Name_____
Class_____

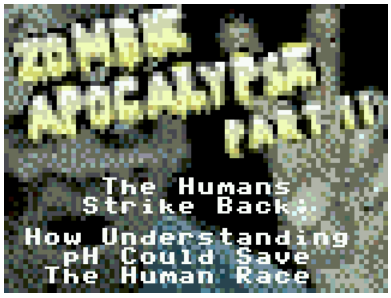
Zombie Apocalypse Part II: The Humans Strike Back

How Understanding pH Can Help Save the Human Race

Adapted from an activity © 2014 Texas Instruments

Background

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!



What Page Am I On?

When you see the **?** (question mark) symbol above GRAPH key, you can press it to find out what page you're on.

Send files to your TI-84 Plus C Silver Edition

Using TI-Connect 4.0 or higher, or a classmate's calculator, send the program ZOMBIEA2 (ZOMBIEA2.8xp) and the AppVar ZA2TD (ZA2TD.8xv) to your TI-84 Plus C Silver Edition. Both files should go to your calculator's Archive.

- **Using TI-Connect:** Open TI DeviceExplorer and select your calculator. Drag ZOMBIEA2.8xp into the item labeled "Flash/Archive" and wait for the transfer to complete. Drag ZA2TD.8xv into "Flash/Archive" as well.
- **From another calculator:** Put the receiving calculator in Receive mode by pressing 2nd XT0n ▶ ENTER. On the sending calculator, go to the `Link` menu with 2nd XT0n, choose `2: All-…`, then find "`ZOMBIEA2 PRGM`" and "`ZA2TD AVAR`" and press ENTER next to each one. Each one should be marked with a square, indicating that it will be sent. Press ▶ ENTER to send the files over.

You will also need Doors CSE 8.1 or higher, which can be found at http://dcs.cemetech.net. The process of sending Doors CSE to your calculator is the same as above, and is also detailed in the Doors CSE readme document.

Name_____
Class_____

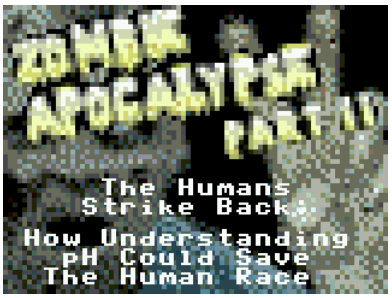
Zombie Apocalypse Part II: The Humans Strike Back

How Understanding pH Can Help Save the Human Race

Run the ZOMBIEA2 program; move to pages 2-11. Answer questions Q1-Q2 here.

1. Run Doors CSE 8 from the Apps menu of your calculator, select ZOMBIEA2, and run the program. You should see the Zombie Apocalypse Part II title screen. Throughout the Zombie Apocalypse Part II activity, you can press the arrow keys (◄►) to move between pages, or ENTER to advance to the next page.
2. On a text page, press the ▼ and ▲ arrows to scroll down and up, and ZOOM or ENTER to scroll down.
3. 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)

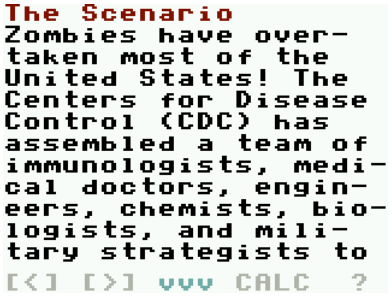


Q1. Changing the internal pH of a living organism could be harmful.

   A. Agree

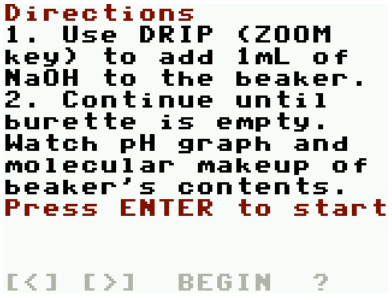
   B. Disagree

Q2. What is “alkalosis”?



Move to pages 12 and 13, a titration simulation and a graph

4. 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. You’ll press the ZOOM to drip NaOH into the HCl, 1mL at a time. You can press TRACE at any time to reset the simulation.



Name_____
Class_____

Zombie Apocalypse Part II: The Humans Strike Back

How Understanding pH Can Help Save the Human Race

Move to pages 14 and 15. Answer the following questions here, in the space provided.

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 16.

5. Read the directions. Return to the titration on page 12 and observe the response to the changes you make.

Move to pages 17-19. Answer the following questions here, in the space provided.

Q5. As NaOH is added, the pH _____.

A. decreases B. increases C. is unchanged

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

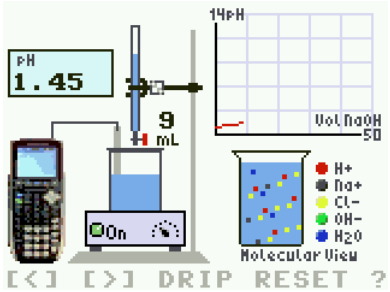
A. decreases B. increases C. is unchanged

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

A. decreases B. increases C. is unchanged

Move to pages 20-27. Answer questions 8-14 here, in the space provided.

6. Read the directions on page 20 and look at the questions on pages 21 – 27. You will return to the titration on page 12 and use the results to answer the questions.



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

Q9. At the equivalence point, how many Cl^- ions are present in the beaker?

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

Zombie Apocalypse Part II: The Humans Strike Back

How Understanding pH Can Help Save the Human Race

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

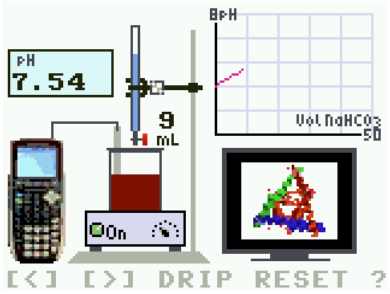
Q13. For a strong acid-base titration, what is the pH at the equivalence point?

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

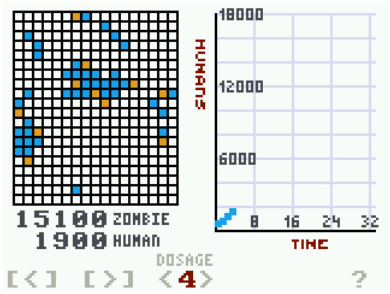
Move to pages 28-32.

7. Follow the directions for the simulation on page 29. 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 33-35.

8. Experiment with the simulation on page 34. 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.



Name_____
Class_____

Zombie Apocalypse Part II: The Humans Strike Back

How Understanding pH Can Help Save the Human Race

Move to pages 36-40. Answer questions 15-19 here, in the space provided.

9. 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 activity found at **http://cemete.ch/pr53**, 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 think a biochemist does?

Image Credits: Texas Instruments. See readme.txt for more acknowledgements.