



# pH Lesson Plan Example

## Overview:

pH is the measurement of acidity or basicity of an aqueous solution. The Open Source Bio Transmitter can measure and log pH values, display calculations, and control pH. Understanding pH and how it is measured is critical in the areas of Chemistry, Biology, Engineering, and Environmental Sciences.

## Introductory Lesson Plan:

### Objectives:

- Basic understanding of Acids and Bases
- Basic understanding of the pH Scale

### Lesson Plan

#### Materials required:

Boekel OSB Transmitter with pH Probe  
Tank or Large Container

#### Consumables

Tap Water  
Soda  
Soap

1) Explain that pH is a measurement of the concentration of hydrogen ions in a solution. Solutions exhibit different properties based on the concentration of hydrogen ions.

2) Set up the transmitter with a pH probe and place the probe in a tank with some tap water. The pH reading should be close to 7, which is neutral on the pH scale of 0 – 14. Explain that below a pH of 7 the solution is considered an acid and above a pH of 7 the solution is basic.

**Action:** Add soda to the tank to demonstrate the pH of soda is acidic. The pH will drop over time as the soda dissolves in the tank. After dissolving the pH of the tank will be around 3. Explain that at a pH of 3 there are 10,000 more hydrogen ions than in pure water because the pH scale is a log base 10 scale. Discuss the properties of acids. (taste sour, react with certain metals, react with bases, conduct electricity)

3) Explain that acids are reactive because of the Hydrogen ions. To demonstrate the pH of a basic solution, prepare an additional tank with tap water and a separate cup of soapy water.

4) Bases have a low concentration of hydrogen ions but a high concentration of hydroxyl ions. These concentrations are related to each other.

5) Soapy water has a pH of around 11 therefore it is considered a base.

**Action:** Add soapy water to the tank to demonstrate the pH change.

6) Explain that the soapy water has 10,000 more Hydroxyl ions than pure water. Discuss the different properties of Bases. (Conduct electricity, taste bitter, react with acids, slippery feel)

7) Explain that when acids and bases are mixed they react and form salts.

**Action:** Add the tank of soda and water to the tank of soapy water and monitor the pH. The pH will become more neutral due to the neutralization of the acid and the base.

## Intermediate Lesson Plan:

### Objectives:

- Basic understanding of how a pH probe works
- Basic understanding of why and how a pH probe is calibrated
- How to calculate pH reading based on millivolts
- Understand how to control pH with a computer program

### Additional Materials required:

Boekel OSB Relay  
Small Pump

### Consumables

Tap Water  
Soda  
Soap

### Lesson Plan

1) A pH meter works by a glass electrode reacting with these hydrogen ions. The meter has sensitive electronics to measure the voltage created by this reaction. This voltage correlates to the concentration of the hydrogen ions. A pH probe is calibrated by taking two or three readings. These voltage readings determine how to convert voltage to units of pH.

**Action:** Navigate to calibration screen and calibrate the transmitter. The transmitter has calibration screens that walk you through the calibration process of calibration. This is an important aspect in all laboratories.

2) The calibration curve converts the voltage read by the meter to a pH reading. The raw millivolts reading can be converted to a pH reading.

**Action:** Navigate to the detailed information screen. This screen displays the readings in millivolts. If you divide this by the constant 5.915 you can obtain an approximate pH reading. Details on this constant are included in the manual.

2) The calculated pH reading is approximate because pH is temperature dependent. The meter is taking into consideration the temperature of the solution. More information on this calculation can be found in the manual.

3) pH regulation is essential in many biological, environmental and industrial systems. In the stomach, in blood and individual cells have mechanisms to regulate pH. pH regulation is essential because many enzymes only work at certain pH levels.

4) In this laboratory example the pH meter will attempt to regulate pH by adding soda to reduce the pH of a basic solution. This will be an introduction to computer programming and automation.

**Action:** Upload the pH control library to the pH Meter. The library will turn the relay on at a certain pH when soapy water is added to the soda solution. The relay should be connected to a small pump. Consult the manual for setup.

**Additional Learning Examples:** Use the USB data logging feature to review the pH trend during the experiment. Compare the trend to the code uploaded to the meter. Discuss how to modify the code to better regulate the pH.