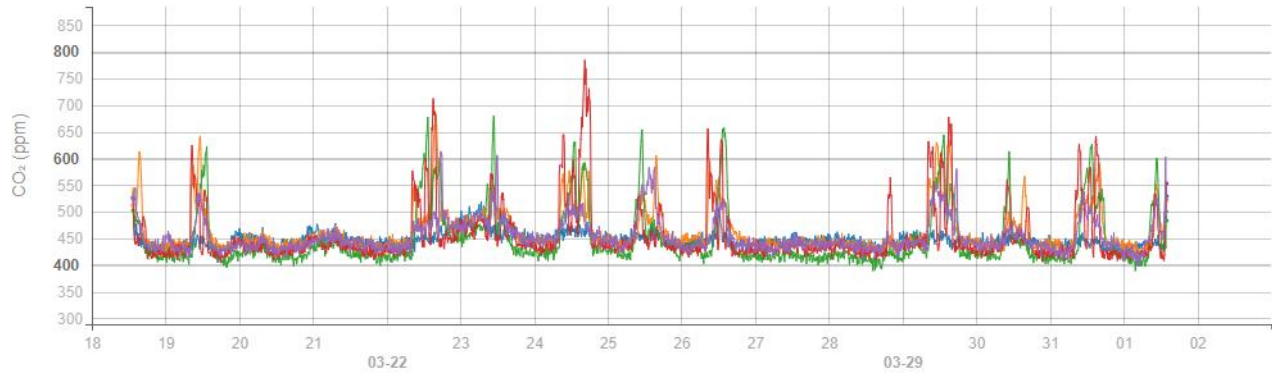


Figure 3: Data of temperature intervals at Lakeland University.

**Summary:**

Figure 3, this data represents the daily temperature data that was collected and recorded. Each color on the graph represents a different sensor.

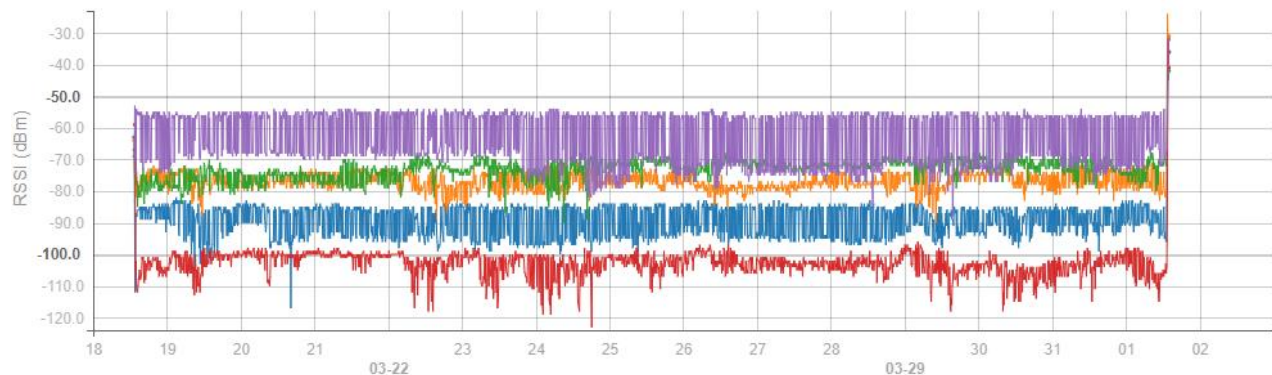


**Figure 4:** Data of carbon dioxide (CO<sub>2</sub>) intervals at Lakeland University

**Summary:**

Figure 4, the data on this graph shows the daily carbon dioxide (CO<sub>2</sub>) levels. As you can see from the graph when the air quality is bad and ventilation is needed the CO<sub>2</sub> concentration will rise.

This next graph shows how RSSI works, and what it is. RSSI is the signal strength from each sensor to the base station. To determine how to make sure you have a strong signal we want to use the Aranet RSSI sensor. This sensor is a wireless sensor that is designed to be used as a signal tester. The signal must be strong between the base station and the sensor, so the data collected is precise and accurate.



**Figure 5:** Data of RSSI intervals at Lakeland University.

**Summary:**

Figure 5, the data on the graph shows how the signal strength is of the sensors to the base station. When the values appear 0 to 99 it means the signal strength is strong, when the values appear 100-119 the signal strength is moderate, and when the values appear 120 and higher the signal strength is weak. The stronger the signal strength the better it is to receive precise and accurate data.

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