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Forensic Chemistry

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Forensic Chemistry - UbD

Stage 1 – Desired Results

Established Goals (e.g., standards)

(C.8) Science concepts. The student can quantify the changes that occur during chemical reactions. The student is expected to

(C) calculate percent composition and empirical and molecular formulas; ***Supporting Standard***

(C.10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to

(B) develop and use general rules regarding solubility through investigations with aqueous solutions; ***Readiness Standard***

(C) calculate the concentration of solutions in units of molarity; ***Supporting Standard***

(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water; ***Supporting Standard***

(C.2) Scientific processes. The student uses scientific

Transfer

Students will independently use their learning to…

--apply chemistry knowledge in a real-world situation.

--use problem-solving skills to investigate a mock crime

--integrate multiple skills, techniques, chemistry tools, chemistry (or physics or biology) concepts to solve a real-world problem.

Meaning

Understandings

Students will understand that….

- Chemistry has practical applications that extend across specific content areas.

- Not all problems in the real world have formulaic solutions.

Essential Questions

- How can chemistry knowledge, principles and skills be used to solve a real-world problem?

-In a court of law, how much information/evidence is needed to prove "guilt beyond the shadow of reasonable doubt?"

- How can the scientific method be used to further a criminal investigation?

Acquisition

Knowledge

Students will know…

- general rules regarding solubility

- the definition for acids and bases and the difference between

Arrhenius and Bronsted-Lowry definitions

-units of concentration

- molar mass

Skills

Students will be able to…

- calculate percent composition and empirical and molecular formulas;

-calculate the concentration of solutions in units of molarity;

- predict products in acid-base reactions that form water;

- plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology

- organize, analyze, evaluate, make inferences, and predict trends from data

methods to solve investigative questions. The student is expected to (E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology (H) organize, analyze, evaluate, make inferences, and predict trends from data;		

Stage 2 – Evidence

CODE (M or T)	**Evaluative Criteria** (for rubric)	
M M T	-A description of the tests run by the Investigative Team and the results of these tests - An overview of the crime and the proposed sequence of events -The final conclusion on the guilty suspect, based upon the clues and evidence.	Performance Task(s) *Students will demonstrate meaning-making and transfer by…* - Solving the crime and creating a Video Crime Report with their lab groups - Completing a detective report which outlines the tests they performed and their conclusions about the crime --- Other Evidence (e.g., formative) - Warm-up over review topics from Lesson 1 - Progress Monitoring sheet for Lesson 2 - Ongoing conversations with detectives on progress

Stage 3 – Learning Plan

CODE (A, M, T)	Pre-Assessment *How will you check students' prior knowledge, skill levels, and potential misconceptions?* During the Lesson 1: Review, students will complete a Warm-Up over the review topics. This will enable the teacher to check the student's prior knowledge, skill level and any misconceptions.	
A M M	**Learning Activities** <u>Lesson 1</u>: Review and Advance Preparation - Review of topics from the year to prepare students for forensic investigation. • pH scale, common acids and bases • solubility and solvents • flame test lab • properties of gases (for fuming chamber) • molar mass -What techniques and skills to you need to know to investigate a problem? • review the scientifc method The Scientific Method (adapted from *Investigating Chemistry, a Forensic Science Perspective*, 2nd ed., Matthew E. Johll, published by W.H. Freeman and Company, New York, 2009): 1. Determine the nature of the problem (Who committed a crime and how?) 2. Collect and analyze all relevant data. (Consider all physical evidence, witness statements, lab and medical reports, etc. Decide which information is helpful, and which is not relevant.) 3. Form an educated guess, called a hypothesis as to what happened (The butler did it in the library, with a candelstick.) 4. Test the hypothesis (Test alibis, reconstruct the crime scene, consider timelines, eliminate possibilities, etc.) 5. If your hypothesis holds up to the testing, you are finished. If not, go back to step two. - What make a persuasive argument? • How many sources or pieces of definitive data are enough? • In a court of law or in a science experiment, what do you need to "prove" that something is true? • What is more compelling - one piece of evidence that points towards a suspect or five pieces of evidence <u>Lesson 2</u>: Introduce the crime and explain task, begin investigation You are all detectives being asked to solve the possible poisoning of a chemistry teacher. In order to solve the crime, you will work with other detectives, collect data, make hypotheses and synthesize your results into a final video crime report. You will be evaluated on your chemistry knowledge and skills, and your ability to present a convincing and accurate case. The scene:	Progress Monitoring (e.g., formative data) - Warm-up over review topics from Lesson 1 - Progress Monitoring sheet for Lesson 2 - Ongoing conversations with detectives on progress

A, M	The science teachers at Lee and ISA were having a meeting one morning when something went horribly wrong. Several hours after the meeting Ms. Victim was found unconscious in her chemistry lab. At first, the police thought that she had accidentally inhaled some chemical fumes, but upon further investigation, it appeared that there may have been foul play. You may read depositions (statements) from suspects and witnesses, then perform a variety of tests to gather evidence and solve the crime. Possible tests to perform: • Illicit substances confirming test • Flame test lab • Saliva swab - acid/base • Mass spec results - molar mass calculation • Chromatography (ink on coffee filter) • Fingerprinting	
A, M	<u>Saliva swab</u> - acid/base: Victim reportedly seen drinking coffee. Students will use swabs from victim's mouth to test for the presence of an acid or base. (Swabs, ziploc bags, indicators/pH paper).	
A, M	<u>Flame test lab</u> - Test to identify unknown white powder on floor next to victim. Possible results: the presence of calcium ion (red-orange), from antifreeze reaction and barium ion (pale green), found in rat poison (barium carbonate). Give them 4-5 samples to compare to.	
A	<u>Illicit Substances Confirming test</u> - Detectives will be given a sample of crystals found in the victim's urine. Using nitric acid, students will confirm the presence or absence of illicit substances in the victim's system.	
A, M	<u>Fingerprinting</u> - Teacher will demonstrate how to develop fingerprints with superglue. Students will scan QR codes to reveal images of the fingerprints found in different areas of the crime scene. They will then compare these fingerprints to real fingerprints collected from different teachers around the campus.	
A	<u>Molar mass</u> - GCMS printed analysis of compound found at scene. Tiering - give higher readiness groups the structure and they must figure out the number of each element and the molar mass. Lower readiness groups - give formula, they must determine molar mass.	
T	<u>Chromatography</u> - Analysis of "threatening note" left by suspect. Using filter paper and 4 other pens from different suspects, determine which pen was used to write the note. (4 pens, filter paper/coffee filters, isopropyl alcohol, beakers, parafilm). <u>Lesson 3</u>: Video crime report Based on the data you collected and the tests that you	

	performed in the past few days, you will now make a 1 minute video report on your findings. In your video you must include: -A description of the tests run by your Investigative Team and the results of these tests - An overview of the crime and your proposed sequence of events -Your final conclusion on the guilty suspect, based upon the clues and evidence.	

Calendar

<u>Day 1:</u> **Lesson 1**: Review	<u>Day 2</u>: **Lesson 2**: Introduce the crime and explain task, begin investigation	<u>Day 3</u>: **Lesson 2**: Continue investigation, collect data	<u>Day 4</u>: **Lesson 2**: Continue investigation, collect data	<u>Day 5:</u> **Lesson 3**: Video crime report and turn in completed Detective Report