Name_____ **Period** _____ **Date** _____

Buffers STEM Sims

Lesson 2: Buffers

Normally, when an acid or base is added to a system, the pH changes. However, many living organisms require a relatively constant pH to maintain good health. In this investigation, you will test what happens to the pH of a buffered system when an acid or base is added to the system.

Doing the Science

1. Open the Buffers simulation.
2. Select and move the "Buffer #1" solution to the center of the tabletop.
3. Select the magnifier and move it to the "Buffer #1" beaker on the tabletop. Note the number and type of particles in the beaker.
4. Note the pH of Buffer #1 on the tabletop. Record this value in Table 1.

Part I: Adding an acid

5. Select a pipette and move the pipette to the beaker containing acid on the shelf.
6. Move the pipette to the "Buffer #1" beaker on the tabletop to dispense the acid.
7. Select the magnifier and move it to the "Buffer #1" beaker and acid on the tabletop.
8. Note and record in Table 1 the number of particles in the solution and the solution's pH.
9. Move the same pipette back to the beaker with acid on the shelf to reload the pipette with acid.
10. Move the pipette back to the beaker on the tabletop to dispense the acid. Repeat this process three more times, then move the pipette to the waste area. Make sure to use the magnifier to view the particles present in the solution and to record in Table 1 this number of particles and the system's pH.

Table 1. Adding an acid to Buffer #1

System	Particles present	pH
Buffer #1		
Buffer #1 + 4 drops acid		
Buffer #1 + 8 drops acid		
Buffer #1 + 12 drops acid		
Buffer #1 + 16 drops acid		

Part II: Adding a base

11. Move the "Buffer #1" beaker on the shelf to the center of the tabletop.
12. Note the pH of the "Buffer #1" beaker on the tabletop. Record this value in Table 2.
13. Select a pipette and move the pipette to the beaker containing base on the shelf.
14. Move the pipette to the "Buffer #1" beaker on the tabletop to dispense the base.

15. Select the magnifier and move it to the "Buffer #1" beaker and base on the tabletop.
16. Note and record in Table 2 the number of particles in the solution and the solution's pH.
17. Move the same pipette back to the beaker with base on the shelf to reload the pipette with base.
18. Move the pipette back to the beaker on the tabletop to dispense the base. Repeat this process three more times, then move the pipette to the waste area. Make sure to use the magnifier to view the particles present in the solution and to record in Table 2 this number of particles and the system's pH.

Table 2. Adding a base to Buffer #1

System	**Particles present**	**pH**
Buffer #1		
Buffer #1 + 4 drops base		
Buffer #1 + 8 drops base		
Buffer #1 + 12 drops base		
Buffer #1 + 16 drops base		

Part III: Testing another buffered system

19. Repeat Parts I and II for the Buffer #2 solution. Make sure to record your data in Tables 3 and 4.

Table 3. Adding an acid to Buffer #2

System	**Particles present**	**pH**
Buffer #2		
Buffer #2 + 4 drops acid		
Buffer #2 + 8 drops acid		
Buffer #2 + 12 drops acid		
Buffer #2 + 16 drops acid		

Table 4. Adding a base to Buffer #2

System	**Particles present**	**pH**
Buffer #2		
Buffer #2 + 4 drops base		
Buffer #2 + 8 drops base		
Buffer #2 + 12 drops base		
Buffer #2 + 16 drops base		

Part IV: Evaluating an unknown buffered system

20. Repeat Parts I and II for the Unknown Buffer solution. Make sure to note and record in Tables 5 and 6 the pH and to count and record the number of particles of A^{-1} and HA in the solution.
21. After you have collected your data for the "Unknown Buffer" solution, select the "Evaluate Buffer" button next to the "Buffers" button at the bottom of the screen.
22. Enter the ratio of A^{-1}/HA in the space provided on screen and in Table 7. If you need to recount the particles to determine the A^{-1}/HA ratio, select the "Return to laboratory" button. Use the pH and the ratio of A^{-1}/HA to calculate the pKa (dissociation constant) for the A^{-1}/HA buffered system. Record this value in the space provided on screen and in Table 7.

Dissociation Constant (pKa) = pH – log ($[A^{-1}]/[HA]$)

Table 5. Adding an acid to the Unknown Buffer

System	**Particles present**	**pH**
Unknown Buffer		
Unknown Buffer + 4 drops acid		
Unknown Buffer + 8 drops acid		
Unknown Buffer + 12 drops acid		
Unknown Buffer + 16 drops acid		

Table 6. Adding a base to the Unknown Buffer

System	**Particles present**	**pH**
Unknown Buffer		
Unknown Buffer + 4 drops base		
Unknown Buffer + 8 drops base		
Unknown Buffer + 12 drops base		
Unknown Buffer + 16 drops base		

Table 7. Using the Henderson-Hasselbalch Equation

Unknown Buffer ID	
pH value	
Ratio $[A^{-1}]/[HA]$	
pKa value	

Do You Understand?

1. What happens to the value of the pH as an acid is added to a buffered system?

2. What happens to the value of the pH as a base is added to a buffered system?

3. If the pH of a buffered system was 6.10 and the ratio of conjugate base to weak acid was 12.6 to 1, what is the value of pKa?