

An Integrated Free Chlorine Sensing System

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Why Free Cl Sensing Important

- ❑ Six Nations has been subject to several short-term boil-water advisories, and local testing showed contaminated water in its wells.
- ❑ Nearly 80 First Nations communities are currently under long-term water advisories in Canada.
- ❑ Therefore it is critical to monitor disinfection residual of drinking water.
- ❑ The most commonly used disinfectant is **free chlorine**:
- ❑ **Too Low Free Chlorine**: Cannot effectively kills bacteria and microorganisms in the water.
- ❑ **Over dosage of free chlorine**: cause health issues, Long-term exposure can cause **lung cancer**.
- ❑ In drinking water, the free chlorine concentration must be between 0.1 – 4 ppm.



Water crisis in First Nations



174 advisories

In May 2018, there were 174 drinking water advisories in over 100 First Nations.



20 years

Some of the advisories date as far back as 1995 – like Shoal Lake 40 First Nation.



5,000

A single drinking water advisory can mean as many as 5,000 people lack access to safe, clean drinking water.



73%

73 per cent of First Nations' water systems are at high or medium risk of contamination.



+0.5%

If Canada raises corporate tax rates from 15 to 15.5 per cent, all First Nations' could have working water systems.



July 2010

In 2010, the United Nations declared water and sanitation human rights, acknowledging they are essential to the realization of all other rights.

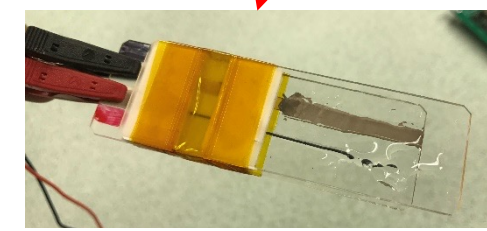
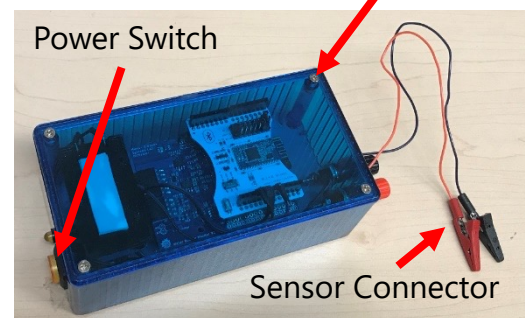
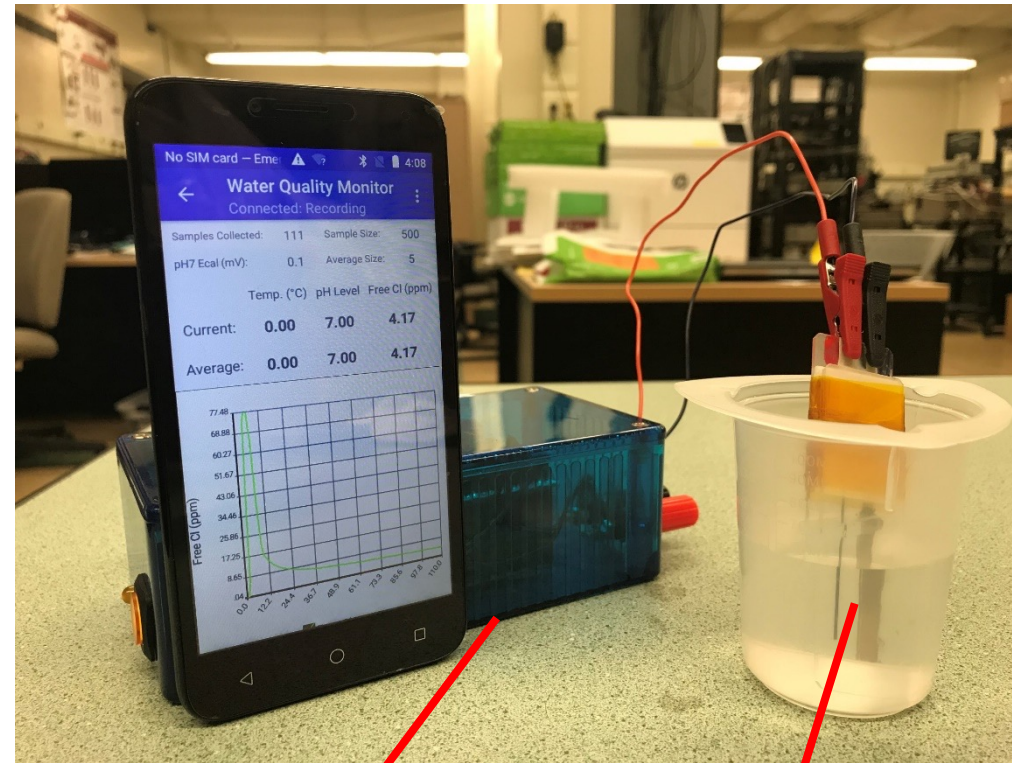
THE COUNCIL OF CANADIANS
LE CONSEIL DES CANADIENS



Free chlorine: 0.1 - 4 ppm

Integrated Free Cl Sensing System (IFCSS)

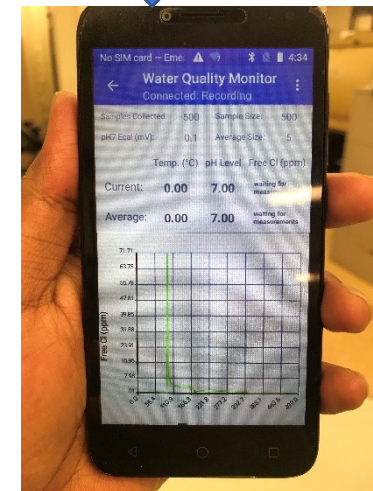
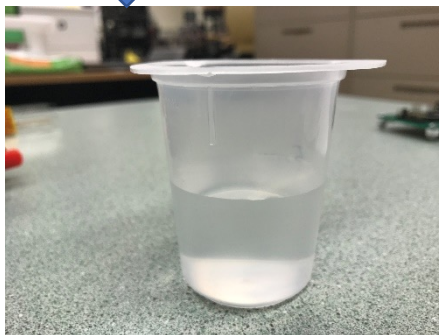
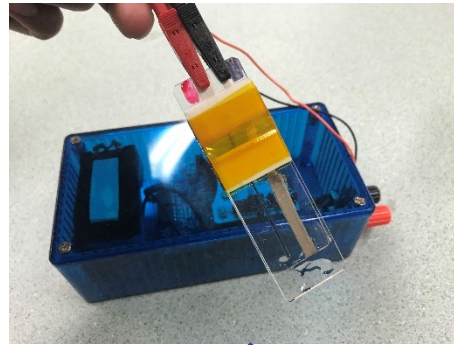
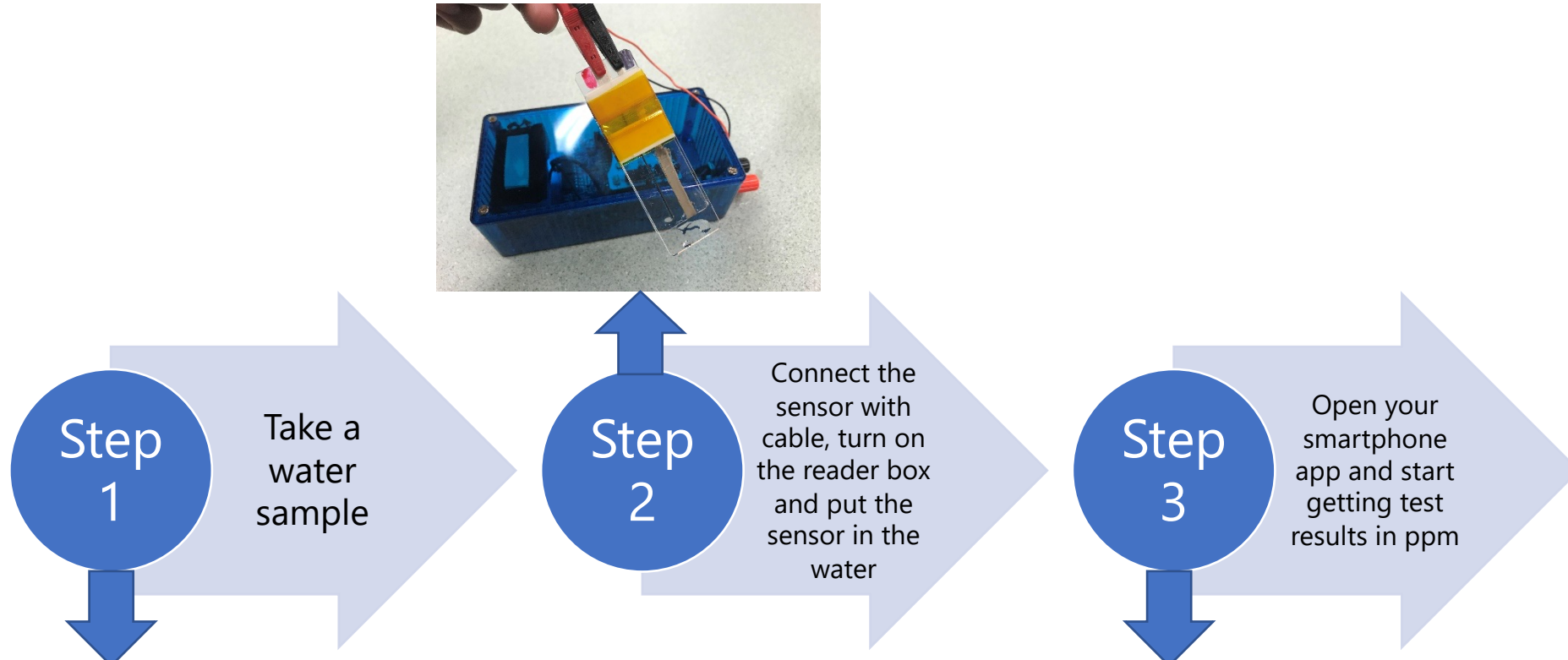
- ❑ We developed an Integrated Free Chlorine Sensing System (IFCSS)
- ❑ **Three** major parts of the IFCSS:
 1. **Sensor:** Pencil lead and Ag/AgCl based electrodes. Sensing is based on electrochemical reactions of free chlorine with pencil lead.
 2. **Data-Logger:** Microcontroller based analog-to-digital converter circuits with Bluetooth wireless system
 3. **Smartphone App:** Android application for wireless reception of free chlorine measurement data, calibration, display and storage



Data-Logger

Sensor

How to Operate the IFCSS



Advantages of the IFCSS

- ❑ Advantages of the proposed IFCSS:
 - ❑ **Low-cost:**
 - The sensor is made of Pencil lead, low-cost silver paste, and microscope glass slide.
 - The data-logger circuits are based on open-source low-cost electronic components.
 - The smartphone app is custom-designed by our lab, and it's free of cost
 - ❑ **Simple Operation:**
 - The sensing system is very easy to operate and does not require special training or trained personnel.
 - ❑ **Portability:**
 - The sensing system is highly portable and can perform tests anywhere.
 - ❑ **Calibration-free:**
 - The sensor is highly stable and does not require frequent calibration. One pencil-lead-based sensor can be used for at least a month.