

Forensics

Crime Scene Investigation



Illinois Mathematics & Science Academy

PBL

Problem-Based Learning

Forensics

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Forensics

Unit Overview

Title: Forensics

Focus: Forensic Science

Embedded Problem: Perform mathematic and scientific investigations to collect data and analyze information to determine the role of a suspect and argue their involvement with reference to evidence present in a crime scene.

Overarching questions:

- How can evidence be analyzed?
- What information can be collected from people and how accurate are those statements?
- What are the important aspects of police investigations?
- What is forensic science and why is it important?
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Role and Situation: Students are asked to actively assume the role of lab technicians in collecting and analyzing evidence from a crime scene. Through performing investigations, students will use their knowledge of forensic science and mathematics to evaluate and organize information needed to determine and argue the involvement of various suspects.

Grade Level/s and Content Area/s: Grades 5th – 7th

Science: Science and Engineering Practices

Math: Data Collection, Number Sense and Operations, Geometry, Ratios and Proportions

Language Arts: Research, Writing, Presentation Skills

Curriculum Outcomes: Throughout a Problem Based Learning (PBL) experience, learners are actively engaged in discovering the content, developing self-directed learning dispositions and applying thinking and reasoning skills.

Forensics

Standards

Common Core State Mathematics Standards:

- 5.MD.A.1: Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- 6.EE.C.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.
- 6.SP.A.2: Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
- 6.SP.B.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- 6.SP.B.5: Summarize numerical data sets in relation to their context.

Common Core Mathematical Practices:

- MP1:** Make sense of problems and persevere in solving them.
- MP2:** Reason abstractly and quantitatively.
- MP3:** Construct viable arguments and critique the reasoning of others.
- MP4:** Model with mathematics.
- MP5:** Use appropriate tools strategically.
- MP6:** Attend to precision.
- MP7:** Look for and make use of structure.
- MP8:** Look for an express regularity in repeated reasoning.

Common Core English Language Arts Standards:

- 5.RI.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- 5.RI.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- 5.RI.9: Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
- 5.RF.4: Read with sufficient accuracy and fluency to support comprehension.
- 5.RL.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

Forensics

- 5.SL.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.
- 5.SL.4: Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
- 5.W.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
- 5.W.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
- 5.W.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- 6.SL.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- 6.SL.2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
- 6.RI.7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
- 6.W.1: Write arguments to support claims with clear reasons and relevant evidence.
- 6.W.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- 7.W.1: Write arguments to support claims with clear reasons and relevant evidence.
- 7.SL.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- 7.RI.4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.
- 7.RI.7: Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium's portrayal of the subject (e.g., how the delivery of a speech affects the impact of the words).
- 6-8.RST.1: Cite specific textual evidence to support analysis of science and technical texts.
- 6-8.RST.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- 6-8.RST.8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
- 6-8.RST.9: Draw evidence from informational texts to support analysis, reflection, and research.

Next Generation Science Standards:

- 5-PS1-3: Make observations and measurements to identify materials based on their properties.

Forensics

MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

NGSS Science and Engineering Practices:

SEP1: Asking questions and defining problems.

SEP2: Developing and using models.

SEP3: Planning and carrying out investigations.

SEP4: Analyzing and interpreting data.

SEP5: Using mathematics and computational thinking.

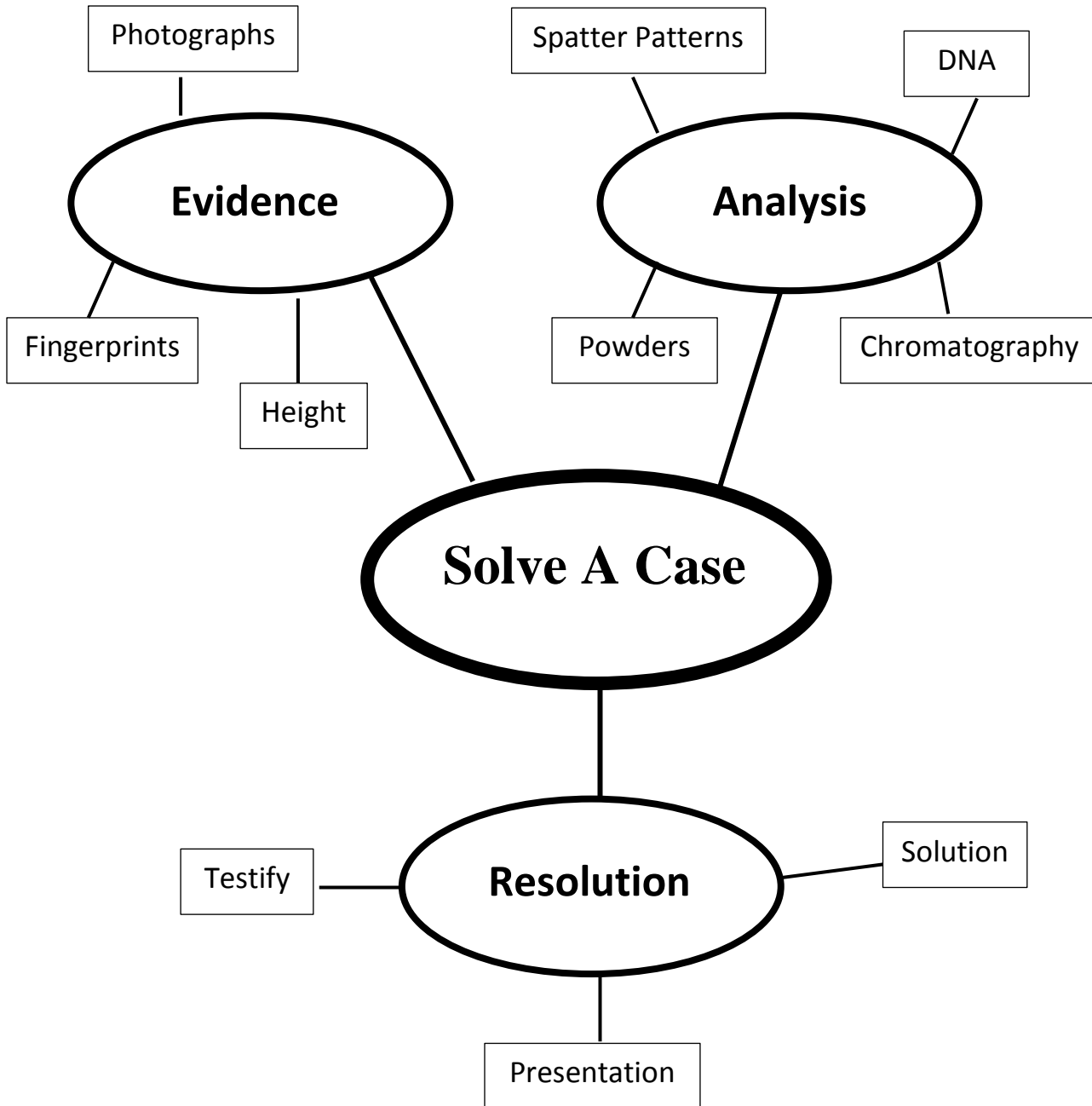
SEP6: Constructing explanations and designing solutions.

SEP7: Engaging in argument from evidence.

SEP8 : Obtaining, evaluating, and communicating information.

Forensics

Map of the Problem



Meet the Problem

Class Age/Size: 5th – 7th Grade/Whole Group

Materials:

- Meet the Problem

Time: 15 minutes

Location: Classroom

Objectives/Standards:

- *Students are introduced to the problem and begin to make sense of it.*
 - **NGSS: SEP8**
 - **Math: MP1**
 - **ELA: 5.RI.2, 5.RI.7, 6.RI.1, 7.RI.3, 6-8.RST.2**

Introduction:

The students will meet the problem through a letter. In order to “hook” the students, make the situation and role as authentic and believable as possible, using the letter and/or video, guest speakers, field trips, etc. However, be sure to avoid information overload, and “giving away” the whole problem. After sharing the letter with the whole group, it is helpful to have the students, individually or in small groups, highlight or underline key information.

Coaching Questions:

- What problem factors do we need to consider?
- What issues connect to this problem?

Assessment:

- Are the students aware that the situation is problematic; did they get “hooked”?
- Can learners participate in a team discussion of the problem situation?

Forensics

Problem Letter

Dear Students,

A crime was committed at one of the homes in our town. No one was hurt, but the suspect or suspects made a mess. Your teacher informed our captain that your class would be studying Forensic Science this year and that you would like to have a real case to work on as you learn about our work. Instead of giving you a case that we already solved, we want you to work this case along with us.

We will bring you evidence from the scene for you to test. If you need more sophisticated equipment, your teacher will send things over to our lab. We will send over more information as we work the case. If you send us questions, we will gather additional information for you since you cannot come out in the field with us. Remember that you are helping, but you cannot go to the house and help in person. We need to make sure you all stay safe. Are you ready to be lab technicians for the police department?

Here are the starting facts:

At 0648 on Tuesday morning, an alarm sounded at a single family residence at 2424 Mockingbird Lane. The American Alarm Company contacted 911 at 0651. Officers arrived on the scene at 0703. Upon entry, officers found several rooms with obvious destruction and no person in residence. The lead detective arrived at 0737 and contacted our crime scene unit. At this time, the whereabouts of the homeowner is not known. An inventory of missing or damaged items cannot be determined at this time. Crime scene officers are currently photographing and collecting evidence. Your case number is ST-261616-EM. Please pay close attention to your teachers as they train you and assist you in analyzing evidence.

The first scene photos have already been delivered to your classroom. Your teacher will let you know how to begin. We look forward to working with you.

Sincerely,

Detective Brian Grublesky

Forensics

Forensics

Know/Need to Know

Class age/size: 5th – 7th Grade/Whole Class

Materials:

- Chart Paper
- Markers
- Know/Need to Know Pages

Time: 45 minutes

Location: Classroom

Safety: No known issues

Objectives/Standards:

- *Students will list their prior knowledge and questions they have whose answers will help them solve the problem.*
 - **NGSS: SEP1, SEP8**
 - **Math: MP.1**
 - **ELA: 5.RI.1, 5.RL.1, 7.RI.4, 6.W.2, 6-8.RST.1**

Introduction:

In this lesson students will develop a list of Know and Need to Know items relating to the problem. The purpose of the activity is to have students think deeply about what they will need to know in order to solve the problem, and to provide a guide for their investigations. Student engagement is increased when they can see the connections between learning activities and questions they have about the problem. The list should be posted in the classroom, and as the questions are addressed, they can be crossed off of the Need to Know list and added to the Know list. Need to Know items can be added to the list as additional pieces of evidence surface, and the students should refer to the list before and after learning activities. It may be necessary to coach students to particular Need to Know items relating to learning activities.

Activity/Activities:

- 1) Using the handout, the students will individually fill out Know and Need to Know items. Remind students that it is all right if there are more items on the Need to Know list than the Know list.
- 2) Pairs of students will compare their lists and add as needed.
- 3) Small groups (4-6) of students will compare their lists. The groups will come to a consensus as to which items are the top 3 on each list.

Forensics

- 4) As a whole class, generate a master K/NK list on chart paper that will be posted in the classroom.
- 5) As an extension, or as an initial activity, students could draw concept maps of the problem, individually or in small groups.

Coaching Questions:

- What do you know about the problem? How do you know that information?
- What questions do you still have? Why do you need to know?
- Are there other areas that you should consider? Why do you think so?

Assessment:

- Can learners identify key elements from the Meet the Problem artifacts and situation? Can they identify key areas of investigation?
- Concept maps and K/NK lists—for breadth and depth of understanding
- Do the students validate and respect the contributions of all individuals?

Forensics

Anticipated Needs to Know items addressed by starting scene photographs:

Photo	KNOW	NEED TO KNOW
Liquid	Puddle of liquid on black surface	What is it? How did it get there? Does it relate to the crime?
Footprints with yellow flags	Footprints in mulch	How big are they? What type of shoe? When were they left? By whom?
Small footprint pic	Footprints in mulch	How big are they? What type of shoe? When were they left? By whom? Same as other prints?
Coffee cup	Starbucks. Spilled. Cold.	When was it dropped? By whom? Did they leave fingerprints?
Flowers on table	Entryway.	What are the white smudges on the table? Why is this room still neat?
Window	Its open.	Was it locked? Was it forced? Were there any fingerprints? Is it near the footprints?
Library shelves	Three empty spots	What are the heights? What was in there? How do we know?
Library vases	Three broken vases. Coke can.	Were these vases on the shelves? Which one was on which shelf? What happened to the coke can?
General from letter and knowledge of crime scenes.	Where the house is. When the alarm went off. When the police arrived.	Who lives at the house? Who lives near the house? What is the crime? What evidence will arrive?

This is a small sample list. Students will have more questions and should be encouraged to make as big a list as possible right now. As they work through the labs, some questions will be answered and new ones created. We recommend having a board dedicated to the Know/Need to Know that all students can see and refer back to throughout the unit.

Forensics

Forensics

Problem Statement

Class age/size: 5th – 7th Grade/Whole Class

Materials:

- Chart Paper
- Markers
- Problem Statement handouts

Time: 45 minutes

Location: Classroom

Objectives/Standards:

- *Students will define the problem that will guide their investigation.*
 - **NGSS: SEP1**
 - **Math: MP.1**
 - **ELA: 5.RF.4, 5.RI.1, 5.RL.1, 6.W.2, 6-8.WHST.9**

Introduction:

The Problem Statement is the key document that will guide the students through the problem. It consists of an overall task, and the factors to be considered in successful completion of the task. The students should carefully consider the information given in the Meet the Problem documents when writing their Problem Statement. Having the students draw concept maps, with the problem in the middle and the factors around it, can help the student clarify their thinking. The Problem Statement should be posted, and can be changed if the need arises.

Activity/Activities:

The students will draw a concept map of the problem.

1. Distribute the Problem Statement handouts.
2. The students will fill in the columns individually, then with a partner, and then with a small group of 4-6 students.
3. Each group of students will present their proposed Problem Statement to the class. The teacher will then work with the class to develop a whole class Problem Statement.
4. The Problem Statement will be revisited on a daily basis to guide the class' investigations.

Forensics

The stem for the Problem Statement is:

“How can we as (role) [overall task], in such a way that we consider [factors]...”

Coaching Questions:

- What have we been asked to do? (overall task)
- Are there other areas to consider? (factors)
- Who else could be affected by this problem?
- Are there other problem conditions to consider?

Assessment:

- Does the problem statement identify most of the key issues of the problem? (individual and group)
- Do they have a working problem statement?
- Do the students validate and respect the contribution of all individuals?
- The Problem Statement worksheet can be used to assess the learners’ overall understanding of the “big picture” of the problem and key factors for solutions.

Final Anticipated Problem Statement:

How can we solve the crime

... in such a way that we consider:

Evidence and scientific analysis

Statements from involved people

Motive, means, and opportunity (may need to coach/define these words for students)

Forensics

Plan for Information Gathering

Class age/size: 5th – 7th Grade/Whole Class

Materials:

- Chart Paper
- Markers
- K/NK handouts, Problem Statement Handouts from previous sessions

Time: 15 minutes

Location: Classroom

Objectives/Standards:

- *Students will design a plan for answering their need to know items and solving the problem.*
 - **NGSS: SEP3, SEP8**
 - **Math: MP.1**
 - **ELA: 5.RI.7, 5.RI.9, 5.SL.1, 6.RI.7, 7.SL.1**

Introduction:

In this lesson students will develop a plan for gathering information. The students will usually come up with the Internet as the first option. The key understanding is that there are other sources of information, such as experts, lab activities, books, surveys, etc. that can be used. The students may need some coaching to get to these ideas.

Activity/Activities:

1. The students will brainstorm ideas for gathering information to address the Need to Know items and the Problem Statement. The teacher will capture the ideas on chart paper.
2. The students will develop a plan for gathering information at the teacher's discretion. Options include assigning individual students or groups of students to address particular items, investigating as a whole class, etc.
3. The Need to Know list and the Problem Statement will be revisited on a daily basis, with completed items being checked off, and new items added as needed.

Forensics

Forensics

Observation 101

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60-90 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Analyze documents for interesting and potentially pertinent information.
- Generate investigable questions intended to collect additional information needed to solve a problem.
- Evaluate information for validity, and organize this information in an efficient manner.
- Collaborate with peers and engage in consensus building.

Materials

Crime Scene Photos (8)

K/NK Student Page

Standards

- **CCSS ELA: 5.SL.1, 5.SL.4, 5.W.7, 6.SL.2, 6.SL.1, 7.SL.1, 6-8.RST.8**
- **NGSS: SEP 1, SEP8**

Advanced Preparation

Print student pages. Hang crime scene photos around the room.

Introduction

Students will be presented with a series of photographs depicting the scene of the crime. Using observation skills, students will analyze each photograph and make observations to collect information that may, or may not, be necessary in solving the crime. This activity provides students with an opportunity to contribute to their Know, Need to Know student pages. By completing the gallery walk and analyzing each photograph, students will generate a list of observable pieces of evidence and pose investigable questions that could be asked to gain more information needed to solve the crime.

Procedure

Hand out student pages and arrange students in partner teams.

Forensics

Students will travel to each individual crime scene photo and analyze the scene for evidence. All observations will be recorded in the “Know” column of their student page. All observations will be recorded in the Know column of their student page. As these pieces of evidence are being collected, students should also document any additional questions which may need to be addressed concerning the items. These questions should be recorded in the Need to Know column of the student page. (*For example, if one picture depicts that presence of a white powder, students may record, “White powder is on the dresser” in the Know column. In the Need to Know column, they may ask, “What is the white powder?”*)

Once all groups have visited each of the crime scene photos, direct students to return to their seats.

Two partner teams will now form a small group of four students. Encourage teams to share their observations while adding new and interesting information to their student pages.

After students have had several minutes to collaborate in their small group, encourage volunteers to share their Know, Need to Know items. Record and organize this information on the whiteboard or a piece of chart paper for all students to see. This document will be edited and revisited throughout the investigation.

Debrief

Prepare students to participate in a whole class discussion. At this time, explain to the students that they will be solving a “cold case”. This is a type of crime that occurred earlier in time, but has not yet been resolved. Throughout the investigation, additional information will emerge from forensic analysis, witness testimonies, and archived evidence. To organize the multiple pieces of information that will surface throughout this investigation, it is recommended that the class develops a working Evidence Board.

The Evidence Board should be constructed in an area of the classroom that is visible to all students. At this time, present the 12 suspects. Arrange and secure each suspect’s identification card at the top of the Evidence Board. Explain to students that they will use this document to display and organize information and evidence that may, or may not, link each suspect to the scene of the crime.

Forensics

10 Unique Digits

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Analyze their fingerprints and identify the type of fingerprint on each finger.
- Practice lifting and identifying fingerprints from a piece of evidence.
- Analyze fingerprints from the crime scene to eliminate evidence from contamination.
- Evaluate lab techniques for accuracy and validity.

Materials

Ink pads

Magnifying lens

Gloves

Microscope Slide

Fingerprint powder

Dusting brushes

Tape

Index Cards

Fingerprints from scene

Fingerprints of suspects and family members

Notebooks

Student Pages

Standards

- **CCSS ELA: 5.SL.1, 5.W.4, 6.W.1, 6.SL.1, 7.W.1, 7.SL.1, 6-8.RST.3**
- **NGSS: SEP4, SEP8**

Advanced Preparation

Print student packets. Set out materials.

Introduction

Inform students that officers have collected fingerprints from multiple sources. However, they do not know to whom any of them belong. Fingerprints from the family that lives in

Forensics

the home, as well as individuals who frequent the house, are available. Using lab techniques, students will analyze the fingerprints for identifying characteristics. These pieces of evidence will then be organized on the Evidence Board. Students will also have an opportunity to collect and analyze their own fingerprints.

Procedure

Students will begin by inking their own fingerprints and identifying the type of fingerprint they have on each finger. They will ink only 1 finger at a time. Make sure that they are rolling their fingers correctly. For the fingers on their right hand, they start on the left side of the finger and roll to the right. For the fingers on their left hand, they start on the right side and roll to the left. Help the students identify their fingerprint types using the information below.



Loops

A **Loop** starts and ends at the same side, which is the side of the opening.

Arches

An **Arch** goes from one side to another.

Whorls

A **Whorl** is roughly circular, with the ridge lines going all the way around.

Once students can successfully identify fingerprint types, put on gloves and hand out a microscope slide to each student. Make sure that group members put on their gloves. At this time, review with students the process to dust for fingerprints as presented in their student pages. You may choose to reiterate that students dust over the paper and do not use too much to avoid a large mess.

Pass out the fingerprints from the crime scene. When they have identified which suspects appear to have left the prints, encourage students to share their observations and analysis.

Debrief

Reconvene students to prepare for a whole class discussion. Pose the following questions:

- *Was it easy or difficult to lift your own fingerprints? Why?*
- *Do you feel fingerprints are a reliable means to build a case against a suspect?*
- *How do the fingerprints at the scene eliminate or confirm a suspect?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

What a Mess!

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: Goggles should be worn during testing. Hands should be washed when the activity is completed.

Curriculum Objectives

The students will:

- Follow a multi-step procedure.
- Conduct multiple tests to identify substances.

Advanced Preparation:

Print student packets and set up materials. Label collection cups with names of the known substances being tested. Decide where in the room the material station will be located and set the materials in that area. Label another cup as “unknown substance” and fill with the substance from the crime scene.

Materials:

For Class:

½ c - Powdered sugar

½ c – Sea salt

½ c - Baking soda

½ c - Corn starch

½ c – Flour

6 – Small spoons (tasting size)

20 - Droppers

20 - Goggles

26 – 9oz cups

Notebooks

Crime Scene Photo (Entryway Photo)

For Group of 4:

2 - SEPUP trays per group of 4

2 – ½ Sheets black construction paper

2 - Hand lenses

1 – Cup with Water

1 – Cup with Vinegar (Acetic Acid)

1 – Cup with Universal Indicator

1 – Cup with Iodine Solution

Standards

- **CCSS Math: MP1, MP3**
- **CCSS ELA: 5.SL.1, 6.SL.1, 6.RI.7, 7.RI.7, 7.SL.1, 6-8.RST.3**
- **NGSS: SEP3, SEP4, SEP7, SEP8, 5-PS1-3, MS-PS1-2**

Forensics

Introduction

Inform students that an unknown substance has been recovered from the scene of the crime. The lab technicians have delivered several samples from the lab of substances that look similar to what was gathered from the scene. The police are unsure if the substance was there before the crime or not. It may have been brought in by the criminal, or could have possibly already been in the home. In this activity, students will investigate various properties of each of the known substances in an effort to identify the substance collected at the crime scene

Procedure

Show students groups where the materials are located. Also, remind they need to wear goggles throughout the activity today. Provide 2 SEPUP trays to each group of 4 and explain to students how the SEPUP tray is labeled. The tray has larger cups that are labeled with letters A through D. The tray had smaller cups that are labeled with numbers 1 through 9. They may not need to use all of the wells and they may need to clean the wells in between tests.

Students should follow the procedure listed in their student pages to test properties of the known substance. Allow students to struggle, encouraging groups as needed through the testing of the known substances.

When students have completed testing the known substances, put out the unknown substance that has arrived from the lab for students to test identify. Allow time for students to conduct tests and provide results on an evidence report for the investigators.

Debrief

Prepare students to participate in a whole class discussion. Pose the following questions:

- *How did you set up your experiment to test the known substance?*
- *How did you determine the unknown substance?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

It's A Matter of Spatter

Logistics

Class Grade/Age: 5th – 7th Grade

Class Size: 30

Instructional Time: 90 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives:

The students will:

- Generate data to predict the height from which a liquid fell.
- Analyze spatter to estimate the distance and angle at which the liquid traveled.
- Evaluate a scientific procedure and data set to determine validity

Materials

Scene Photos

10 mL syringe

Liquid for dropping (tempera paint)

Construction Paper

Ruler, Meter Stick or Measuring Tape

Graph Paper

Evidence Cards

Paper Towels

Student Pages

String

Pieces of butcher paper

Notebooks

Standards

CCSS Math: 5.MD.A.1, 6.SP.B.4, 6.SP.B.5, MP1, MP2, MP3, MP4, MP5, MP6, MP7

CCSS ELA: 5.SL.1, 6.SL.1, 6.RI.7, 7.RI.7, 7.SL.1

NGSS: SEP3, SEP4, SEP5, SEP7, SEP8

Advanced Preparation

Print student pages. Set out materials and prepare the liquid. You may choose to set up various stations where student groups can conduct their investigation.

Activities

Activity 1: How High?

Activity 2: Splash Spatter

Introduction

Detectives use a collection of evidence to recreate a crime. Dropped liquids can help create a more complete picture of the crime scene. The shape and size of drops can tell a story. If

Forensics

the drops are perfect circles, then they fell straight down and their size is in relation to the height at which they fell. Drops that are oblong fell at an angle. The narrow part of the drop will point back to where it originated. Using at least three of the drops, you can triangulate the exact position of the source.

Inform students that they will be participating in a training lab to investigate liquid spatter. Explain that officers found evidence of liquid spatter at the crime scene. The detective needs an analysis of the drops and explanation of the possible height at which the liquid fell.

Activity 1: How High?

Estimated Time: 60 minutes

Materials

Scene Photos	Student Pages
10mL syringe	Notebooks
Liquid for dropping	Paper Towels
Measuring Tools	Evidence Cards
Graph Paper	
Evidence Cards	

Procedure

Arrange students in groups of four. Provide all materials and explain to students where they will be conducting their investigation in the classroom. Discuss safety rules and reiterate the importance of keeping a clean working space.

Students will need to test drops from a series of heights to determine a possible relationship between drop diameter and height. Each student should have a turn measuring, dropping and recording. Circulate the room to ensure students are working efficiently, and answer questions as needed.

After students have completed the data table, encourage them to organize their information in a mathematical representation. A line graph or scatter plot may be appropriate. Also, students may choose to combine their data with other groups to have a larger sample. Encourage students to consider these ideas as they develop their work.

Next, hold a whole class discussion. Pose the following questions:

- *What shape are all of the drops that you made in this activity?*
- *Is this true of the crime scene?*
- *Are you able to predict the height at which the liquid fell based on evidence from the crime scene? Why or why not?*

Forensics

Allow students time to investigate the drops from the crime scene evidence photos. Students may choose to fill out an evidence card. Post any student generated information on the Evidence Board.

Activity 2: Splash Spatter

Estimated Time: 30 minutes

Materials

Scene Photos	Student Pages
10mL syringe	String
Liquid for dropping	Piece of butcher paper
Measuring Tape	
Paper Towels	
Notebooks	

Procedure

Students will continue working in the small groups from the previous activity. The next portion of the activity should be done outside, if possible. If not, have some paper towels ready for floor clean up.

Small groups will get a piece of butcher paper and create a liquid spatter from a pre-determined distance and location. They will then trade papers with another small group. Students will then use the string and measuring tools to determine the location (distance and direction, if possible) of the source of the spatter. During this investigation, circulate around the room to verify that students are using at least three spatter drops to determine the location of the source.

Debrief

Prepare the class for a whole group discussion. Pose the following questions:

- *Using the crime scene photos, what can we say about the direction from which the spatter may have originated from?*
- *Do you feel the method you used to determine this information is reliable? Why or why not?*
- *What additional factors have we not considered that may alter our findings?*
- *Do you have any additional questions that you would like to ask investigators about this piece of evidence?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

Just the Facts

Logistics

Class Grade/Age: 5th – 7th Grade

Class Size: 30

Instructional Time: 30 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The student will:

- Describe the difference between fact and opinion
- Write a police report from a narrative

Materials:

Student Pages

Police Reports

Notebooks

Standards

- CCSS ELA: 5.SL.1, 5.W.4, 6.W.1, 6.SL.1, 7.W.1, 7.SL.1, 6-8.RST.8
- NGSS: SEP2, SEP7, SEP8

Advanced Preparation:

Print student pages.

Introduction:

Testimonial evidence includes oral or written statements given to police as well as testimony in court by people who witnessed an event. Eyewitness accounts can be a useful tool in helping investigators with analyzing a crime scene, but are not viewed to be highly reliable. In addition, eyewitness identifications (right or wrong) can have a big influence on the outcome of an investigation or trial. People are likely to view the same scene in different ways depending on their positions, line of sight, familiarity with the area, and other factors that can interfere with a person's ability to remember details.

Procedure:

Students will work in partner teams.

Inform learners that they will analyze a series of conducted interviews that have been documented by police. At this time, hold a class discussion to address the role that facts

Forensics

and opinions have in an interview. Then, provide students with police reports to record important information.

Debrief

When all students have completed their work, reconvene as a whole class. Pose the following questions:

- *Do you feel that interviews are a reliable method for collecting evidence? Why or why not?*
- *What type of information can be taken from interviews?*
- *What additional questions would you have wanted to ask the interviewees?*

Forensics

Finding the Suspect: Height

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60-90 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Use measurement tools to determine foot size and height
- Generate and analyze data, and organize this data into a graphical representation
- Summarize the shape, spread, and trend of data in a scatterplot, and use this information to make predictions

Materials:

Student Pages

Crime Scene Footprints

Ruler or Measuring Tape

Calculator

1” Graph Paper

Sticker Dots

Wikki Stix

Notebooks

Standards

- **CCSS Math:** 5.MD.A.1, 6.EE.C.9, 6.SP.A.2, 6.SP.B.4, 6.SP.B.5, MP1, MP4, MP5, MP6
- **CCSS ELA:** 5.SL.1, 6.SL.1, 6.RI.7, 7.RI.7, 7.SL.1
- **NGSS:** SEP3, SEP4, SEP5, SEP8

Advanced Preparation:

Print student pages. Set out materials.

Activities

Activity 1: Evidence Analysis

Activity 2: Data Collection

Introduction

Explain to the students that the police have collected many different footprints from the

Forensics

scene of the crime. The investigator needs to analyze the footprints and provide information about each of the possible suspects or witnesses. In this activity, students will investigate a possible correlation between foot size and height. Conducting their own analysis, students will collect data, organize their information as a mathematical representation, and use a scatterplot to determine the relationship between foot size and height. They will then predict the height of each suspect based on the provided evidence.

Activity 1: Evidence Analysis

Estimated Time: 30 minutes

Materials:

Student Pages
Ruler or Measuring Tape
Calculator
Notebooks

Procedure:

Arrange learners in small groups of 3-4 students. Explain to students that they will be analyzing a collection of footprints to gain additional information related to possible suspects. Provide students with the measuring materials and student pages.

Allow time for students to complete the procedure as detailed in the student pages. Once all groups have measured the provided footprints and recorded their predictions and observations, reconvene the class to discuss the following questions:

- *The police have asked us to predict the average height of each person whose footprints were found at the scene. Do you feel that we have enough information to do this? Why or why not?*
- *How could we conduct an investigation using our own footprints to more accurately predict the height of the suspects? Explain.*

Activity 2: Data Collection

Estimated Time: 60 minutes

Materials:

Student Pages
1" Grid Paper
Sticker Dots
Wikki Stix

Explain to students that they will be measuring their own footprints and height. Then, as a class, they will organize their data in a mathematical representation to determine a possible relationship between foot size and height.

Forensics

Students will continue to work in small groups. Provide each group with the appropriate materials. Allow time for students to work through the procedure outlined in their student pages. While they are working, circulate the room to assess student understanding and address any questions.

Once all students have collected their data, display the 1" grid paper in the front of the classroom. Explain to students that they will be creating a scatterplot. This mathematical representation plots variables along two axes. The resulting pattern can then be analyzed to determine a correlation between the variables.

Begin by discussing an appropriate scale for the x- and y-axis. This will vary depending on the range of data collected by individual students. Students will then identify the location on the graph which represents their foot size and height by placing a sticker dot in the appropriate location. Once all students have recorded their information, ask students to summarize the shape and spread of the data. Then, using a Wikki Stix, ask students to follow the trend, or apparent pattern, in the data. Students should use a smooth curve or line to represent the data. *Note: If there is no apparent pattern in the data, encourage the students to discuss how they could refine their investigation. This may include obtaining a larger sample size.*

Direct students back to the information they collected on each of the suspects' footprints. At this time, students will use the data collected in the scatterplot to predict the height of each person whose footprints were found at the scene. When all students have completed their work, take several minutes for each small group to share their predictions. Then, present that actual height of the suspects.

ACTUAL HEIGHT OF SUSPECTS	
Edna Roberts	5 feet, 2 inches
Nathan Roberts	6 feet
Earl Fletcher	6 feet, 1 inch
Sugar McAllister	5 feet, 8 inches
Ellie Smith	5 feet, 4 inches
Mary Sinclair	5 feet, 7 inches
Boyd Grainger	5 feet, 10 inches
Harry Higgenbottom	6 feet, 1 inch
Felipe Eduardo	6 feet, 2 inches
Penelope Harris	5 feet, 5 inches

Forensics

Johnny Bishop	5 feet, 11 inches
Natasha Knox	5 feet, 6 inches

Debrief

Prepare the class for a whole group discussion. Pose the following questions:

- *How did you use our mathematical representation to predict the height of each suspect?*
- *Do you feel that our data allowed us to make an accurate prediction? Why or why not?*
- *How could we have modified our investigation to make an even more accurate prediction? Explain.*
- *Is there another way that we could calculate the approximate height of a suspect from their foot length? (Note: One possible solution would include students determining what percent of their height is equivalent to their foot size. Research indicated that a person's foot is approximately 13-15% of their height.)*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

Heavy Treasure: How Much Does It Weigh?

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 100 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Generate, organize and analyze data
- Design and evaluate an experiment to collect information
- Calculate the weight needed to crush a soda can to a desired thickness

Materials:

Evidence bag (Coke can and photos)

Drainage Pipe with holes drilled at three heights

Dowel rod for height spot

Drop containers

Gravel

Metal Spheres

Ziplock bags to contain gravel and metal spheres

Balances

Cans for crushing

Evidence Paperwork

Scale

Notebooks

Standards

- **CCSS Math:** 5.MD.A.1, MP1, MP4, MP5, MP6, MP7
- **CCSS ELA:** 5.W.2, 5.SL.1, 6.SL.1, 6.W.1, 7.SL.1, 7.W.1
- **NGSS:** SEP3, SEP4, SEP7, SEP8

Advanced Preparation:

Print student pages. Set up materials.

Introduction

Inform the students that officers on the scene found glass from three broken vases on the floor surrounding a crushed Coke can. Officers took various pictures for the lab. The

Forensics

officers suspect that something valuable might have been hidden inside one of the vases. They believe that the targeted vase would have been heavy enough to crush the can. The detectives need to know how much each of the three vases would have to weigh to crush a can if falling freely. In this activity, students will devise an experiment to test for the potential weights of the objects found within the three vases. They will use alternative materials to model the scene of the crime.

Procedure

Arrange learners in small group of 4-5 students. Reiterate the problem scenario to students, explaining that the weight of each vase at each of the three individual heights will need to be determined. Provide students with the appropriate materials. You may find it necessary to demonstrate how the drop apparatus functions.

Students may start at any of the three heights. Students will use canisters of gravel and metal spheres to crush cans. Dowels and holes are set at each height identified by the police.

They will design the experiment and data table for this activity. All information should be recorded in the appropriate student pages. They will most likely start out with trial and error, but should then move into scientific strategies for subsequent predictions. While students are working, circulate the room to verify that all learners are on task and using the materials appropriately. Answer student questions as needed.

One possible solution is dropping the canister from Height #3 with a mass of 604.8g.

Debrief

Encourage small groups to compare results. Interested or advanced students may attempt to create a formula for the results. Pose the following questions:

- *How did you design your experiment? How did you utilize a data table?*
- *Did your experiment provide you with the data necessary to reach a conclusion? If not, how would you revise your experiment?*
- *Describe the relationship between the weight of a falling object and the height at which the object is dropped?*
- *Do you feel that your conclusion is valid? Why or why not?*
- *What do you think the valuable object could be?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

So Slick

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Carry out the process of chromatography.
- Interpret and use chromatograms as evidence

Materials

12 oz Cups – for chromatography paper

9 oz Cups or 3 oz Cups – for samples

Kool-aid: 7 flavors

Pencils

Masking tape

Chromatography paper strips

Ruler

Droppers

Water

Sample of liquid chromatogram from crime scene

Standards

- **CCSS Math: MP1, MP2, MP3**
- **CCSS ELA: 5.SL.1, 6.SL.1, 6.RI.7, 7.RI.7, 7.SL.1, 6-8.RST.3**
- **NGSS: SEP3, SEP4, SEP7, SEP8**

Advanced Preparation:

Print student packets. Determine where the evidence stations will be setup for students to obtain samples for testing. Prepare the Kool-Aid for by making very concentrated mixtures.

Introduction

Inform students that the police have sent over a sample of liquid found outside the house at the crime scene. To analyze this information, students will first participate in chromatography training. With their new knowledge, they will then investigate the

Forensics

evidence from the crime scene. Students will use chromatography to separate colors in an unknown liquids.

Procedure:

Students will work individually or with a partner to complete this activity. Provide each learner with the appropriate materials. Students should work carefully to follow the procedure outlined in their student pages. During their investigation, circulate around the room to assist with lab techniques and answer questions as needed. When necessary, demonstrate how to set up the cup, chromatography paper, water and pencil.

Student procedure:

1. Measure 2 cm from the end of the chromatography strip. Use your pencil to make a faint line across the strip of paper from one side to the other side.
2. Take the chromatography strip to the oil sample station. Put a drop of oil on the center of the line. Allow the oil sample to dry thoroughly.
3. Select three other colors you and your investigative team would like to test. Repeat steps 1 and 3 with a clean chromatography strip each time.
4. Listen and watch the demonstration that explains how to setup the cup, water, and pencil.
5. Now it is time to prepare your testing cups. You will conduct two tests in each cup.
6. Carry out the investigations with your team.
7. Catalog your evidence.

Then, explain to students, **“Now that you are chromatography experts, you and your team are ready to evaluate evidence from the lab. Here [share the chromatogram from the crime scene] are the results from the liquid found at the scene.”**

When teams are ready, put out the chromatogram from the liquid that was found at the scene of the crime. Students will then compare this piece of evidence to their samples and determine if they have enough information to determine a match.

Debrief

Prepare the students for a whole class discussion. Pose the following questions:

- *Do your samples provide an exact match to the chromatogram from the crime scene? Why or why not?*
- *If it is not an exact match, can you eliminate any of the samples? Why or why not?*
- *What questions would you like to forward to the investigators regarding this lab technique?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

Forensics

DNA Match?

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Determine how portions of DNA sequences (loci) can be analyzed to gain valuable information
- Use computational thinking to look for patterns in a contextual situation
- Analyze various solutions to a problem and determine which solutions most appropriately fit the constraints of the problem.

Materials

5 DNA loci samples from Suspects A-E (printed on colored paper)

Evidence DNA sequences for each locus

Student Pages

Notebook

Evidence Report

Standards

- **CCSS Math: MP1, MP2, MP4, MP7**
- **CCSS ELA: 5.RI.4, 5.SI.1, 6.SL.1, 6.RI.7, 7.SL1**
- **NGSS: SEP4, SEP5, SEP7, SEP8**

Advanced Preparation

Print the DNA loci sequences of each suspect on a different color of paper (i.e., Suspect A is green, Suspect B is yellow, Suspect C is orange, etc.). Cut all sequences apart and place in a bag. Then, cut each of the evidence DNA loci into individual cards.

Introduction

Inform students that DNA evidence from the crime scene has been recovered. However, the evidence was badly degraded. With our knowledge of DNA and several lab techniques that map pieces of DNA to a suspect, we are hopeful that this evidence may be useful.

Procedure:

Forensics

Arrange learners in small groups of approximately three students. Pass out the appropriate materials to each group. Ask for a student volunteer to read the Background Information aloud. Prior to beginning the activity, review the idea of loci and how they are used in forensic investigations. If necessary, students may need additional time to research and review characteristics of DNA.

To begin the activity, inform students that each color of DNA loci sequences corresponds to an individual suspect (Suspects A-E). Unfortunately, the labels that had identified these sequences have rubbed off. The students must first analyze the DNA loci sequences to know which sample is from which locus. At this time, students will match a DNA loci sequence from one suspect to a DNA loci sequences from the other suspects by comparing similarities among included nucleotide bases. This will result in 5 groups of 5 loci sequences representative of each individual suspect.

While students are working, circulate the room to evaluate student understanding and answer questions as needed.

Next, pass out the sequences from the Evidence DNA sequences for each locus.

At this time, ask students to place each the Evidence DNA locus with the appropriate group of loci (as determined in Activity 1). Then, ask students to determine if the Evidence DNA sequence matches any of the DNA sequences provided by the suspects. Students should record their information in the appropriate sections of their student pages.

Debrief

Prepare the students for a whole class discussion. Pose the following questions:

- *Did you use a strategy to identify the loci of each DNA sequence? Explain.*
- *What do you notice about the sequences of nucleotides within each loci?*
- *What can you conclude from your evidence?*
- *Could you exclude any suspects completely?*
- *Can you include any suspects completely?*

Conclude the debrief session by encouraging students to place any additional pieces of evidence or information gained in this activity on the Evidence Board. Discuss these items.

Forensics

Answer Key																	
Locus 1: TTCAA	A	G	T	T	C	A	A	C	C	C	G	A	T	G	G	A	C
	B	C	T	T	C	A	A	G	C	C	G	A	A	G	G	A	C
	C	G	T	A	C	A	A	C	C	C	C	T	A	G	G	A	C
	D	G	A	T	C	A	T	G	C	C	G	T	T	G	G	A	C
	E	C	T	T	G	A	A	G	C	C	G	T	T	G	G	A	C
Locus 2: GAACT	A	T	C	C	A	G	A	A	C	T	T	A	C	C	G	A	T
	B	T	C	G	A	C	A	A	C	A	T	A	C	C	C	A	A
	C	A	G	C	A	G	T	T	C	T	T	A	C	G	G	T	T
	D	T	G	G	A	G	A	A	G	T	T	A	G	C	G	A	T
	E	T	C	G	T	G	A	A	C	T	A	A	G	G	C	A	T
Locus 3: ATTGG	A	C	G	T	A	T	T	T	G	G	C	C	A	A	C	A	T
	B	C	G	T	T	A	T	T	G	G	C	C	A	T	C	T	T
	C	G	G	T	A	A	T	T	G	G	G	C	A	A	G	A	T
	D	C	G	T	T	A	A	T	G	C	C	C	A	A	C	T	T
	E	G	C	T	A	T	T	T	C	G	C	C	A	T	C	A	T
Locus 4: AAAGG	A	C	C	T	A	G	G	T	T	C	A	A	A	G	G	C	C
	B	C	G	T	A	C	C	T	T	C	A	T	A	G	G	C	C
	C	G	C	T	A	G	C	A	T	C	A	A	A	G	G	C	C
	D	C	C	A	T	G	G	T	T	G	A	A	A	C	G	C	C
	E	C	C	T	A	C	G	A	A	C	A	A	A	G	G	G	G
Locus 5: TTCTA	A	A	A	C	C	G	T	C	A	G	G	T	T	C	T	A	G
	B	T	A	C	G	C	T	C	A	C	G	T	T	C	T	A	G
	C	A	A	C	C	C	A	C	A	C	C	T	T	C	T	A	G
	D	A	A	G	G	G	T	G	A	G	G	T	T	C	A	A	G
	E	T	A	C	C	G	T	C	T	G	G	A	T	G	T	A	G

Suspect A matches Loci 1, 2, 4, and 5

Suspect B matches Loci 1, 3, and 5

Suspect C matches Loci 3, 4 and 5

Suspect D does not match any loci

Suspect E matches Loci 2 and 4

Forensics

Forensics

Testify

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Demonstrate understanding of all lessons for the week by answering questions about evidence and lab procedures learned.
- Evaluate handwriting samples

Materials

Envelope with topics

Testify questions

Handwriting baggies from Monday

Student pages

Notebooks

Advanced Preparation

Set up table with four seats at front of room for testifying group.

Standards

- **CCSS ELA: 5.RI.4, 5.SI.1, 6.SL.1, 6.RI.7, 7.SL1**
- **NGSS: SEP4, SEP6, SEP7, SEP8**

Activities

Activity 1: And the Envelope, Please

Activity 2: Handwritten Confession

Introduction

“Welcome to court prep. Lab techs will be called to testify in court about the lab evidence. In order to prepare for court, techs will practice with lawyers. Today, you will practice testifying about the evidence that you worked on all week.”

Activity 1: And the Envelope, Please

Estimated Time: 50 minutes

Materials:

Envelopes

Questions

Procedures:

Student lab groups select a card from the envelope. Once all groups have a topic, lab groups are given 10 minutes to review all of their notes before they are called to testify.

Forensics

Teachers have the question cards. Try to encourage answers from each student in the lab group. Allow one or two additional questions from the other groups, if you would like. Each group has 8 minutes of testify time.

Activity 2: Handwritten Confession

Estimated Time: 5 minutes

Materials:

Handwriting cards from Suspects

Procedures:

Give each table a baggie of cards. They will work to match the sentence cards with the names. If they do them all correctly, they will find out who confessed to the crime when faced with the evidence they collected.

You have a picture of the correct matches in moodle.

Debrief

Estimated Time: 3 minutes

Assessment: Students will work together to demonstrate what they learned this week and to analyze handwriting.

Clean-up: Reset materials for next class or pack items up if end of day.

Forensics

Who Done It?

Logistics

Class grade/age: 5th – 7th grade

Class size: 30

Instructional Time: 60 minutes

Location: Science lab/classroom

Safety: No safety issues in this lesson.

Curriculum Objectives

The students will:

- Demonstrate cooperation skills as they play a board game.

Materials

Game board

Game cards

Dice

Game pieces

Activities

Activity 1: Who Done It?

Introduction

“Welcome to Who Done It? Please sit in your lab groups and read the directions. When you are ready, you may begin to play the game.”

Activity 1: Plan

Estimated Time: minutes

Materials:

Game board

Game cards

Dice

Game pieces

Procedures:

Read directions.

Play the game

Debrief

Estimated Time: 5 minutes

Procedure: Students may play multiple games if time allows.

Assessment: The students should play the game using appropriate language and behaviors.

Clean-up: Reset materials for next class or pack items up if end of day.

Forensics

Forensics

Generate Solutions

Class age/size: 5th – 7th Grade/whole class

Materials:

- K/NK Charts
- Final Problem Statement
- Generating Solutions sheets or post-it notes
- Information from activities and research

Time: 20 minutes

Curricular Objective:

The students will:

- Brainstorm solutions to the problem.

Standards

- NGSS: SEP6, SEP7, SEP8

Introduction:

Brainstorming solutions is the next step towards developing the ultimate solutions to the problem. At this stage, students should not be trying to choose solutions, the goal is to generate a large list of solutions for students to consider in the next lesson.

Activity/Activities:

The students will brainstorm ideas for the ultimate solution to the problem by writing them on either the Generating Solutions handouts or post-it notes. They will then hang their solutions on the wall. As a class, or as small groups, the students will categorize the solutions according to common themes.

Coaching Questions:

- Have you investigated all of the areas of the Problem Statement?
- Do you have enough information?
- Have you investigated all of the Need to Know items?
- What options are you considering?

Forensics

Assessment:

- Do the proposed solutions address the overall task and factors to consider in the Problem Statement?
- Do the proposed solutions show evidence of sufficient content knowledge to support the learners' case?
- Do they actively consider a broad range of solution elements?
- Do they offer valid support for their solution elements?
- Do all learners participate?

Forensics

Best Fit

Class age/size: 5th – 7th Grade/whole class

Materials:

- K/NK Charts
- Final Problem Statement
- Generating Solutions sheets or post-it notes
- Information from activities and research
- Decision matrix or similar (if desired)

Time: 20 minutes

Location: Classroom

Curricular Objective:

The students will:

- Determine the best solution to the problem.

Introduction:

The students will develop criteria for evaluating which solutions best fit the problem, and determine which solution(s) are a best fit. The key understanding is that there is seldom a perfect solution for a messy problem, just solutions that are a better or worse fit. The students may come up with one solution for the class, a solution with several components, or several solutions.

Standards

- **CCSS ELA: 5.RI.4, 5.SI.1, 6.SL.1, 6.RI.7, 7.SL1**
- **NGSS: SEP7, SEP8**

Activity/Activities:

By referring to the Meet the Problem letter and the Problem Statement, the students will develop a list of criteria to judge the proposed solutions. Teachers may have the students use a decision matrix, SWOT analysis, or other methods for evaluating the solutions.

Coaching Questions:

- What is at stake in the problem? Have you considered all of the stakeholders/factors?
- What are the pros and cons of each possible solution?

Forensics

- What solutions or combination of solutions seems most reasonable? Why or why not?
- What is the best-fit solution? How do you know?
- What are the potential consequences of this solution?
- What is the hardest question that you might be asked when you present this solution?
- Have you reached consensus?
- Is the solution realistic?

Assessment:

- Does the solution incorporate the information and content that learners have gained throughout this problem?
- Does the best-fit solution address all the factors in the problem statement?
- Do the learners work cooperatively to reach consensus on their shared vision?
- Do they set criteria for establishing priorities?
- Do they analyze the factors by means such as: feasibility, ethics/morals, cost benefit and risk analysis, consequences?
- Do they consider the consequences of their decisions?

Forensics

Present the Solution

Class age/size: 5th – 7th Grade/Whole Class

Materials:

- K/NK Charts
- Final Problem Statement
- Generating Solutions sheets or post-it notes
- Information from activities and research
- Decision matrix or similar (if desired)

Time: 2 hours (1 hour for preparation, 1 hour for presentations)

Location: Classroom

Curricular Objective:

The students will:

- Design a presentation of their solution and give the presentation to poser of the problem.

Standards

- CCSS ELA: 5.RI.4, 5.SI.1, 6.SL.1, 6.RI.7, 7.SL1

Introduction/Activity/Activities:

The students will develop presentations of the solution(s) to the problem. There may be multiple solutions within the class, or one solution with multiple parts presented by different groups. This is an especially powerful experience if the students are able to present their solutions to the problem poser.

Coaching Questions:

- Do you know what your role in the presentation is?
- Are your presentation materials ready?
- Have you considered and prepared for questions from the audience?

Assessment:

- Do the presentations communicate learners' solutions effectively, accurately, and clearly?
- Do learners ask appropriate questions of other presenters?
- Do learners engage with all of the presentations?

Forensics

Forensics

Final Debrief

Class age/size: 5th – 7th Grade/Whole Class

Materials:

- Chart Paper
- Markers

Time: 30 minutes

Location: Classroom

Curricular Objective:

The students will:

- Reflect on what they learned from the presentations and from the problem as a whole.

Standards

- CCSS ELA: 5.RI.4, 5.SI.1, 6.SL.1, 6.RI.7, 7.SL1

Introduction and Activity/Activities:

The learners will reflect upon their learning through journaling small group discussion, whole class discussion, or any combination of these activities. Students sometimes don't realize how much they have learned until they are asked to reflect and make connections.

Coaching Questions:

- Guide learners to critically analyze their groups' presentation and those of other groups for effectiveness and completeness of the solution.
 - What elements worked and what didn't? How did you know?
 - What did you see in other presentation that was different from yours?
 - What content did other teams find that your team did not?
 - What would you exclude or add to your presentation if you were to do it again?
 - What would be the best solution to the problem?
- Guide learners to critically analyze their processing and group skills.
 - What skills worked for you as you gathered information, and what did not?
 - How effective did you think you were in solving the problem?
 - How effective did you think your group was in solving the problem?
 - How would you change your research tactics for another problem?
 - What helped you most to understand the problem?

Forensics

- Guide learners to critically analyze their learning throughout the problem.
 - What new content knowledge did you gain through this problem?
 - How did that content knowledge help you to understand the problem?
 - What questions do you still have about the content of this problem?
 - Did your beliefs change after listening to others?
 - How did your thinking change during this problem?

Assessment:

- Can learners articulate the problem and solution in an individual journal entry?
- Do learners engage in whole group sharing about the presentation, the process, and the learning?

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Know/Need to Know

Your Name:	Team:	Date:
------------	-------	-------

Know	Need to Know	Need to Do

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Problem Statement

Your Name:	Team:	Date:
------------	-------	-------

	Here's what I think . . .	Here's what we (pair) think . . .	Here's what our group thinks . . .
Overall Task			
Factors to Consider			

How can we . . .

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in such a way that we consider.....

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10 Unique Digits

Page 1 of 3

Problem: At the site, the officers collected fingerprints from multiple sources. They do not know to whom any of them belong. They do have samples from the family that lives in the home to narrow the possibilities of prints left by the suspect.

Materials:

- | | |
|--------------------|--------------------------------|
| Ink pad | Piece of paper |
| Magnifying lens | Tape |
| Gloves | Note card |
| Glass | Fingerprints from scene |
| Fingerprint powder | Fingerprints of family members |
| Dusting brush | |

Procedure:

1. Your group will begin with each member making your own fingerprints and identifying what type of fingerprint you each have on each finger. Do 1 finger at a time. Press your finger into the ink pad and then make your fingerprint in the correct box below. For your right hand, start from the left side of your finger and roll it to the right. For your left, start from the right side of your finger and then roll to the left.

	Left Pinky Finger	Left Ring Finger	Left Middle Finger	Left Pointer Finger	Left Thumb
Type of fingerprint					

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10 Unique Digits

Page 2 of 3

	Right Thumb	Right Pointer Finger	Right Middle Finger	Right Ring Finger	Right Pinky Finger
Type of fingerprint					

2. Using the information below. Identify the type of fingerprint for each of your fingers.



Loops

A **Loop** starts and ends at the same side, which is the side of the opening.



Arches

An **Arch** goes from one side to another.



Whorls

A **Whorl** is roughly circular, with the ridge lines going all the way around.

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10 Unique Digits

Page 3 of 3

3. Now you will practice lifting and studying fingerprints. Your teacher will give you a microscope slide. Carefully push one finger into the glass of the slide.
4. Dust the glass to find the fingerprint. Place a piece of paper on the desk. Gently tap the powder over a section of the glass. Gently brush the powder off of the glass. If no finger prints are found, rotate the glass and tap powder over a new section of the glass. Continue until you find the fingerprint.
5. Once you find the fingerprint, you will lift it off of the glass. Have an index card and a piece of tape that is longer than the fingerprint. Place the tape over the fingerprint, leaving a piece that you can hold and remove the tape easily. Pull the tape off and place it on the index card.
6. Use the magnifying glass to examine your fingerprint and compare it to your card. Can you easily tell which finger you printed?
7. Now use the fingerprints lifted from the scene and fingerprint cards to make decisions about the fingerprints found at the scene.

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What A Mess

Page 1 of 2

Problem: A white powder was found on the table in the entryway of the home near a vase of flowers. Please conduct tests to determine what the material could be. Once you have completed your tests, create questions that the investigators should ask.

Materials: Investigative Team of 4

Goggles

2 - Black construction paper

2 - SEPUP tray

1 – Acetic acid

1 – Indicator solution A

1 – Indicator solution B

1 – Water cup

Samples of known substances

Sample of unknown substance found at crime scene

Procedure:

1. Gather the materials needed for your investigation of the known substances. Use the chart on the next page to take detailed notes.
2. Perform the following tests and record results:
 - a. **Observations:** Put a half spoon of each substance on a piece of black paper. Observe with a hand lens.
 - b. **Water:** Put 3 drops of water on the material on the black paper. Observe what happens.
 - c. **Acetic Acid:** Put a half spoon of each substance in cups and label. Put 3 drops of acetic acid on the material in each cup. Observe what happens.
 - d. **Indicator Solution A:** Put a half spoon of each substance in cups and label. Put 3 drops of indicator A on the material in each cup. Observe what happens.
 - e. **Indicator Solution B:** Put a half spoon of each substance in cups and label. Put 3 drops of indicator B on the material in each cup. Observe what happens.

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What A Mess

Page 2 of 2

Known Substance Chart

Cup	Observations	Water	Indicator Solution A	Indicator Solution B	Acetic Acid
1					
2					
3					
4					
5					
6					
7					
8					
9					

Procedure:

Once you have completed the tests on the known substances, you will receive the unknown substance from the scene. Conduct tests and provide your results on an evidence report to the investigators.

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It's a Matter of Spatter

Page 1 of 3

Problem: At the site, the officers found spatter of several unknown substances. The detective needs the lab to analyze the drops and explain the probable height each drop fell from.

Materials:

Scene photos

Droppers

Liquid for dropping

Construction paper

Ruler

Measuring tape

Graph paper

Pen

Detective cards

Notebooks

Piece of butcher paper

Procedure:

1. Your group will need to test drops from four different heights in order to determine the relationship between drop diameter and height. Label 4 different pieces of construction paper with the four heights your lab team selects. Label them on the graph below:

Height								
Drop 1								
Drop 2								
Drop 3								
Drop 4								
Drop 5								
Average								

2. Using the measuring tape, hold the dropper at the first height and release one drop of mystery liquid. Move to above another area of the paper at the same height and release another drop. Repeat until you have five drops. Carefully circle each drop immediately (before it dries!). Repeat procedure until you have data on all 4 heights.

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It's a Matter of Spatter

Page 2 of 3

3. Make a graph of your results. On the x-axis, put the drop height (in cm), and on the y-axis, put the average drop diameter (in mm).
4. Look at your graph and try to draw some conclusions based on your results. How did the diameter of the spatter change as the mystery liquid was dropped from different heights?

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Just the Facts

Page 1 of 1

Background: Testimonial evidence includes oral or written statements given to police as well as testimony in court by people who witnessed an event. Eyewitness accounts can be a useful tool in helping investigators with analyzing a crime scene, but are not viewed to be highly reliable. In addition, eyewitness identifications (right or wrong) can have a big influence on the outcome of an investigation or trial. People are likely to view the same scene in different ways depending on their positions, line of sight, familiarity with the area, and other factors that can interfere with a person's ability to remember details.

Problem:

There are three parts to a police report: the **fact** sheet, the **narrative**, and **supplemental** sheets. In the fact sheet, you will record the basic information and facts of the crime needed to organize the case. You will fill in all of the information and check the correct boxes. The narrative portion includes witness statements and officer comments. Supplemental sheets are any supporting documents.

Police reports focus on answering the basic six questions of informational writing:

- ✓ **WHO** - Who did what to whom? Who is involved in this case (name the victims, suspects, witnesses)?
- ✓ **WHAT** - What happened? What crime was committed? What was taken? What was used to commit the crime?
- ✓ **WHEN** - When was the time of day, day of week, month, and year?
- ✓ **WHERE** - Where was the crime committed? Where was the weapon found? Where was the victim taken?
- ✓ **HOW** - How was the crime committed?
- ✓ **WHY** - What is the motive of the crime?

Fact, Opinion, Conclusion

Fact: A statement that can be proven to be true

Opinion: A belief that cannot be proven, a personal view

Conclusion: A meaning drawn from facts, opinions, and evidence. Has more value from someone deemed an expert in the field?

Read the transcript from each interview and fill out a police report. Focus on the facts!

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Finding the Suspect: Height

Page 1 of 2

Problem: The police have collected many different footprints from the scene of the crime. The investigator needs to analyze the footprints and provide information about each of the possible suspects or witnesses.

Materials:

Inked shoe prints

Ruler

Calculator

Tape measure

Notebooks

Evidence cards

Procedure:

1. In your notebook, create a page for each individual footprint. Be clear and consistent with how you label and the information you include. Make any predictions you can, but be sure to indicate which is a prediction is and which is a fact. You will need these notes to write reports and you might be called to testify in court.

2. The police will need you to predict average height of each person whose footprints were found at the scene. How can you figure out how to predict height using your fellow investigators? Chat with your team and take notes here:

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Finding the Suspect: Height

Page 2 of 2

3. Give this a try: Measure the height of each member of your team. Measure the foot length of each member. Record all data in the chart provided.

Name				
Height				
Foot length				

4. You will now use class data to organize information in a mathematical representation. With the assistance of your teacher, mark your foot length and height with a sticker dot on the provided chart paper.

5. What does the class data illustrate? Do you notice any trends? Does there seem to be a relationship between a person's foot size and their height?

6. Now use what you figured out to predict the height of each person with footprints found at the scene. Add this information to your notes and fill out the evidence cards for the detectives.

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Heavy Treasure: How Much Does It Weigh?

Page 1 of 2

Problem: The officers on scene found glass from three broken vases on the floor surrounding a crushed Coke can. They took various pictures for the lab. The officers suspect that something valuable might have been hidden inside one of the vases. They believe that vase would have been heavy enough to crush the can. The detectives need to know how much each of the three vases would have to weigh to crush a can if falling freely.

Materials:

Drainage pipe with holes drilled at three heights

Height pole

Drop containers

Gravel

Metal spheres

Balances

Cans for crushing

Scene photos and reports

Evidence cards

Notebooks

Procedure:

1. Examine the photos from the scene and take any necessary notes. Gather with your team and design an experiment to test for the different weights. You will need to design your own data table to collect your information. Be sure to discuss what data you will need to collect. Create a table on the next page.
2. Now use what you figured out to predict the weight of the items in each vase. Add this information to your notes and fill out the evidence cards for the detectives.

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Heavy Treasure: How Much Does It Weigh?

Page 2 of 2

Create your own data table below.

Data Table

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So Slick

Page 1 of 2

Problem: The police sent over a sample of a liquid found outside the house at the crime scene. You will start with chromatography training and then you will analyze the evidence from the scene. Chromatography is a method of separating materials.

Materials:

4 – 12 oz Cups
Liquid samples
4 - Pencils

Masking tape
Chromatography paper
Ruler

Water
Coloring supplies

Procedure:

1. Measure 2 cm from the end of the chromatography strip. Use your pencil to make a faint line across the strip of paper from one side to the other side.
2. Take the chromatography strip to the sample station. Put a drop of any sample on the center of the line. Allow the oil sample to dry thoroughly.
3. Select three other samples you and your investigative team would like to test. Repeat steps 1 and 3 with a clean chromatography strip each time.
4. Listen and watch the demonstration that explains how to setup the cup, water, and pencil.
5. Now it is time to prepare your testing cups. You will conduct two tests in each cup.
6. Carry out the investigations with your team.
7. Catalog your evidence in the table below.

Sample	Observations

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DNA Match

Page 1 of 1

Problem: Does the DNA evidence match any of the suspects?

Background information:

Every human's DNA is over 99% identical to each other. Even with this high amount of identity, there are still over 3 million differences between each person. These differences allow the police to match DNA from a crime scene to a person. To do so, they don't look at just one place (locus) on the DNA. They attempt to make matches at several different loci. The more loci that match, the higher the probability that the DNA evidence belongs to the suspect. Investigators do not say that a sample matches or does not match a suspect. If the DNA matches, then the evidence **includes** the suspect. If it does not match, then it **excludes** the suspect.

Does your evidence include any suspect completely? Explain.

Does your evidence exclude any suspect completely? Explain.

What can you conclude from your evidence?

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Who Done It?

Page 1 of 1

Game Rules

All markers should be placed at Start.

Each lab tech rolls die. Highest roll goes first and play continues clockwise.

The board has spaces marked with three letters:

- If you land on an E space, pick an evidence card. Lay it face up in front of you.
- If you land on a C space, pick a court order card. Read it out loud and follow the instructions.
- The S space is the only spot you can be on to win the game. It is a freeze space—if you are two spaces away and you roll a 6, you move the two spaces and stop on the S. Once you are on the S, select a suspect card. If you have all of the evidence you need to convict that suspect, you have won the game! If you are missing evidence, return the card to the bottom of the pile. Your turn ends. On your next turn, you may roll and move forward to collect more evidence until you make it back to the S space again.

The game ends when the first player lands on the S space and has all of the evidence needed to convict.