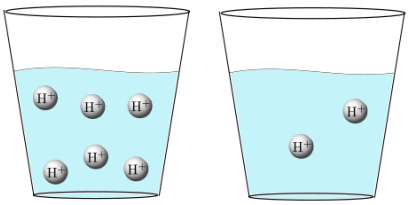
pH Indicators and Titration

- **Acids** are chemicals that like to drop hydrogen ions (H+) when dissolved in water.
- **Bases** are chemicals that grab extra hydrogen ions (H+) out of solution.
- The **pH** of a **solution** measures how many H+ ions
  - Low pH (below 7) means acidic (lots of H+ ions).
  - High pH (above 7) means basic (few H+ ions)
- A **pH indicator** turns different colors depending on the pH of the solution.



Part 1: pH Indicator

1. Put 2 teaspoons of the purple cabbage juice into each of 6 wells in the egg carton.
2. Add 1 teaspoon of each of the substances in the table below, one per well. Fill in the table with the color observed, and your best estimate of of the pH.

Substance	Color	pH estimate
water	purplish-blue	~7
vinegar	pink	2-3
Baking soda ($\frac{1}{4}$ teaspoon)	dark blue	9-10
Lemon juice	pink	2-3
Sprite or 7-up	violet	~5
Windex	green	11-12

List the substances from most acidic to most basic:
vinegar = lemon juice, Sprite, water, baking soda, Windex
Two of the substances have very similar acidities. Which two?
Vinegar and lemon juice

Part 2: Measuring pH with Titration

- Mixing an acid with a base can **neutralize** them both – the base soaks up the extra ions from the acid.
- **Titration** is used to precisely measure and compare pH.
- A titration involves making a basic solution with a pH indicator mixed in, then slowly adding an acid of unknown pH until the solution changes color. The stronger the unknown acid, the less of it you have to add to get to neutral.

1. Put 3 teaspoons of purple cabbage juice into each of 2 clean wells. Add 1 teaspoon of Windex to the 1st well and mix.

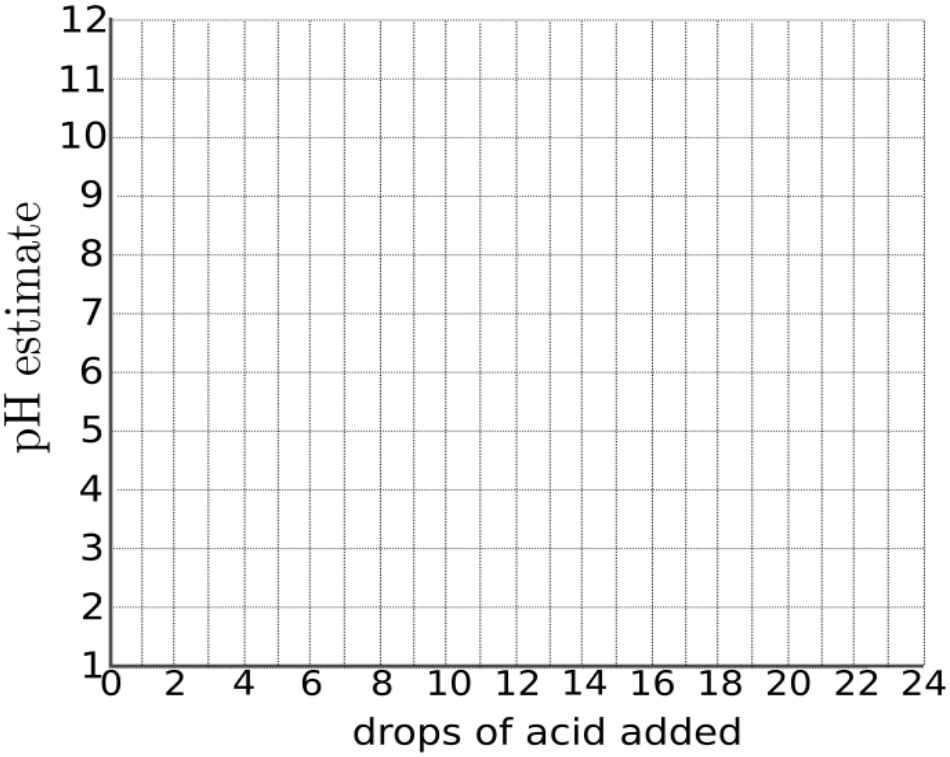
The 2nd well will be your "**negative control**". It lets you see the color of the indicator when nothing is added, for comparison.

2. Suck up some vinegar in a pipette. Start adding the juice slowly, one drop at a time to Well #1. Use a clean spoon to stir after each drop you add. Count the drops you add. Whenever you notice the color changes enough to correspond to a different pH, write down the number of drops added and the color. Stop when you get to 20 drops.

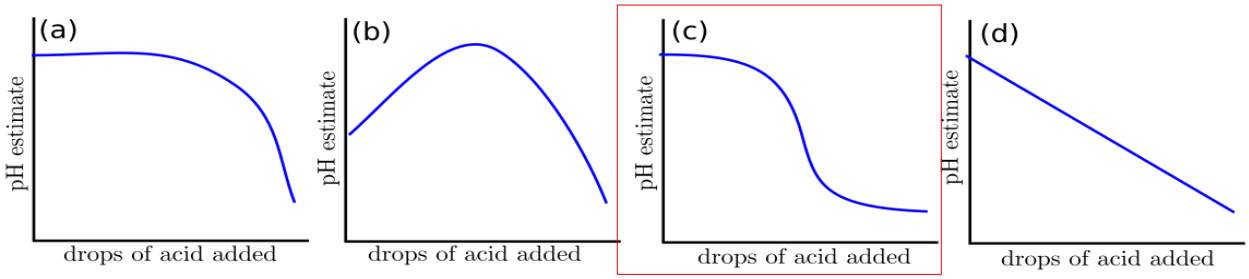
Vinegar titration

# drops added	pH estimate		# drops added	pH estimate
0				

3. Use the data in your table to plot points on the graph below. Connect them with straight lines.



Which of the following looks most like your graph?



Approximately how many drops of vinegar did you need to get a neutral solution?

~7

4. If you have extra time: make another well with 3 teaspoons of cabbage juice + 1 teaspoon of Windex. Repeat the titration, one drop at a time, with lemon juice. Plot on the same graph above.

Approximately how many drops of lemon juice did you need to get a neutral solution?

~ 8

Which of your substances is more acidic (circle one): vinegar lemon juice

Answers will vary. We found that vinegar was slightly more acidic (fewer drops needed to neutralize the windex) but it is a very small difference, and may depend on ripeness of lemon, etc.