

**2008
Winning Lesson Plan
from Colfax, California**

*pHishing for Clues:
Solving the Mystery
of the Strange Spill*

by Suzanna Johnson
Colfax High School

Subject: Integrated
Science 1

Grade Level: 9–11

Duration: Five 90-Minute
Class Periods

Overview and Purpose

The purpose of this lesson is to teach and assess students about pH and to give students the background and skills to recognize and properly handle everyday acids and bases in their lives. This unit teaches and assesses student understanding of acids and bases, pH, neutralization reactions, indicators and laboratory skills. Each class period is 90 minutes long. For schools with shorter periods, this unit might take 10 days instead of 5 days.

Innovation

This instructional plan is innovative because it solicits prior knowledge and addresses misconceptions about acids and bases and real household chemicals. The plan also uses technology and lab activities effectively to teach about acids and bases. Students also complete inquiry-based scientific investigations to identify a mystery chemical, which makes the content previously taught relevant and meaningful. Students also create indicators at home with their family, which they use during the lab investigation. Finally, the assessment involves writing to show mastery of the material rather than just answering questions.

The unit that this instructional plan falls within is the unit about chemistry. Students will have demonstrated their understanding of atomic structure, the organization of the periodic table, ionic and covalent bonding, chemical reactions, and chemical thermodynamics before completing this mini-unit.

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Educational Standards Addressed

California State Science Standards:

5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:
 - a. Students know the observable properties of acids, bases, and salt solutions
 - c. Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate.

National Science Standards:

Content Standard 3: As a result of their activities in grades 9- 12, all students should develop an understanding of:

- Structure of atoms
- Structure and properties of matter
- Chemical reactions

Objectives

Students will demonstrate that they know and understand characteristics of acids, bases, neutralization reactions and indicators through their superior performance on formative assessments including a lab activity, quiz and on the unit summative assessment.

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Materials

Day 1 :

- Household chemicals (orange juice, soda, batteries, vinegar, bottled water, glass cleaner, Baking soda, soap, and bleach),
- PowerPoint projector, PowerPoint presentation,
- pH probe or indicator.

Day 2:

- Variety of acids and bases, indicators (methyl orange, litmus rod and blue, pH paper, and phenolphthalein) in dropper bottles,
- aluminum foil,
- 8 spot plates,
- goggles, and lab notebooks.

Day 3:

- Crime scene tape,
- mystery chemical,
- variety of household chemicals and other acids and bases,
- spot plates,
- indicators (same as day before except students bring homemade indicator for this lab),
- dropper bottles,
- spot plates,
- goggles and lab notebooks.

Day 4:

- Same as day 3, poster paper, and colored pens.

Day 5:

- Summative assessment.

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Procedures

Day 1:

Students sit in lab groups of four and have household chemicals in front of them. They are asked to categorize the chemicals into acids, bases and neutral solution groups and state their reasons why in a chart in their notebooks. Next, each group shares their categories and reasons for them.

Next, I present the PowerPoint presentation about acids, bases, neutralization reactions and indicators while students take notes according to the Cornell note-taking guidelines in their science notebooks in their notebooks. During the PowerPoint presentation the teacher demonstrates using the pH probe how baking soda (a base) can be used to neutralize vinegar, an acid. The probe's software shows the pH graph increase until it is neutral. Next, the teacher adds more baking soda and raises the pH so that the solution becomes basic. I ask the class how to lower the pH. I also ask them to relate this to their life and explain why it is important. After the students answer, I present situations where neutralization of an acid or base might be critical or useful. Finally, we end the class period by re-categorizing the household chemicals on their tables and writing their new lists for each category and reasons for them in their science notebook. Next students write questions and summaries on the notes taken during class according to the Cornell note-taking format.

Homework: Students read the textbook section on acids and bases and create a Venn diagram showing the differences and similarities of acids and bases.

Day 2:

Students complete a standard indicator lab where they use a variety of indicators to identify the pH of a variety of chemicals that can be standard acids and bases of different pH or household chemicals. Students also test each chemical's reaction with aluminum foil (a metal). Strong acids react with aluminum foil to produce Hydrogen gas. Students record their observations in a table in their science notebooks.

Homework: Students have been previously given the Friday before directions on how to make an indicator from cabbage.

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Procedures (Cont'd)

Day 3:

Students arrive to find out that they have been asked by the school administration and school resource officer to identify a suspicious mystery chemical that has been spilled on the cafeteria's floor. They go to the cafeteria where crime scene tape is secured around an area of the cafeteria and students are allowed to take photographs and sketch the crime scene in their science notebooks. They are also allowed to question the school resource officer and cafeteria manager. Next, students go back to the lab to do scientific lab work to try and identify the chemical. A sample is provided of the mystery chemical. Students write down their qualitative observations of it using acceptable laboratory methods such as wafting for smell and observing for color. Next, they are given a sample in groups to test for pH. Students use their own indicators and the indicators provided to identify the pH of the chemical. Next, they make observations about chemicals "discovered" near the crime scene and test the known chemicals for pH. They try to match the unknown to one of the known suspect chemicals based on color, consistency, odor, and pH. Students record all data in their lab notebook. They discuss their findings as a group.

Homework: Students are asked to do Internet research on the chemical spill suspect chemicals and to bring the information gathered in to share with their group.

Day 4:

Groups finish their lab testing and discuss their results. Together they write their lab conclusions. They also create a poster to share their conclusion and evidence supporting it with the entire class. The groups then share their conclusions and evidence. Every student takes notes on the other group's presentation and the class comes to a consensus on what the mystery chemical could be. The class writes a letter (using the overhead or computer projector) to the school resource officer, cafeteria manager and school administration stating the class's lab results and conclusion about what the chemical might be.

Homework: Students study for a summative assessment on acids, bases, neutralization reactions and indicators.

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Day 5:

Students break into groups of three. Each group creates a series of flash cards for different terms that they have studied during this mini-unit. One student stands up holding the cards while the other two students sit facing each other. The standing student holds the term above one student's forehead so that only the facing student can see it. The facing student gives clues about the term without giving it away to the student with the card above his head. The student tries to guess the term. If he/she cannot, he/she says pass. The goal is that all three students have to do all three jobs for all terms. This is a fun and good review activity that is easily monitored. Students then have a chance to ask any questions about the material. Next, students take the exam of which part of it asks them to write personal advertisements for an acid and for a base that demonstrate content mastery of characteristics of properties of acids and bases, neutralization reactions and indicators. *Example: Slippery, bitter base seeks a sour, burning acid who turns litmus red and has lots of Hydrogen ions to neutralize her. Call 530-888-BASE.*