

ScienceCube



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# Wireless pH Sensor (WL104PH) User Guide



Rev. WL104PH-02-2024

**This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.**

 **KOREADIGITAL**

*The Science Cube wireless pH sensor can measure the hydrogen ion concentration in a solution.*

**The wireless pH sensor** is a sensor that measures hydrogen ion concentration. It is a principle to determine the pH value from the potential difference between the glass electrode and the reference electrode with two standard solutions that know the pH value.

The Science Cube Wireless pH Sensor does not require a separate connection cable, so it can be easily used in complex experimental environments such as monitoring pH change during neutralization of acid-base, chemical reaction and checking pH in a water tank during photosynthesis. You can use this sensor for investigation of acid rain and water quality as well. Also, it is possible to connect up to 4 sensors at same time, so you can use it with other kinds of sensors together.

You can measure by remotely connecting to a smart device or PC wirelessly or wired.

## Suggested experiments

- Neutralization titration of acid base
- Acid rain research
- pH measurement in various solutions
- Measurement of changes in pH value during chemical reactions
- Measurement of changes in pH value through photosynthesis

## Composition

*The ScienceCube wireless pH sensor consists of the following.*

- Wireless pH sensor(WL104PH)
- pH Electrode
- USB-A/C cable

- Booklet

## Feature

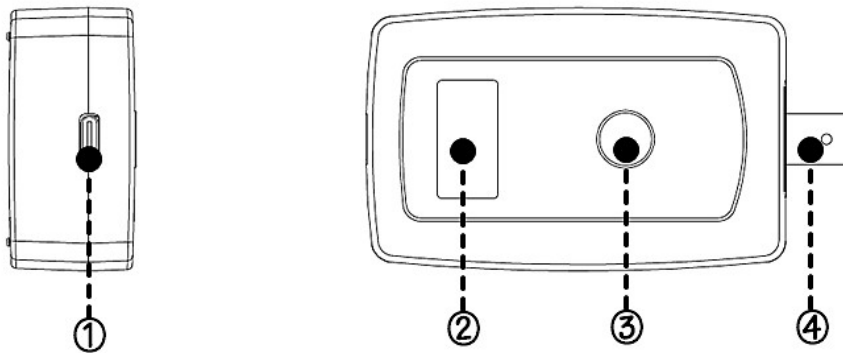
- Up to four Science Cube wireless sensors can be connected to a PC or smart device at the same time.
- It supports dual-mode Bluetooth, allowing you to connect not only smart devices but also desktop and laptop PCs to conduct experiments using the **Science#** application.
- It can be connected to a PC through a USB port and experiments can be performed using the **Science#** program.



## Function of wireless sensor

**Caution** : Do not measure beyond the sensor's measurement range. Doing so can reduce the accuracy of the sensor, cause sensor malfunctions, or result in permanent damage. Please use within the safe measurement range.

## Structure



- ① USB port : Connect the sensor to a PC and use it for experiments or charging.
- ② OLED Display : Displays measured sensor values, sensor type, sensor ID, and remaining battery level.
- ③ Power/Function Button : It has functions such as power ON/OFF, measurement sensor change and calibration, etc.
- ④ Sensing part : There is a BNC connector for connecting the pH electrode, which can be connected by turning.

## Power/Function Button

Status	Turn	Action	Description
When the power is off	Click once	■	A short press turns the sensor on.
	Long click	■■■■■	A long press changes the mode and turns on the sensor.
When it's on	Double click	■■	A user calibration is performed and <b>UC</b> is displayed above the device.
	Long click	■■■■■	Turns off.

## Start screen

V250

ScienceCube  
SC:VOLT-001

V250 : Displays the sensor's firmware version.

SC:NAME-001 : When you search for a Bluetooth device, the device name will be displayed. (Sensor name and 3-digit serial number)

### Mode change


V250

Bluetooth mode  
Change 0000

When you press and hold the power button and turn it on, the Bluetooth connection mode changes to **Mobile** or **PC** with the following message.

### Measurement screen



① Connection mode	Mobile : Connecting an Android or iOS. PC : Connecting a Windows-based PC.  : Connected via USB cable.
② Sensor-ID	When connecting wirelessly using the sensor's serial number, this is the sensor name displayed in 'Device Name'.
③ Battery	You can check the battery status, and when you connect the USB charging cable, the display changes to charging.
④ Sensor Value	1) Displays sensor measurement values and units in real time. 2) When using 'User Calibration', <b>UC</b> is displayed above the unit.

## How it Works

### Hydrogen ion concentration

pH is an indicator of the hydrogen ion concentration in a solution and can be expressed as the following equation.

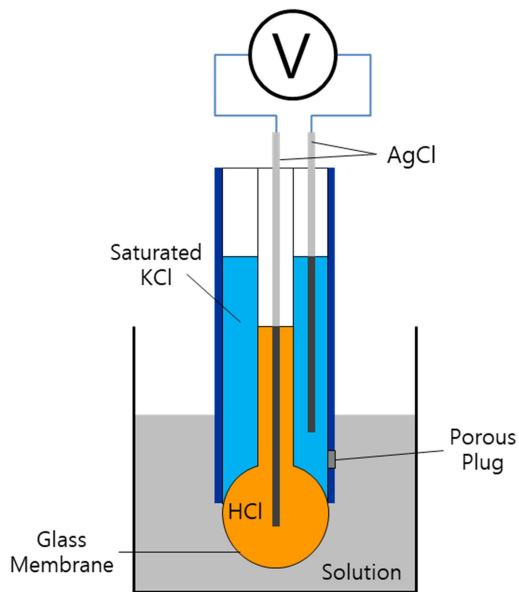
$$pH = -\log_{10} a(H^+) = \log_{10} \left( \frac{1}{a(H^+)} \right), \quad a(H^+) \cong [H^+]$$

Because the hydrogen ion concentration that exists in nature is very large, the value is expressed by taking the logarithm of the reciprocal, which is expressed as an exponent and is called pH.

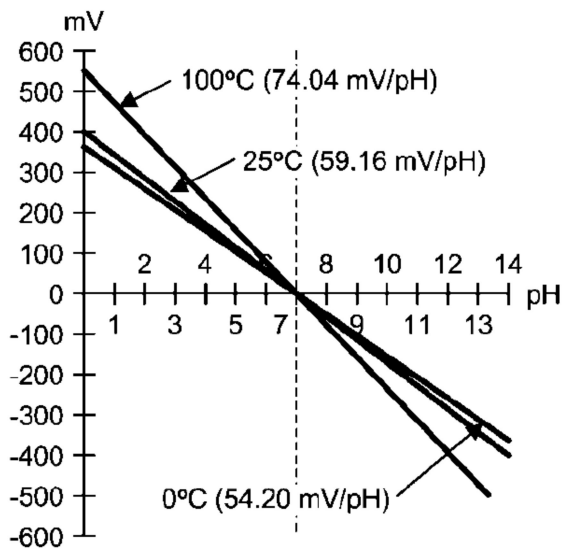
### pH Electrode

Science Cube's wireless pH sensor uses a composite electrode that integrates a *glass electrode* and a *reference electrode*, enabling simple measurement without electrolyte replenishment. It consists of a glass electrode connected to silver chloride (AgCl) containing a hydrochloric acid (HCl) solution in the center and an epoxy electrode containing a potassium chloride (KCl) solution surrounding it.

When the electrode is immersed in the measuring solution, hydrogen ions (H<sup>+</sup>) move through the membrane and change the HCl concentration. At this time, a potential difference with the comparison electrode occurs, which is measured and converted to pH.

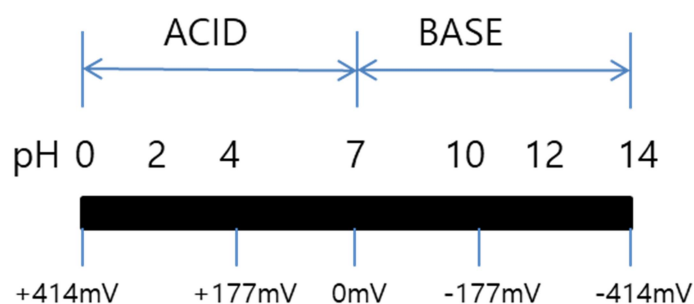


Generally, a potential difference of about 59.16 mV occurs for every 1 change in pH at 25 °C.



### Neutral, acidic, basic (alkaline)

In the case of a neutral aqueous solution, the point where the activity of hydrogen ions (H<sup>+</sup>) and the activities of hydroxide ions (OH<sup>-</sup>) are the same is set as pH = 7.0. A pH value lower than 7 is acidic, and a pH value higher than 7 is basic.



## Using the Sensor

**CAUTION** : When removing or inserting an electrode from a storage bottle, leave the bottle cap partially or fully open to prevent damage to the electrode due to pressure differences.

The ScienceCube wireless pH sensor can be measured in the following ways

1. Run 'Science#' and connect the sensor wirelessly or wired.
2. Calibrate using standard solution in [Sensor Calibration]. *(optional)*
3. Set the [Data Collection Interval] and [Experiment Time] in [Experiment Settings].
4. Click [Start] to start the experiment.

For more information on how to use the Science# application, see the help.

**WARNING** : Do not experiment with acid or basic solution with density higher than 1.0 M as it will damage the electrode. Also, do not use sensor beyond the given range.

## Calibration

All sensors are precisely calibrated using standard solutions during the manufacturing process before being shipped and are ready for immediate use. However, you can perform **[User Calibration]** for more accurate measurements.

**NOTE :** [User Calibration] is reflected temporarily and then returns to the default when the sensor is turned on again.

## Preparation

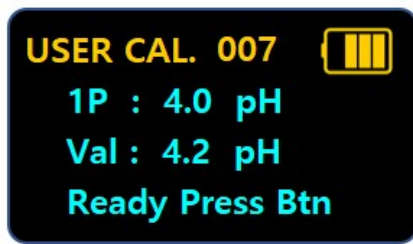
- For [sensor calibration], pH standard buffer solution, distilled water, and laboratory tissue are required.
- In order to maintain the properties of the electrode, protect the electrode with a storage bottle containing KCl (3.3M) solution.
- Before immersing in the solution or after taking it out, wash the tip of the electrode with distilled water and then gently remove any moisture with a laboratory tissue. At this time, be careful not to rub the glass electrode.
- Standard buffer solution can be purchased and used separately at a scientific materials store.
  - **NIST** Standards : pH 4.0, pH 7.0, pH 10.0,
  - **JIS** Standard : pH 4.01, pH 6.86, pH 9.18

## Calibration directly on the sensor

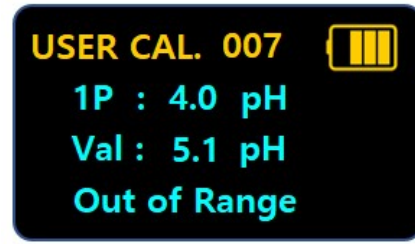
### 1P. Calibrating pH 4.0

Immerse the electrode in pH 4.0 standard buffer solution, and when the measurement value stabilizes at 4.0, press the power/calibration button twice in succession. After about 3 seconds, the reference value (1P: 4.0 pH) and the current value (Val) are displayed.

If a value similar to the reference value is measured, 'Ready Press Btn' is displayed. If the standard buffer is contaminated or the deviation is large due to a problem with the electrode, 'Out of Range' is displayed and the correction value is not applied. In this case, recheck the buffer solution or electrode and try again from the beginning.



<Normal>

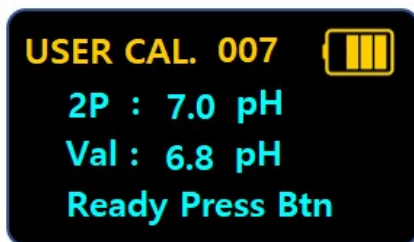


<Abnormal>

If the display is normal, move the electrode to the 2<sup>nd</sup> standard buffer solution (pH 7.0) and prepare to press the button.

### 2P. Calibrating pH 7.0

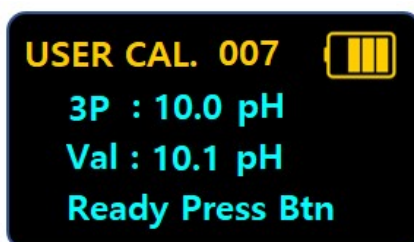
If you press the button in the previous step, the measured value will be reflected the same after about 3 seconds.



Also, transfer the electrode to the following 3<sup>rd</sup> standard buffer solution (pH 10.0) and prepare to press the button.

### 3P. Calibrating pH 10.0

If you press the button in the previous step, the measured value will be reflected the same after about 3 seconds.



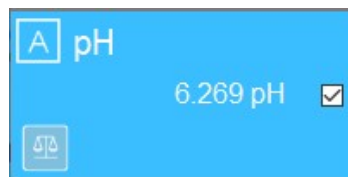
After proceeding with all processes normally, press the button one last time to complete **[User Calibration]**. The word '**UC**' appears above the unit display on the sensor screen.

To cancel **[User Calibration]**, press the button twice in succession. '**UC**' disappears and returns to default.

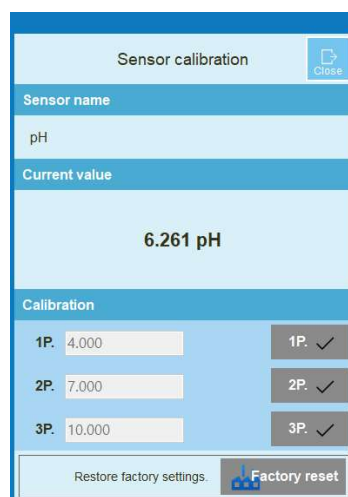
Calibration within the '*Science#* ' program.

**Note:** This does not reflect the values displayed on the sensor or the values corrected by **[Calibration directly on the sensor]**, but only the measurements collected within the Science# program.

Connect the wireless pH sensor to *Science#* and click the '**calibration icon**' that appears on the screen.



On the [Sensor Calibration] screen, immerse the electrode for each point in pH standard buffer solution and click.



If you press **[Factory reset]**, it will return to the values before calibration.

## Storage and maintenance

### pH Sensor Safekeeping

- When not in use, clean out the electrode with distilled water (remove all moisture with laboratory tissue). Then place the complex electrode (glass) in the 3.3M KCl provided container for safekeeping.
- For a short period up to a several hours, safekeeping electrode in pH 4.0 or 7.0 standard buffer solution is possible. However, for longer periods the electrodes must be soaked in the pH 4.0, 3.3M KCl solution provided.
- If by negligence, the electrode has been kept dry, it should be soaked in the buffer container for at least 2 hours before use.
- If there is a small amount of solution left in the storage bottle, you can replenish it with small amounts of tap water the first few times you use the electrode, but this is not a permanent solution. Be sure to replenish 3.3M buffer/KCl storage solution


### Electrode replacement period

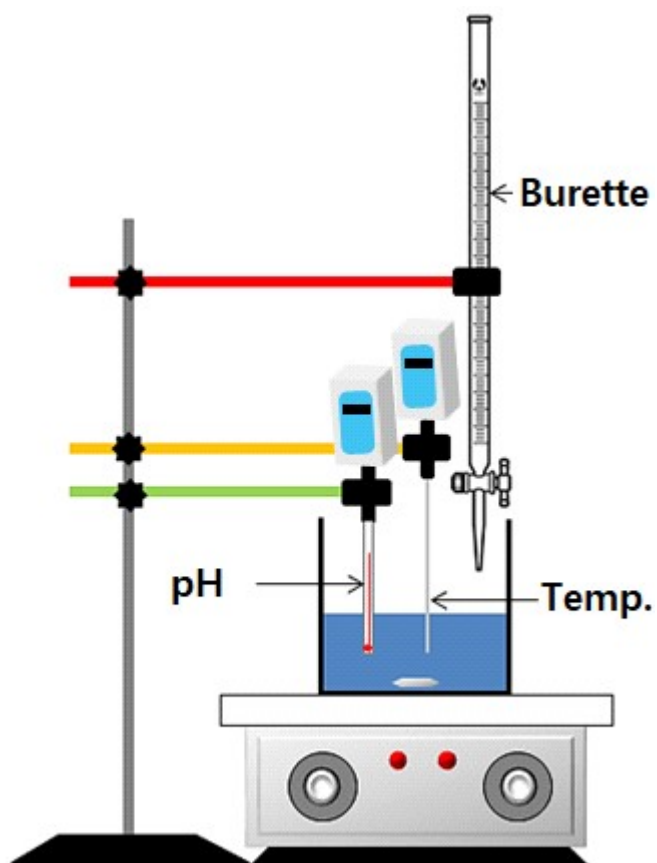
When the pH figure gauged from 3.3 M KCl safekeeping solution has changed severely or if the reaction to gauging is slow than usual, discard the electrode and replace it with a new one. Electrodes can be purchased through **ScienceCube**.


## Experiment example

### Acid-base neutralization reaction

- ① Add 50ml of hydrochloric acid solution(HCl) to the beaker and place it on the stirrer.
- ② Insert the stirring magnet into the beaker.
- ③ Fill the burette with 60mL of sodium hydroxide and fix it on the stand.
- ④ Wash the electrode of the pH sensor with distilled water and lightly remove moisture with a laboratory tissue.

- ⑤ Fix the pH sensor and temperature sensor to the stand so that they are submerged in hydrochloric acid.
- ⑥ Calibrate the pH sensor.
- ⑦ After running **Science#** , turn on the temperature sensor and pH sensor and connect the sensors.
- ⑧ Start data collection.
- ⑩ Adjust the burette so that 3 to 5 drops fall from the burette per second.
- ⑩ Observe changing pH and temperature values.



\*For detailed experiments, please refer to contents in **Science#** .

## Specifications

Item	Description
Range	0 ~ 14 pH
Resolution	0.001 pH (When using <i>Science#</i> ) 0.01 pH (Sensor display)
Sampling Time	Max. 100Hz (0.01 sec.), (Typical 1Hz)
Condition	-20 ~ 60°C, Max. 85%RH, Probe : 0 ~ 80°C
Wireless Connection	Bluetooth 5.0 or Classic 2.1
Wired Connection	USB-C
Battery	700mAh Li-Polymer rechargeable
Charging Time	within 2 hours
Operating Time	Approximately 13 hours after full charge (depending on usage conditions)
EMC	CE : EN 61326-1, EN 55011, EN 55032, EN 301 Ⓜ R202-SMD070

**CAUTION : Exceeding the limit values for extended periods of time may result in reduced sensor stability. If you conduct an experiment in a highly concentrated acidic or basic solution over 1.0M, the electrode may be damaged. Also, do not perform experiments at temperatures outside the intended range.**

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- The contents of this manual are provided for informational purposes only, and product specifications and functions may be changed without prior notice to improve performance.
- This product is designed for science education. No warranty is provided and no liability is assumed for errors in industrial testing or manufacturing process controls, medical analysis or controls, or commercial design applications.

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