**CHEM 12 – pH Intro Lab Teacher notes**

*Intro to students:*

In our look at Kw, we saw that neutral water has a [H+] = 1.0 x 10-7M. This corresponds to pH 7.  
Without getting into full logarithm math, I explain that likewise

pH 3 = 10-3M H+ pH 9 = 10-9M H+

Materials:   
 1.0 M and 0.010 M HCl 1.0 M and 0.010 M NaOH  
 Water Any glassware you need (max. size available = 1.0L)  
 \*\**Teacher will need universal indicator*

Your task (in groups of 2) is to create the following 2 solutions:  
 \*I actually prefer to assign the first pH (the acidic one) and give the next task only   
 when they’ve completed the first… it sets them up!  
 \*The pairings below are intentional, as the pH’s close to 7 require significant amounts   
 of dilution whereas pH 0 is straight from the 1M HCl bottle.

|  |  |  |
| --- | --- | --- |
| Solution 1 pH | Solution 2  pH | Group(s) –may have 2 groups working on the same set. |
| 0 | 8 |  |
| 1 | 9 |  |
| 2 | 10 |  |
| 3 | 11 |  |
| 4 | 12 |  |
| 5 | 13 |  |
| 6 | 14 |  |

I give hardly any instruction, but might remind them of the dilution math C1V1 = C2V2.  
I intentionally do NOT remind them of Kw = [H+][OH-]…

When they're done, students bring the sample to the front and place it on the pH scale strip I have created. We test each solution with universal indicator to see if they’ve been made correctly (I use distilled water for “pH 7” as a reference point, and put 6M HCl and 6M NaOH as book-ends).

***Why this lab matters:***

Without any front-loading, kids will prepare acid solutions by diluting their acid sample to the desired pH. On average, half of them will then try to use the same strategy to create a basic solution… start with HCl and water it down to 10-10M. When they are astonished by the volumes required, or when they make a solution and it doesn’t test as basic, I have conversations with individual groups…

“I can take a solution of pH 4, dilute it by 100x, and get a solution of pH 6. But I can’t take that solution of pH 6, dilute it by 100x, and get a solution of pH 8. How come?”

Most students cannot answer this question, so I ask another:

“If you took one drop of this 0.01M HCl, and put it in a bathtub of water, what would the approximate pH be?” They answer 7. “And would adding more water change that?” No.

So we get to have 1:1 conversations about how you can’t dilute water… 10-7 is a dividing line. If you need a concentration below that, you need to actively remove H+ from neutral water. How can we do that? Add OH-. Now I remind them of Kw, and how to connect to [OH-]… and they manage just fine.

Take-home messages:

1. The pH connects to the concentration of H+ in the solution.
2. Acids can’t create basic solutions (it seems obvious, but…)