Vandal in the Chem Lab!: Teacher Guide

Subject: Physical Science or Chemistry.
Grade Level: High School (9th-12th) on Block Schedule. Can be adapted to fit a shorter class period.

Case Summary
Can you identify paper based upon the pH of the paper? Paper has been around since ancient Egypt during the third millennium BC. Paper is typically made from cellulose fibers that come from wood pulp. Earlier types of paper were made from linen or cotton. Cellulose fibers break down when exposed to acids. This is why so many papers today are made “acid-free”. Art conservators must learn how to treat artwork on paper and deal with these acidic conditions so that the artwork is not lost.

Credits
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This case was adapted from Acids, Bases, and Paper Lab (Smith, et al., 2013).

Learning Objectives
1. Define and describe acids and bases.
2. Use a pH pen to identify the pH level of different types of paper.
3. Use pH paper and a pH scale to identify whether a paper is an acid or a base.
4. Graph the values of pH from the different papers versus time.
5. Explain the process of acid-base neutralization.

Georgia Performance Standards
SCSh3. Students will identify and investigate problems scientifically.
   a. Suggest reasonable hypotheses for identified problems.
   b. Develop procedures for solving scientific problems.
   c. Collect, organize and record appropriate data.
   d. Graphically compare and analyze data points and/or summary statistics.
   e. Develop reasonable conclusions based on data collected.
   f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.
SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
   a. Develop and use systematic procedures for recording and organizing information.
   b. Use technology to produce tables and graphs.
   c. Use technology to develop, test, and revise experimental or mathematical models.

SPS6. Students will investigate the properties of solutions.
   a. Describe solutions in terms of solute/solvent, conductivity, and concentration.
   b. Observe factors affecting the rate a solute dissolves in a specific solvent.
   c. Demonstrate that solubility is related to temperature by constructing a solubility curve.
   d. Compare and contrast the components and properties of acids and bases.
   e. Determine whether common household substances are acidic, basic, or neutral.

Assessment
   • The students are to turn in the box charts for scene 1 and scene 2. Both box charts should include key terms and items that are discussed in class with the teacher. The box charts can be taken as a completion/participation grade.
   • The lab handout will also need to be completed by each student and assessed. Chart 1 (Step 2, part I) is worth 10 points. Chart 2 (Step 5 part II) is worth 30 points. Step 8 (part II) is worth 5 points. Chart 3 (Step 12, part II) is worth 5 points. Step 13 (part II) is worth 10 points. The Graph is worth 30 points.
   • The total points for the complete assignment is 90 points.

Implementation Strategy
The case was implemented using a block class schedule (110 class minutes). Scene 1 and 2 were completed in one block class schedule.

Day 1:
   • Scene 1 was passed out and read by student volunteers and then the teacher passed out the box chart for the students to fill in.
   • The teacher acted as the facilitator and recorded all box chart suggestions on the white board.
   • The first scene and box chart took a total of 30 to 40 class minutes to read and complete the box chart.
   • The second scene was passed out to the students and read by student volunteers.
   • The second scene box chart was completed by the students and the teacher acted as the facilitator and recorded all box chart suggestions on the white board.
   • The second scene and box chart took a total of 40 to 50 class minutes to read and complete.
   • Both box charts were turned in to the teacher at the end of the class period for an assessment grade.
Day 2:

- The second day was dedicated to the completion of the pH paper identification lab.
- Part I will take about 20 minutes to complete.
- Part II will take about 70 to 80 minutes to complete in class.
- The lab handout and graph will need to be completed for homework if not completed in class.
- The students will need to be grouped into groups of 4 to 5 students per group.
- Enough materials will need to be provided to equip each group with supplies to complete the lab activity.
- The groups can then be divided according to group roles of leader, recorder, time-keeper, organizer, and ambassador.
- The teacher will need to be available to answer questions and may wish to limit the number of questions that the lab groups can ask or the teacher may allow each group a specific number of questions that they can ask (spy) on another group.
**Facilitator Guide:**
Sample box chart from Scene 1 and Scene 2.

### Box Chart

<table>
<thead>
<tr>
<th>Scene 1 Facts/Data</th>
<th>Learning Issues</th>
<th>Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small pieces of paper all over the floor. Paper is brown and yellow. Class locked over the weekend. Teacher had to unlock the door on Monday.</td>
<td>How did the paper get on the floor? How does the paper get ripped and on the ground if door is locked?</td>
<td>Need to find out what books/texts the paper came from. Were there animals, bugs, or other things in the classroom. Could someone have unlocked the classroom door before the teacher came in on Monday.</td>
</tr>
</tbody>
</table>

### Box Chart

<table>
<thead>
<tr>
<th>Scene 2 Facts/Data</th>
<th>Learning Issues</th>
<th>Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids react with fibers causing papers to turn colors. Janitor used old newspaper. Student was reading an old book. School telephone directory missing two pages. Art teacher assigned a paper art project.</td>
<td>Who could have left the papers on the chemistry classroom floor?</td>
<td>Conduct the pH paper lab to determine what type of paper was left on the classroom floor.</td>
</tr>
</tbody>
</table>