How to Get Unstuck: Teacher Guide

Subject: Physical Science or Chemistry
Grade Level: High School, 9th -12th grade. May be adapted for middle or elementary classes.

Case Summary
Conservators must use a wide variety of tools and materials to repair broken pottery. Adhesives and glue are vital components that conservators will use to repair pottery. Understanding the solubility of the adhesive along with the adhesives strength and viscosity can help conservators determine how to repair art objects. Adhesives many times also have to be functional and reversible so that the object can be altered in the future. In this case study, the students are asked to use specific adhesives to adhere broken tiles and then are asked to use specific solvents to remove the adhesive from the tile. A lab report will be written by the student team as a method of assessment.

Credits
This case was written by Shannon K. Watkins (M.Ed., North Paulding High School, Dallas, GA). Author may be contacted at kaitlynwatkins@yahoo.com

This case was adapted from Solubility of Adhesives lab (Smith, et al., 2013).

Learning Objectives
1. Define the term solubility, solution, solvent, and solute
2. Demonstrate the effect of temperature on solubility
3. Demonstrate the effect of surface area on solubility

Georgia Performance Standards
SPS6. Students will investigate the properties of solutions.
   a. Describe solutions in terms of solute/solvent, conductivity, or 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.
Assessment

- Student learning will be assessed using both a box chart and a written report from the lab teams. The student lab handout includes the information that is necessary in the written report. The report should include answers to the questions in the lab.
- The students should identify that the students in scene 2 had accidentally used gelatin to glue the tile back together based upon the data that they collected in their lab. Scientific evidence should be given to support their lab report findings.
- The lab and report can be assessed using both the self/group evaluation and the grading rubric given below.
- The students could make a presentation of their findings to the class as another form of assessment.
# Self & Group Evaluations

Name: _______________________________  Teacher: _________________  Period: ____

Reflect on how you and your group members did at working as a team. Be specific and be fair. Scores range from “0” (unacceptable), “1” (good), “2” (better), “3” (best), “4” (excellent). Place a score for yourself and each of your team members. This will only be read by your teacher so please be honest with your evaluation.

**SELF (score): ____**

What I did well: ________________________________

________________________________________________________________________

What I can improve: ________________________________

________________________________________________________________________

**Group Members:**

<table>
<thead>
<tr>
<th>Name</th>
<th>(score)</th>
<th>comments</th>
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What did your group do well? ________________________________

________________________________________________________________________

What can your group do to improve your results for next time? (Be very specific)

1. __________________________________________

2. __________________________________________

3. __________________________________________
Grading Rubric for Lab Assessment

Adhesives Lab Group Paper

1. Correct Grammar, Punctuation, and Spelling  _____/20 points

2. Minimum 1 page with 12 Font Times New Roman
   Names and Date in right hand corner  _____/10 points

3. Answers each question and gives data to support (10 pts each)  _____/70 points
   a. Which glue was dissolved by water?
   b. Which glue was dissolved by acetone?
   c. Which glue was dissolved by ethanol?
   d. Which glue was not dissolved by any solvent?
   e. Did the temperature of the water speed up or slow down the solubility of the glue?
   f. Notice the difference in the amount of time or success to reverse good and bad joins.
      Do those joins that are uneven, gapped, or stepped respond differently to the solvents
      used to remove the glue? Why is this a factor?
   g. Based upon the team’s findings from scene 2, which glue did the students probably use and why?

4. Total points for report  _____/100 points
Implementation Strategy

Prelab:

• The teacher needs to make the gelatin adhesive ahead of class time and keep it warm. Directions are given in the Teacher guide on how to make gelatin adhesive.
• The case is designed for a two to three class periods on a block schedule. The teacher needs to have purchased all supplies and set up all lab supplies prior to completing the lab.

Day 1:

• The students can be grouped into teams of three students (but teams of two or four also work). The students can be assigned the following roles: leader, recorder, and organizer.
• Scene 1 and the box chart will take about 20 to 30 minutes to complete.
• Scene 2 will take about 10 minutes to read.
• Give the students an opportunity to add items to their first box chart and make adjustments.
• Day one of the lab will take about 30 minutes for students to break the tiles and use the adhesive to glue the tiles together. The tiles need to dry for a minimum of a week.

Day 2:

• Day two testing for solubility should take about 50 minutes to complete.
• The rest of the class period should be dedicated to the student groups completing the assessment lab report.

Day 3:

• The third day should be used for all student groups to complete the written lab report and make sure they have answered all questions about the lab.
• If desired, the students can leave their tiles in the solvent chamber and/or water baths overnight and these tiles (and the joins) can be evaluated first thing.
**Example of How to Get Unstuck - Adhesives Box Chart**

<table>
<thead>
<tr>
<th>Facts – What we know from the scenario, data, or observations</th>
<th>Questions – What we want to ask the characters in the scenario to gather more information (but not things we could look up the answer to)</th>
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<tbody>
<tr>
<td>MCCM conservators have a puzzle. Ancient Greek collector has sent pottery to MCCM to analyze and study. Collector believes incorrect adhesive has been used and could damage the pottery. Conservator has been tasked to determine the adhesive used on the pottery and to take down those joins. Adhesives have different properties that include strength, viscosity, and solubility.</td>
<td>Where did the pottery come from in Greece? How did the collector acquire the specific piece of pottery? How was the pottery originally damaged? Why was the pottery glued back together?</td>
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<tr>
<th>Hypothesis – What we think is going on; possible diagnosis; predictions</th>
<th>Learning Issues – What we need to know to address the problem; Questions we could find the answer to in our texts, on the web, from an expert, etc.</th>
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<td>A conservator must pick an appropriate adhesive.</td>
<td>What are the properties of adhesives that the curator needs to consider to make the best adhesives? What are strength, viscosity, and solubility? How does temperature affect glue? (this can be added after reading scene 2. How does solubility affect glue? (this can be added after reading scene 2. Why would a conservator be unlikely to choose any of the three adhesives used in class?</td>
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