



Zombie Apocalypse Part 2 – The Humans Strike Back!

How understanding pH can help save the human race

TEACHER NOTES



Science Objectives

- Students will observe what happens during a titration of a strong acid with a strong base by using a simulation that allows them to visualize molecules in solution and a titration curve.
- Students will determine the volume of base needed to reach the equivalence point.
- Students will determine the relationship between pH and the presence of H^+ ions or OH^- ions in a solution.

Vocabulary

- concentration
- equivalence point
- pH
- strong acid
- strong base
- titration
- biochemist
- military strategist
- virologist
- acidosis
- alkalosis
- prion
- acid dissociation constant

About the Lesson




- This lesson features a pH titration simulation that includes a molecular view of the chemical changes that occur as a strong base (NaOH) is added to a beaker containing a strong acid (HCl) solution.
- This lesson also contains a simulation of a titration of sodium bicarbonate and “zombie blood” that allows students to monitor changes in the pH of blood as baking soda is added.
- As a result of this lesson, students will:
 - Understand the nature of strong acids and strong bases.
 - Be able to identify the chemical species present before, after, and at the equivalence point.



TI-Nspire™ Navigator™ System

- Send out the *Zombie_Apocalypse_Part_2.tns* file.
- Monitor student progress using Class Captures.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software



Tech Tips:

- This activity includes class captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

Lesson Files:

Student Activity

- *Zombie_Apocalypse_Part_2_Student.pdf*

TI-Nspire document

- *Zombie_Apocalypse_Part_2.tns*



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Discussion Points and Possible Answers

STEM CAREERS NOTE – In this activity, the student will be part of a special team of biochemists, virologists, medical doctors, programmers, engineers, and military strategists. The team is tasked with identifying the nature of an outbreak, determining a means of stopping the outbreak, and deploying the solution on a wide-spread basis. The activity focuses primarily on a fictional biochemist who is the team leader. It also exposes students to aspects of the other career fields throughout the activity.

Move to pages 1.2 - 1.11.

1. Students should read the storyline and answer questions 1 – 2 in the .tns file, the activity sheet, or both.



TI-Nspire Navigator Opportunities

Ask the question on page 1.4 as a Quick Poll by pressing Start Poll on the TI-Nspire Navigator Software. Other Questions pages can be also as Quick Poll for formative assessment to check for student understanding make sure they are making progress.

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

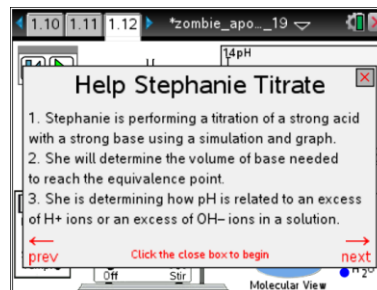
Answer: A. Agree. Changing the pH of a living organism can cause many negative symptoms and even death.

- Q2. What is “alkalosis”?

Answer: *Answers will vary. Suggested response:* Alkalosis is the increase in body pH which causes negative symptoms and potentially death.

Move to pages 1.12 - 1.13.

2. Students should read the directions for the simulation on page 1.12.



Teacher Tip: Before beginning this activity, teachers should make sure that students understand the definition of equivalence point. Page 1.11 of the .tns file offers a brief explanation.




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

Move to pages 1.14 and 1.15.

Have students answer the questions on either the handheld, on the activity sheet, or both.

Q3. Initially the beaker contains _____.

Answer: A: H^+ and Cl^- ions

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

Answer: 9

Move to page 1.16.

3. After students read the directions on page 1.16 for running the simulation, they will move back to page 1.12 and start the titration. The first stage is to add 5 drops and observe the changes. They then answer the next set of questions.

Move to pages 1.17 – 1.19.

4. Have students answer the questions on either the handheld, on the activity sheet, or both.



TI-Nspire Navigator Opportunities

Have students take turns being Live Presenters and have them explain how the graph and the molecular view correspond to what is happening in the titration. This will enhance student understanding of the lab simulation and how to interpret the molecular view and the titration graph. Students should pause, or tap the off switch on the stir plate so that they can count the molecules.

Q5. As NaOH is added, the pH _____.

Answer: B. increases

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

Answer: A. decreases



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

Answer: C. is unchanged

Move to pages 1.20 - 1.27.

5. Have students answer the questions on either the handheld, on the activity sheet, or both. After students read the directions on page 1.20, they will move back to page 1.12 and continue to add drops and observe the changes. They should pause the animation as needed and answer the next set of questions.



iPad Tip: Students' screens will not include the play, pause, back buttons in the upper left, or the down button near the burette valve. They should tap the appropriate images instead. In this case, they should turn off the stir plate.

Teacher Tip: The model neglects the self-dissociation of water, which is a weak acid. You may wish to tell students that there is actually a very small (10^{-7} mol/L) concentration of H^+ ion at the equivalence point, and review the definition of pH. You may wish to point out that the original solution has an H^+ concentration one million times greater than pure water.

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

Answer: 25 mL

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

Answer: none

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

Answer: none



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

Answer: $H^+ + OH^- \rightarrow H_2O$

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

Answer: B. equal to

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

Answer: 7.0

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

Answer: B: OH^- ions

Move to pages 2.1 - 2.5.

6. Have students explore the modified titration set up and observe the graph that is created. Students will see that the ZVIT team has switched from NaOH to $NaHCO_3$ instead since it is much less caustic. Page 2.2 will give them the opportunity to experiment with fictional zombie blood and baking soda. They will see that the blood pH increases slowly with the addition of bicarbonate.

Move to pages 3.1 - 3.3.

7. Students will see a simulation of zombie vs. human population. They can change dosage levels of the bicarbonate serum to see the effects on the rate of healing in the population.

Move to the Extension Questions on pages 4.1 - 4.5.

8. Students will have an opportunity to answer questions related to STEM careers.

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

Answer: A, B, C, and D



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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?

Answer: 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?

Answer: Agree (Not only because zombies are fictitious but, as generally defined, they do not possess a functional cardiovascular system which would be required to transport the serum to the target area).

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.

Answer: A military strategist will need to be aware of the technology available as well as the conditions of the situation. A strong grasp of math and science will help the strategist.

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

Answer: *Answers will vary. Suggested response* - A biochemist investigates the ways in which various chemical structures & compounds behave in a living system.



TI-Nspire Navigator Opportunities

If students answer the questions within the .tns file, the files can be collected at the end of class and graded electronically and added to the Portfolio.




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Teacher Tip: On Self-Check questions, after answering the question students can select Menu () and select Check Answer. If desired, by using the TI-Nspire Teacher Edition software or TI-Nspire Navigator software, teachers can change these Self-Check questions to Exam so students cannot check their answer. On any Question page, in the Document Toolbox, select Document Tools > Teacher Tool Palette > Question Properties. Change the Document Type from Self-Check to Exam.

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions by opening in Review Workspace.

Assessment

- Formative assessment consists of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved by TI-Nspire Navigator. The TI-Nspire Navigator Review Workspace can be utilized to give students immediate feedback on their assessment. These embedded questions can be also used as Quick Polls with the TI-Nspire Navigator. Press Start Poll on a Question page.
- Summative assessment consists of a lab report (optional), questions/problems on the chapter test, inquiry project, performance assessment, or an application/elaborate activity.