## Required Training

- UC Lab Safety Fundamentals

## Required PPE

- Lab coat, safety glasses/goggles, nitrile gloves

## Equipment

- Two 4L beakers
- pH meter

## Chemicals

- 2 L ammonium buffer solution (10.7g/L NH₄Cl and 4g/L NaOH in DI water)
- 2 L DI water
- 1 N NaOH for pH adjustments
- 10 mL universal indicator
- ¼ slab dry ice

### Procedure:

1. Measure pH of the buffer prepared in the 4L beaker
2. Adjust pH of the water in the other beaker using 1N NaOH to be the same as that of the buffer
3. In class, add about 5mL of Universal Indicator to each of the beakers (solution in each beaker should be the same color)
4. Add an equal amount of dry ice to each beaker
5. The beaker of water will change color quickly
6. The buffer will maintain its color for a long time until the capacity is passed

## Alternative presentation:

### Acidity Change of Dry Ice in Water

#### Procedure

1. Add a few mLs of Universal Indicator to 900mL of water in a 2L graduated cylinder. Drop in a chunk of dry ice. Color is red from dissolved CO₂ in the water.
2. Add 5mL of 3N NaOH. Color starts to change from purple to yellow as the pH drops back down. The pH will never get low enough again to turn red. Repeat cycle.
3. Reaction slows down with successive aliquots of NaOH showing the buffering effects of the salts formed.

**Discussion:**

\[
\text{CO}_2 (\text{S}) \rightarrow \text{CO}_2 (\text{g})
\]

\[
\text{CO}_2 (\text{g}) + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^- (\text{aq})
\]

\[
2 \text{NaOH (aq)} + \text{CO}_2 (\text{g}) \rightarrow \text{Na}_2\text{CO}_3 (\text{aq}) + \text{H}_2\text{O}
\]

**Hazards:**

Sodium Hydroxide is corrosive. If any comes in contact with skin, wash the affected area with water for at least 15 minutes.

**SOP:**

Corrosive – Sodium Hydroxide

**Disposal (by Storeroom)**

Neutralize the solution and flush down the drain with copious amounts of water.