Teacher Guide: The Weapon Analysis Evidence

Time: 4–5 days
Grades: 11 and 12 (2nd-year Chemistry)

Objectives

1. Students will solve a forensics case using their knowledge of chemistry (for performance assessment #4, this includes half-reactions, voltaic cells, activity series, acid/base chemistry, and titrations).
2. Students will assemble their evidence and present their case at the end of the year.
3. Students will answer seven questions:

Part I

1. Which suspects are potential matches to the fingerprints found on the gun with the aluminum foil handle?
2. Which suspects are potential matches to the fingerprints found on the gun with the copper handle?

Part II

3. Which bullet type was matched to each gun and what evidence proves this?

Part III

4. Which suspects were positive matches for gunshot residue? Which were negative matches?

Part IV

5. Which of the suspects and/or victims had stains on their clothing that fell into the pH range of blood?
6. Why might Suspect #1, Harold, have had a basic stain on his clothing and Suspect #3, Elizabeth, have had an acidic stain? You may have to look back at previous assessments and/or suspect files.
7. Which of the suspects/victims matched the blood stains?

Preparation

Part I

You will need pieces of copper foil and aluminum foil to represent the gun handles. Place one of each sample into a baggie for each group to analyze, labeling them with a Forensics Tag. Make sure that the copper foil contains the fingerprints for Gladys and Gerald. The aluminum foil should contain the fingerprints for Larry and Gerald. You will also need to

make fingerprint charts for each suspect so that students can compare the fingerprints on the gun handles to the fingerprint charts. Only one chart needs to be made; you can provide copies for each group to use as a comparison. Any fingerprints can be used for Harold and Elizabeth because you will not need those prints again until you need to make new fingerprint charts. However, for the prints of Gladys, Gerald, and Larry, make sure you use fingerprints from someone who is available to make fresh prints every year since you will need to re-make the copper and aluminum foil samples each year.

Part II

In order to do the half-reaction calculations, students will need a half-reaction chart to look up the cell potentials for each of the four metal half reactions. These charts are readily available in most advanced chemistry textbooks.

Part III

For this activity, you will need to prepare two acidic solutions, likely HCl. One of these solutions needs to be a high concentration (0.2M or higher), and the other needs to be a low concentration (0.05M). There needs to be a definite difference in concentrations in order for the students to determine who does and does not test positive for gunshot residue.

Part IV

No lab preparation needed for this assessment. Students will need an understanding of how to calculate pH from the $[H_3O^+]$ and $[OH^-]$ concentrations to complete the calculations portion of this activity.

Question Guidelines

For calculations, formulas, and work, see the student example at the end of the chapter.

Part I

1. Aluminum Foil prints belong to Suspect #4: Larry J. and also an Unknown (later introduced in Suspect File D as Suspect #5: Gerald V.).
2. Copper Handle prints belong to Suspect #2: Gladys V. and also an Unknown (later introduced in Suspect File D as Suspect #5: Gerald V.).

Part II

1. Aluminum handle gun had the zinc bullet; copper handle gun had the silver bullet.
2. Aluminum handle gun belongs to Larry J.; copper handle gun belongs to Gerald and Gladys V.

Part III

1. Suspects Gladys and Gerald and victim Larry were positive for gunshot residue. Suspects Harold and Elizabeth were negative for gunshot residue.

Part IV

1. Victims Kirsten and Larry and Suspects Gladys and Gerald all had clothing that tested positive for blood stains.
2. Harold was positive for a basic stain because he is a plumber and works with basic cleaners. Elizabeth was positive for an acidic stain because she uses glyoxilic acid when making vanilla for her cakes, as learned in the second performance assessment *(See Chapter 4: The Chemical Evidence)*.
3. Kirsten's blood stains were her own blood. Larry's blood stains were both his own blood and the blood of Gerald. Gerald's blood stains included his own blood, the blood of Kirsten, and the blood of Larry. Gladys' blood stains included the blood of Gerald.

Materials

Part I

- Suspect File D
- Student Guide
- Copper foil pieces
- Aluminum foil pieces
- Fingerprint Evidence Charts
- Powder/brushes/clear tape/white and black paper

Part IV

- Titration set-ups per lab group
- 0.1 M NaOH
- HCl samples for each suspect

Teacher Hints

Introduction to the Assessment

- Included at the end of this teacher guide is the script used with the school police officer. If you do not have a police officer at your school, you could call the county coroner, a defense lawyer, or a local forensic scientist to come in and speak.
- DO NOT HAND OUT THE SUSPECT FILE WITH THIS ASSESSMENT! You will want to hand out the fingerprint assessment Part I prior to handing out the rest of the assessment parts (II-IV) and suspect file as a new suspect will be introduced after Part I is complete.

Part I

- For the recurring fingerprints for the gun handles (Larry, Gerald, and Gladys), I use prints that are readily available. For example, I use my own prints for Gladys and my husband's prints for Gerald. A school administrator provides the prints for Larry. It doesn't matter who you choose, as long as they can provide prints every year. Otherwise, you will have to remake the fingerprint charts each year.
- Fingerprints need to be made as close to using them as possible. Otherwise, they get smudged if stored for long periods of time and are harder to identify.

Script for Chemistry II Class Forensic Case

Part I: Announcing the Murder

- Come in during the first 15 minutes of each class and pull me out of class
- When we go back in to class I can make the following announcement:
    - "I have some breaking news in the forensic case you all have been working on for the police department. Larry J. has been found dead with several bullet wounds to the chest."
    - If they ask any additional questions we will just say it is "Classified at this time."

Part II: Crime Scene Analysis

- Then you will discuss the tests that need to be done in this kind of a case. Discuss the following tests that the police department needs the students to complete:
    - Test #1: Fingerprinting (latent prints from the gun; what latent prints are and the process of dusting for them; if you have a dusting kit where you could show how prints are lifted off a coffee mug or something else that would be great.)
    - Test #2: Bullet Matching (from the gun to the bullet at the crime scene or matching bullets at the crime scene to other bullets at the crime scene)
    - Test #3: Gun Shot Residue (we will be doing an acid base titration for this but you can talk about how it is done for real)
    - Test #4: Blood (you can talk about DNA but our test will not involve that; it will probably involve a pH test or a reaction of the chemicals in the blood)
- For each of the tests just explain why those tests are done and how they can match or not match suspects to the scene of the crime. You can discuss which tests are more conclusive than others and why.

Part III: Lab Work

- I will have all the labs for the tests they need to do set up already, so after you are done speaking I will announce that we need to perform the tests you just spoke about. I will just announce that "we will start work on this case right away".
- This does not need to take the whole hour…if you could just talk for about 10-15 minutes about the 4 different tests that would work out great.

(All fields marked in **BOLD** are mandatory)

ARREST CARD

Transaction Control Number

FRM0130L31611125

Document Control Number: L31611125

Ref. DCN:

Arresting agency ORI-NCIC:

Subject Last Name:

First Name:

Middle Name/Suffix:

Photo Available: Yes ☐

Palm Prints Available: Yes ☐

Arestee Armed With
(Choose maximum of two)

Unarmed	☐	Unknown Firearm	☐
Handgun	☐	Rifle	☐
Shotgun	☐	Other Firearm	☐
Lethal Cutting Instrument	☐		
Club/ Blackjack/ Knuckles	☐		
Automatic Weapon	☐		

Adjustment Term		Term	y/m/d/hrs
Community Mediation	M		
Community Service	X		
Contact Limitations	L		
Counseling	U		
Curfew	C		
Geographic Restrictions	G		
Juvenile Officer Reporting	J		
Peer Support Program	P		
Possession of Firearms Limitations	F		
Restitution	R		
School Attendance Required	S		
Other	O		
Specify Length of Term by placing term followed by y/m/d/hrs			

Arrest Type

On View Arrest	V
Summoned/Cited (Not Taken into Custody)	S
Original Arrest Warrant	A
Bond Forfeiture Warrant	B
Probation Violation Warrant	P
Probation/ Mandatory Supervised Release Violation Warrant	M
Out of State Warrant	O

Parent/ Legal Guardian (Please Print)

Name:_____

Address:_____

Employer:_____

Home Phone:_____ Work Phone:_____

Relationship:_____

Please Send This Copy To:
Local Police Department

Finger Print Images

1. R. THUMB	2. R. INDEX	3. R. MIDDLE	4. R. RING	5. R. LITTLE
6. L. THUMB	7. L. INDEX	8. L. MIDDLE	9. L. RING	10. L. LITTLE

LEFT FOUR FINGERS TAKEN SIMULTANEOUSLY	L. THUMB	R. THUMB	RIGHT FOUR FINGERS TAKEN SIMULTANEOUSLY