Lesson Plan #2- pH Indicators

Instructors: Astella Leung | Grade Level(s): HS (9-12)

Subject: Chemistry | Topic: Acids and Bases

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Context: Students have covered the Arrhenius definition of acids and bases + went over what the pH scale is.

Central Focus for the Lesson: Acids and Bases- pH Indicators

Content Standard(s):

Performance Expectations:
HS-PS1-11. Plan and conduct an investigation to compare properties and behaviors of acids and bases. [Clarification Statement: Examples of properties could include pH values (concentration), neutralization capability and conductivity. Observations of behaviors could include the effects on indicators, reactions with other substances, and efficacy in performing titrations.] [Assessment Boundary: Reactions are limited to Arrhenius and Bronsted-Lowry acid-base reactions.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-11) ● Select appropriate tools to collect, record, analyze, and evaluate data. (HS-PS1-11)	**PS1.B: Chemical Reactions** (NYSED) Acids and bases play an important role in the daily lives of humans and other organisms (e.g. agricultural applications, environmental impacts (acid rain), animal and plant physiology). (HS-PS1-11)	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HSPS1-2),(HS-PS1-5),(HS-PS1-11)

Student Population

- Regents Chemistry (10th Grade)
- General Education Classroom (within a specialized high school)

Learning Objectives associated with the content standards:

- SWBAT identify an acid or base's strength based on pH indicators
- SWBAT understand how pH indicators are used to determine acidity or basicity

Teaching Models (Check one or more)

_✓_Direct Instruction _✓_ Cooperative Learning
_✓_Discussion _✓_ Inquiry

Teaching Strategies:

1. Teacher will provide opportunities for both learning through direct instruction and peer-based sense making.
2. Teacher will walk around the classroom as students work on the group activity to gauge student understanding, misconceptions, and questions.
3. Teacher will utilize students' prior knowledge on everyday items (ex. Soap, lemons, etc.) to introduce the topic of acids and bases.

Learning Tasks (How will the students be actively involved? What will THEY be doing?)

- Students will work in groups to determine patterns in compounds classified as acids vs. compounds classified as bases (Arrhenius definition).
- Students will apply their real-world knowledge to understanding properties of acids and bases.

The teacher and students will discuss the following Do-Now together (5 min):

(Practice problem based on prior lesson; most likely a conjugate acid// base problem)

Transition- Throughout our unit, we've discussed what acids, bases, and pH are, but how do scientists determine these pH values if they're invisible to the naked eye? pH Indicators!

Students will learn and copy the following concept:

- Indicator – changes colors according to what the approximate pH of the solution is.

Explain that today, using the solutions you brought in today, test each of them with the various indicators.

- In groups, students will assign themselves the following roles:
  Recorder: Records the findings of your group
  Reporter: Present on behalf of your group
  Researchers: Uses their phones to do research online (about the chemical formulas) (must have internet access)
  - Together, students will fill out the following table, using the results of each indicator to estimate the pH of their item. When they are done, students can double-check their results by searching for the pH levels of their items.

- As students work, the teacher will go around checking their answers and asking questions like "Based on the chemical formula, what do you predict will happen for each indicator?" "What does the color change on the litmus paper tell you about the compound?" "Does this result match what you know about acids and bases?"

- Students will be given the instructions/ color guide for each indicator, so they can learn how indicators are read.
- After completing the activity, the teacher will call on each group to provide their answers for some of the items.
- End-of-Class Report (5-min)
  - Exit Ticket- What are three things you learned about indicators and pH?

Differentiation and Planned Supports:

- Provide guided notes to students.
- Pair students based on English and math proficiency.
- Given the emphasis on social learning, sentence starters will be in the classroom (ex. "I think…")

CER Rubric-

	1	2	3	4
Claim	Student incorrectly identifies the most acidic item based on their data and includes chemistry concepts or reasoning within their claim.	Student incorrectly identifies the most acidic item based on their data and does not include chemistry concepts or reasoning within their claim.	Student correctly identifies the most acidic item based on their data but includes chemistry concepts within their claim.	Student correctly identifies the most acidic item based on their data and does not include chemistry concepts or reasoning within their claim.
Evidence	Student does not list observations from each indicator test as evidence and uses chemistry concepts to explain the results.	Student does not list all observations from each indicator test as evidence and does not use chemistry concepts to explain the results.	Student lists observations from each indicator test as evidence but uses chemistry concepts to explain the results.	Student lists observations from each indicator test as evidence without using chemistry concepts to explain the results.
Reasoning	Student does not utilize chemistry knowledge to explain acidity and basicity, and does not explain the data to compare the various items.	Student utilizes chemistry knowledge to explain acidity and basicity BUT does not use the data to compare the various items.	Student utilizes chemistry knowledge to explain how each indicator test result relates to acidity and basicity BUT does not use the data to compare the various items.	Student utilizes chemistry knowledge to explain how each indicator test result relates to acidity and basicity AND uses the data to compare the various items.

Chemistry Period- _____

pH Indicators

Aim- How can we tell if a solution is acidic or basic by using indicators?

From the foods we eat, to the medicine we synthesize, pH (the level of acidity) plays a vital role in our everyday lives. This silent, invisible force dictates the tartness of your morning orange juice, the vibrant colors of a hydrangea blooming in your garden, and the very survival of coral reefs deep within the ocean. To quantify this invisible world, chemists use pH indicators.

In groups, you will learn how to use and analyze different indicators to determine the pH of various household items.

Item	mical Formula	ıe Litmus (Color)	d Litmus Color)	ɔH Paper (Color)	ɔssible pH	aflower Tea (TBD)

Based on the items your group brought in, which item is the most acidic? How many times more acidic is it than your most basic item?

Claim: The _____ is the most acidic item out of all the items above.

Evidence (Data-Driven):

Reasoning:

Bonus Problems: The pH of a tree's soil is vital in its cultivation, as extremely acidic or basic conditions can impact nutrition absorption and can cause nutrients to react with one another. At Fort Greene park, a botanist decides to assess the health *Ginkgo Biloba* trees in Fort Greene park by testing the acidity of the soil. *Ginkgo Biloba* trees experience optimal growth at pH levels between 5.0-5.5.The botanist decides to use various pH indicators, noting the following results:

- Blue litmus paper stays blue.
- Red litmus paper turns red.
- pH paper turns orange.

1. Based on these results, what pH is the soil? Is this within the health pH range of the *Ginkgo Biloba* tree?

2. Based on the soil pH, how does the following reaction explain the pH observed in the soil?

$$CO_2 + H_2O \; HCO_3^- + H^+$$