

Physical Science (NATS 1010)
Neutralizing Acids and Bases
Guided Practice

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OVERVIEW When an acid and a base react with each other, a neutralization reaction occurs forming a salt and water. The water forms from the combination of the H^+ ion from the acid and the OH^- from the base. Strong acids and bases completely dissociate, so the reaction yields a neutral solution with a pH of 7.

LEARNING OBJECTIVES

At the end of the lesson, students will be able to:

Basic Learning Objectives (to be practiced *prior* to class)

- To define an acid and a base
- To classify acids and bases by their strength (pH scale)
- To identify acid and base reactants
- To create the salt and water products
- To apply the charges of ions
- To know the steps to neutralizing an acid and base

Advance Learning Objectives (to be mastered *during* and *after* class)

- To construct a salt from the neutralization of an acid and a base by combining the cation (metal) from the base and the anion from the acid
- To determine whether an equation is balanced or unbalanced
- To balance (calculate) equations
- Given the reactants of an acid and base, to construct neutralizing and balanced equations.

RESOURCES FOR LEARNING

Prior to coming to class, go through the following resources

- Text:
 - Read Chapter 18, pages 455-465, Conceptual Physical Science (5th edition), by Hewitt, Suchocki, Hewitt (30 minutes)
- Video:
 - Learn about acids and bases: <https://youtu.be/N-WaZRxf0cE> (5 minutes)
 - Acid-base neutralization reactions, write total ionic equations, and balancing equations: <https://youtu.be/UfTJrAPjeys> (13:32 minutes)
 - Writing ionic formulas: <https://youtu.be/URc75hoKGLY> (11:43 minutes)
 - Balancing equations

- PowerPoint:
 - How an acid and a base is neutralized
 - Balancing equations
- Online quizzes:
 - What is an acid and a base? What is pH
 - Neutralizing an acid and a base: Writing neutralization equations
 - Ionic charges and writing ionic formulas
 - Balancing equations
- Worksheets (*see appendices from lesson plan*)

EXERCISES (Out of class)

- read your textbook
- Watch the assigned videos
- Complete the online quizzes until you receive 100%
 - Textbook Quizzes [homework]
 - Video Quizzes [participation]
- Complete “Muddiest Point” and **Bring to class**.
- Write test question with answer onto Moodle (Post-Activity)

GROUP ACTIVITY (In class)

- *Half-Class Lecture* - Review by identifying Acids & Bases
 - Half the class will be given the definition of an *acid* and other half will be given the definition of a *base*.
 - On the provided handout (APPENDIX B) the respective groups need to identify the acid and the base.
 - Once each group completes their assignment, they will need to pair up with opposite half of the class and teach/review their work
- *Picture Prompt* - Neutralizing an acid and a base
 - Students will be shown a series of acid-base questions that have been neutralized on the overhead projector (APPENDIX C)
 - Students are required to write down an explanation to the rules/process of neutralizing an equation
- *Ask the Winner* – Ask students to solve a problem on the board. After revealing the answer, instruct those who got it correct to raise their hands (and keep them raised); then have the other students to talk to someone with a raised hand.
 - “Writing Ionic Formula” sample problem will be written on the board for all students to solve. The answer will be provided and the students who got it correct will be required to raise their hand.
- *Think-Pair-Share* – Students share and compare possible answers to questions from student worksheet
 - A “Writing Ionic Formula” worksheet will be given to students to complete in pairs.

- *Pair-Share-Repeat* – After a pair-share experience, ask students to find a new partner and debrief the wisdom of the *old* partnership to this *new* partner
 - Once paired students are done with their “Writing Ionic Formula” worksheet, they will be required to switch partners and compare their answers.
- A variety of the above activities will be done to cover “balancing equations”
- Pop Quiz: List the 5 steps to neutralizing equations
- Write Your Own Test Question (LMS)
 - Needs to be a word problem
 - The answer needs to be provided
 - What formula is needed?
 - What are the variables?
 - Show the steps to solve the problem

Physical Science (NATS 1010)
Neutralizing an Acid and a Base
Lesson Plan
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LESSON: Neutralizing acids and bases

TIME FRAME: 75 minutes (1st of 4 lectures)

MATERIALS NEEDED:

- Acid-base handout
- Whiteboard
- Mobile devices for Kahoot

LEARNING OBJECTIVES:

Basic Learning Objectives (to be practiced *prior* to class)

- To define an acid and a base
- To classify acids and bases by their strength (pH scale)
- To identify acid and base reactants
- To create the salt and water

Advance Learning Objectives (to be mastered *during* and *after* class)

- To construct a salt from the neutralization of an acid and a base by combining the cation (metal) from the base and the anion from the acid

BACKGROUND: The course consists primarily of mostly freshman and some sophomore non-science majors. This part of the course students will learn the basics of acids and bases and what happens when an acids and bases are mixed (they are neutralized).

INTRODUCTION TO LESSON: During the week prior to class, students will be required to read their textbook, answer basic textbook questions, and watch YouTube videos to get a clear understanding of what acids and bases are, and how pH is used to measure they strength. Students must complete online quizzes prior to meeting in class. They will receive participation points once the online quizzes are complete, although they must receive 100% (on unlimited tries) to receive credit. Sample Questions are provided (Appendix A).

During the in-class group activity, students will apply what they learn to neutralize acid-base equations.

PROCEDURE*Pre-Class Individual Space Activities and Resources*

| Activity | Purpose | Estimated Time | Learning Objective |
|---|--|-----------------------|---------------------------|
| Step 1: Read textbook on "acids, bases and pH" Chapter 18, pages 455-465 Online Moodle Quiz – 5 questions (2.5 points) | Provide students with an overview of acids, bases and pH | 60 minutes | #’s 1, 2 and 3 |
| Step 2: Watch video "Acids & Bases" https://youtu.be/N-WaZRxf0cE Following the video take a Moodle quiz - 5 questions (2.5 points) | Deepen students understanding of acids and bases and how to measure the strength of an acid and base | 7 minutes | #1, 2 and 3 |
| Step 3: Submit a single "Muddiest Point" question onto Moodle worth 2 points. | Prerequisite for starting the discussion in the group space. | 10 minutes | All basic LOs |

In-class Group Space Activities and Resources

| Activity | Estimated Time |
|--|-----------------------|
| Opening Minutes <ul style="list-style-type: none"> Answer a selection of the muddiest point questions submitted before class | 15 minutes |
| Main Activities <i>Half Class Lecture</i> – Review by identifying Acids & Bases <ul style="list-style-type: none"> Half the class will be given the definition of an <i>acid</i> and other half will be given the definition of a <i>base</i>. On the provided handout (APPENDIX B) the respective groups need to identify the acid and the base. | 25 minutes |

| | |
|--|------------|
| <ul style="list-style-type: none"> Once each group completes their assignment, they will need to pair up with opposite half of the class and teach/review their work <p><i>Picture Prompt</i> - Neutralizing an acid and a base</p> <ul style="list-style-type: none"> Students will be shown a series of acid-base questions that have been neutralized on the overhead projector (APPENDIX C) Students are required to write down an explanation to the rules/process of neutralizing an equation | 20 minutes |
| <p>Closing Minutes</p> <p><i>Kahoot</i> - Review concepts with an online mobile game</p> <ul style="list-style-type: none"> Students will work in groups of 4 to answer the following to review today's learning objectives (APPENDIX D) | 10 minutes |

Post-Class Individual Space Activities and Resources (5 minutes)

Describe upcoming homework assignment (writing formulas and balancing equations) for individual space activity and discuss how it relates to the next group space activity

ANALYSIS The students in this class are primarily non-science majors of mostly freshman and some sophomore standing. They can understand simple rules and are able to apply it easily to problems when working with their classmates but tend to have a difficult time combining these rules and working on them by themselves. The pre-class activity will give students their first exposure of the content alone so that students are familiar with independent work. The in-class activity will help students work out complex concepts with their concepts. And, the post-activity will give students the opportunity to practice these concepts individually to prepare them for exams.

Post-Class Individual Activity

Many freshman-level students have a difficult time transferring what they have learned as a group and performing individually on a class exam. Students will apply their newfound knowledge by completing sample test question for each concept that

they have learned. They will then be required to post ONE unique test question with the answer on the course's Moodle "Students' Test Questions" discussion board where the instructor will choose student questions for the in-class exam. Although students are required to submit one unique question with answer, they may work in groups. Extra credit for questions used. Students could use the Student Test Questions as a study guide.

Connections to Future Lesson Plans:

The topics covered in today's activity builds on future concepts to neutralizing acid-base reactions; such as writing formulas and balancing equations. A strong foundational knowledge of acids, bases, and the double replacement of the cation from the base and the anion from the acid to form a salt is imperative to writing formulas.

The individual space activities (reading the text, watching videos, doing quizzes and submitting "Muddiest Point question") would be similar. Group space activities could also be similar or tailored for each topic.

APPENDIX A

Online Quiz Questions

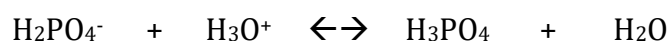
Must receive 100% (on unlimited tries) to receive participation points

Textbook Moodle Quiz

- Any chemical that donates a hydrogen ion is called a _____.
 - Acid
 - Base
 - Neutral
 - Water
- A ____ is any chemical that accepts a hydrogen ion.
 - Acid
 - Base
 - Neutral
 - Water
- What does the acronym BAAD represent for remembering how acids and bases handle protons?

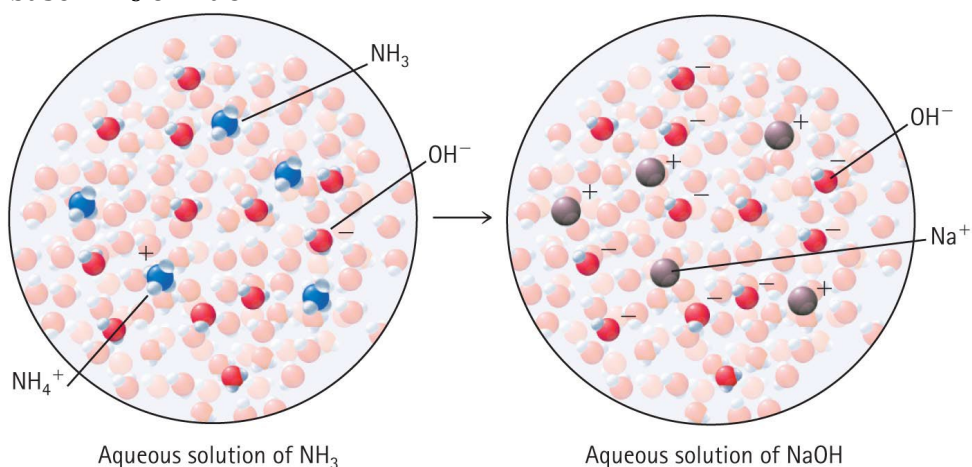
Bases Accept, Acids Donate

- Identify the acid and base behavior of each participant in the reaction in (a) the forward direction and (b) the reverse direction.



(a) **Base** **Acid** **Acid** **Base**
 (b)

- According to the aqueous solutions illustrated below, which is the stronger base: NH_3 or NaOH ?



The solution on the right contains the greater number of hydroxide ions, meaning that sodium hydroxide, NaOH , is the stronger base. Ammonia, NH_3 , is the weaker base, indicated by the relatively few ions in the solution on the left.

Video #1 Moodle Quiz

1. Arrhenius Theory states that a volume of water, H₂O, is not just water. It is a mixture of H₂O molecules and two ions: ____ and _____. (mark two answers)
 - a. H⁺
 - b. H₂
 - c. OH⁻
 - d. O₂
2. In pure water, hydrogen ions (H⁺) are in ____ concentrations than hydroxyl ions (OH⁻).
 - a. greater
 - b. lesser
 - c. equal
 - d. unequal
3. What would happen if sodium hydroxide (NaOH) was added to a water solution?
 - a. It would make it more acidic.
 - b. It would increase the amount of OH⁻ making it more basic.
 - c. It would increase the amount of OH⁻ making it more acidic.
 - d. It would increase the amount of Na keeping the solution neutral.
4. True/False
 - a. ____ Strength of an acid can be determined by measuring how electrically conductive it is.
 - b. ____ Citric acid does not dissociate easily; therefore, it is a weak acid
 - c. ____ Higher pH means a solution is more acidic

Answer: (a) T, (b) T, (c) F

5. A ____ solution resists changes in pH even if an acid or base is added to it.
 - a. buffered
 - b. neutral
 - c. amphoteric
 - d. basic

APPENDIX B
In-Class Worksheet
Acid-base Definitions and equations.

Definitions

Acids: (right side of the class)

- Tastes sour
- Donates a H^+
- $HCl \rightarrow H^+ + Cl^-$

Bases: (left side of the class)

- Tastes bitter
- Accepts a H^+
- $NaOH \rightarrow Na^+ + OH^-$

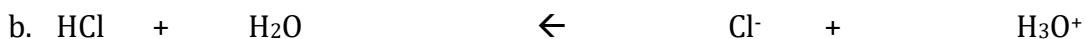
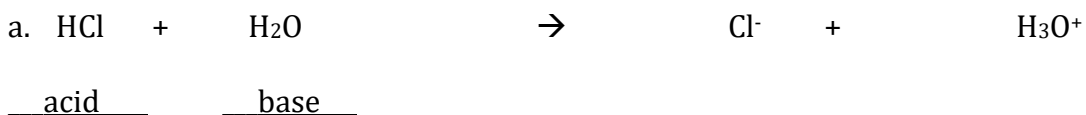
Instructions

In the following equations, identify the acid (or base) and write “acid” and “base” under the correct compound (For example, under HCl write “acid” underneath and under H_2O write “base” – see example):

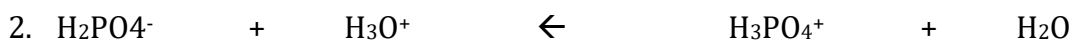
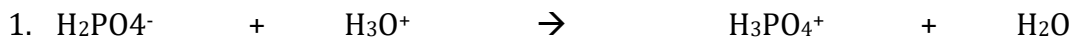
- a. On the left side of the equation
 - Ask yourself, which compound gave up a H^+ atom?
- b. On the right side of the equation
 - Ask yourself, which compound accepted a H^+ atom?

Practice Problems

(1)



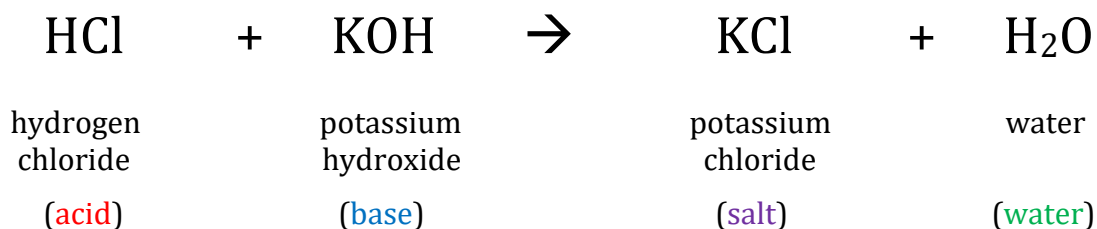
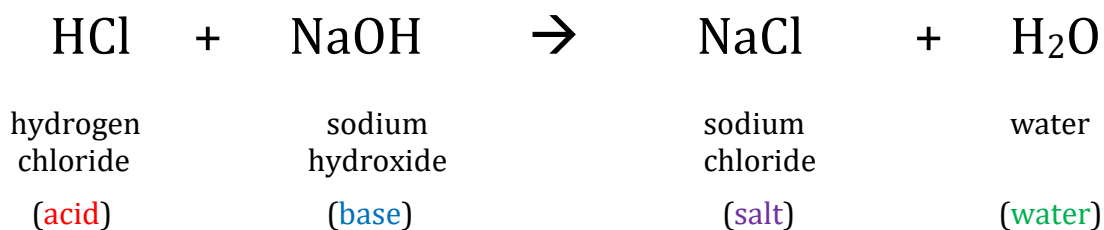
(2)



APPENDIX C

Overhead Projector of Acid-Base Neutralizations

Instructions The following equations shows the reaction between an acid and a base. In groups of 4, evaluate the neutralization equations and identify the process shown.



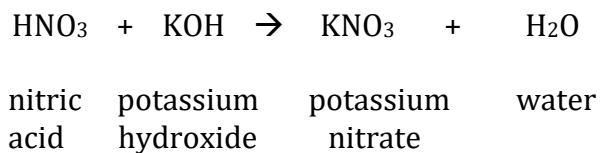
Things to pay attention to:

- What do you start off with?
- Which elements dissociate?
- What do they combine with?
- What are the charges of the elements?
 - Which are cations (metal)?
 - Which are anions?
- What does it form? What do you end up with?

APPENDIX D
End of Activity Kahoot

Instructions: Work in groups of 4, one person uses their phone to sign into Kahoot, and give your team a unique team name (please keep it rated PG).

Answer the following questions given the following formula:



- Moving from left to right, identify the acid.
 - HNO₃**
 - KOH
 - KNO₃
 - H₂O
- Moving from right to left, identify the base.
 - HNO₃
 - KOH
 - KNO₃**
 - H₂O
- Water acts as a(n) ____ because it ____ a hydrogen ion.
 - acid; accepts
 - base; donates**
 - acid; donates
 - base; accepts
- If you combine hydrogen chloride (HCl) with calcium hydroxide (CaOH)₂, then the salt would be ____.
 - ClCa
 - HOH
 - HCa
 - CaCl**