Zombie Apocalypse Part 2 – The Humans Strike Back!

How understanding pH can help save the human race **Name** _____

Student Activity **Class** _____

Open the TI-Nspire document *Zombie_Apocalypse_Part_2.tns.*

Zombie Apocalypse!?! What will humanity do? Who do we turn to when looking for an answer? Scientists and Engineers of course! In this lesson you will explore acid/base titration as it relates to looking for a solution to the zombie apocalypse. You will understand what an equivalence point is. You will ask yourself, "What happens at the molecular level during a titration of a strong acid with a strong base?" In this activity you will be able to answer this question by simulating a titration and observing the molecular view. Eventually you will either save humanity or turn into another brain-hungry ZOMBIE!

Move to pages 1.2 - 1.11. Answer questions 1 - 2 here and/or in the .tns file.

1. Read about the scenario and its background. This activity includes a simulation of a titration of a strong acid with a strong base. The strong acid is HCl, and the strong base is NaOH.

   HCl(aq) + NaOH(aq) → HOH + NaCl(aq)

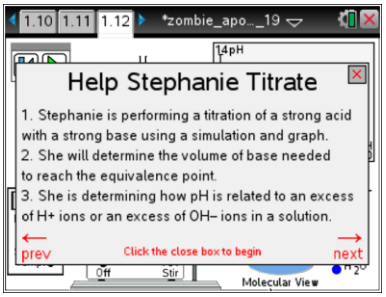
Q1. Changing the internal pH of a living organism could be harmful.

   A. Agree
   B. Disagree

Q2. What is "alkalosis"?

Move to pages 1.12 and 1.13.

2. Read the directions and study the set-up. The beaker contains 50 mL of 0.10M HCl acid and the burette contains 50 mL of 0.20M NaOH.



iPad Tip: To bring up the directions again, select > Titration > Show Help Screen

Move to pages 1.14 and 1.15. Answer the following questions here and/or in the .tns file.

Q3. Initially the beaker contains _____.

A. H^+ and Cl^- ions
B. HCl, H^+, and Cl^- ions
C. HCl and NaOH
D. Na^+ and OH^- ions

Q4. How many H^+ ions are present in the beaker initially?

Move to page 1.16.

3. Read the directions. Return to the titration on page 1.12 and observe the response to the changes you make.

Move to pages 1.17 – 1.19. Answer the following questions here and/or in the .tns file.

Q5. As NaOH is added, the pH _____.

A. decreases B. increases C. is unchanged

Q6. As NaOH is added, the number of H^+ ions _____.

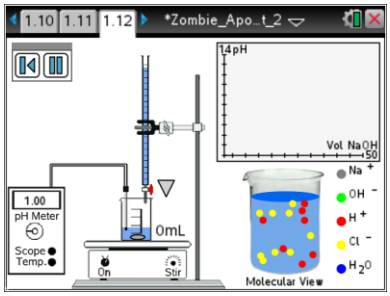
A. decreases B. increases C. is unchanged

Q7. As NaOH is added, the number of Cl^- ions _____.

A. decreases B. increases C. is unchanged

Move to pages 1.20 – 1.27. Answer questions 8 - 14 here and/or in the .tns file.

4. Read the directions on page 1.20 and look at the questions on pages 1.21 – 1.27. You will return to titration on page 1.12 and use the results to answer the questions.



iPad Tip: If you are using an iPad, the screen will not include the play, pause, back buttons in the upper left, or the down button near the burette valve. You should tap the appropriate images instead. In this case, you should turn off the stir plate.

Q8. How many mL of NaOH are needed to reach the equivalence point?

Q9. At the equivalence point, how many H^+ ions remain in the beaker?

Q10. At the equivalence point, how many OH^- ions are present in the beaker?

Q11. Write a net ionic equation to show what happened to the H^+ ions.

Q12. At the equivalence point, the number of Cl^- ions is _____ the number of Na^+ ions.

A. less than B. equal to C. greater than

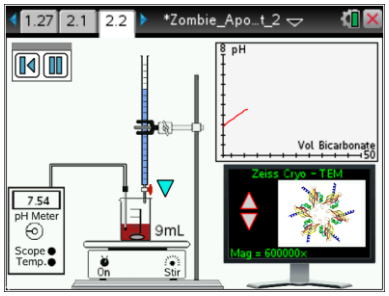
Q13. For a strong acid–strong base titration, what is the pH at the equivalence point?

Q14. As more NaOH is added, beyond the equivalence point, the pH increases because of the increase in the number of _____.

A. H^+ ions
B. OH^- ions
C. Na^+ ions
D. Cl^- ions

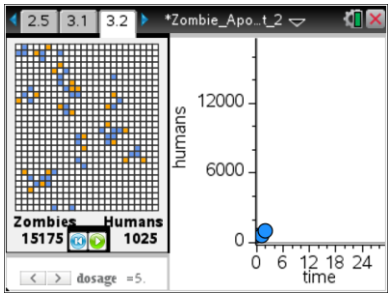
Move to pages 2.1 - 2.5.

5. Follow the directions for the simulation on page 2.2. Notice that in this simulation, you will be titrating with from $NaHCO_3$ (sodium bicarbonate, otherwise known as 'baking soda') rather than NaOH.



Move to pages 3.1 - 3.3.

6. Experiment with the simulation on page 3.2. This represents a simulation made by a programmer on the team. It models the potential population of zombies being healed and turned back into healthy humans.



Move to pages 4.1 - 4.5. Answer questions 15 – 19 here and/or in the .tns file.

7. These extension questions offer insight into scientific inaccuracies of the whole zombie concept as well as information regarding some of the very real STEM careers portrayed in the story.

Q15. Which of the following do you think could limit the effectiveness of the proposed treatment?

A. Too much would cause alkalosis
B. Too little would not denature the prion
C. Changing pH could adversely affect the normal proteins in the body
D. The amount needed will likely vary for each individual

Q16. If you explored the first Zombie Apocalypse file found at stemhollywood.com, you noticed that the prion caused major damage to the brain. Is it likely the new treatment would cause a full recovery of the patient?

A. Yes, it is likely the patient would fully recover
B. No, regeneration of lost/badly damaged tissue is unlikely

Q17. Zombies are known as "the living dead" because their normal body systems don't function properly. Bicarbonate would be administered intravenously (IV). Some have argued that this form of treatment would not allow the drug to hit the targeted areas. Do you agree or disagree with this concern?

A. Agree
B. Disagree

Q18. The military strategists on the team are responsible for determining ways to administer the treatment to the zombie population. They are the deep thinkers that plan on how the resources of the military will be used most effectively to meet goals. Explain how you believe an understanding of science and math would be advantageous to this team of military experts.

Q19. Dr. Stephanie Mann is a biochemist. What do you believe a biochemist does?