STEM Innovation Academy Unit Plan

Subject: NJIT FRSC 201- Introduction to Forensic Science **Unit Title:** Unit 4- Fingerprints and Documents **Grade:** 12th	**Teacher:** Ms. Dy-Anni Austin **Duration:** 9-80 min blocks (3 Weeks)

Unit Summary

Students will be able to transfer their understanding of dactylography so that on their own, they will be able to cite evidence of how to identify and analyze the three general fingerprint patterns, and assess the minutiae found in fingerprints in order to prove a positive match. This unit is also designed to address the fundamental aspects of document examination as it applies to forensic science. Students will explore handwriting analysis as well as some guidelines for collecting known writings for comparison to a questioned document. Students will also discuss some of the class and individual characteristics of printers, photocopiers, inks. Students will use document examination techniques to uncover alterations, erasures, obliterations, and variations in pen inks. Students will familiarize themselves with US currency security features and identify counterfeit currency.

Stage 1 – Desired Results

Enduring Understanding *Students will understand that…*	**Essential Questions**
• Explain the history and development of fingerprints as identifying features for civil and law enforcement agencies. • Fingerprints are unique to individuals and can be used as evidence in arguing which individuals were present at a crime scene • Handwriting becomes personalized almost as soon as students begin learning it. • Questioned documents and other collected documents can be analyzed for handwriting comparisons to determine if the author of each is the same. • Inks (printer, pen, and photocopier) can be compared to determine if they share a common source. • Questioned documents may be analyzed for alterations, obliterations, erasures, or variations in pen inks.	• How can the various methods for processing,classifying, and identifying fingerprints aid in a criminal investigation? • How can fingerprints identify a criminal with absolute certainty? • How can handwriting be used as individual evidence? • How can the forensic scientist detect forgeries or counterfeits? • What are the important guidelines necessary to collection of handwriting examples? • What is a “questioned document” and what is the value of a questioned document in forensic investigation?

Student Learning Objectives

What students should be able to do after instruction.	*Evidence Statements*
Analyze the common ridge characteristics of a fingerprint.	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-LS1-1 HS-LS1-2
Identify and compare the three major fingerprint patterns and their respective subclasses.	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-LS1-1 HS-LS1-2
Distinguish between visible, plastic and latent fingerprints	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-LS1-1 HS-LS1-2
Describe the concept of an automated fingerprint identification system (AFIS) and its importance to forensic investigation.	HS-ETS1-1 HS-ETS1-2

	HS-ETS1-3 HS-LS1-1 HS-LS1-2
List and demonstrate the techniques for developing latent fingerprints on porous and nonporous objects.	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-LS1-1 HS-LS1-2
Describe and demonstrate the proper procedures for preserving a developed latent fingerprint	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-LS1-1 HS-LS1-2
Define questioned document, explain some of the techniques document examiners use to uncover alterations, erasures, obliterations, and variations in pen inks	HS-LS1-2 HS-LS1-3 HS-LS1-5 HS-LS1-6
Identify what common characteristics are associated with handwriting and list important guidelines for collecting known writings for comparison to a questioned document.	HS-LS1-2 HS-LS1-3 HS-LS1-5 HS-LS1-6
Describe Anti-counterfeiting features on US currency	HS-LS1-2 HS-LS1-3 HS-LS1-5 HS-LS1-6

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

Planning and Carrying Out Investigations:
 	
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)
 	
Constructing Explanations and Designing Solutions:
 	
Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world
	• LS1: From Molecules to Organisms: Structures and Processes
	• LS3: Heredity: Inheritance and Variation of Traits
	• Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both
		• Patterns
		  ○ Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
		• Cause and effect
		  ○ Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
		• Structure and function
		  ○ Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and

operate today as they did in the past and will continue to do so in the future. (HS-LS1-1) Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1 6),(HS-LS2-3) **Using Mathematics and Computational Thinking** Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4) **Engaging in Argument from Evidence** Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8) **Analyzing and Interpreting Data:** Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3) **Obtaining, Evaluating, and Communicating Information:** Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1)	genetic and environmental factors. (HS-LS3-2, HS-LS3-3)	connections of components to reveal its function and/or solve a problem. **Connections to Nature of Science** Science is a human endeavor ● Technological advances have influenced the progress of science and science has influenced advances in technology. ● Science and engineering are influenced by society and society is influenced by science and engineering.

Stage 2 – Assessment Evidence

What activities truly support this as an honors level class? Use the last three stages of Bloom's Taxonomy to address this section including 4-<u>analyze</u>- drawing connections among ideas, 5- <u>evaluate</u>- justify a stance or decision, 6- <u>create</u>- produce original work.

Performance Task 1: **General Fingerprinting** ***(approximately 1-80 min block)***

Materials

- Several sheets of blank paper
- Fingerprinting pad (if available) or ink pad
- Magnifying glass

Procedure

Fingerprinting is perhaps the oldest method of scientific forensic identification. No two sets of same fingerprints are the same, yet they all exhibit characteristics that allow investigators to classify them for quicker identification. In this exercise, students should be matched up in teams of three. Each member of the group should roll the fingerprint of the right index finger of another group member onto a piece of paper. The paper should contain a print from every team member. Now, roll a print from each team member onto a separate blank piece of paper. Do NOT write the names of the team members on these papers. When the ink is dry, shuffle the papers and set two aside at random. Using the magnifying glass, each person on the team has 2 minutes to compare the unknown print to the named prints and determine who made it. Answer the following questions individually, then compare notes as a team and see if everyone agreed on the identity of the print.

Follow-Up Questions

1. Who do you believe made the unknown print?

2. What is the general pattern of the print – arch, loop, or whorl?

3. Did everyone in the team agree on the identity of the unknown print?

Latent Prints. Latent fingerprint development always proves to be a fun exercise. The following supplies can be purchased from police equipment suppliers such as Sirchie Fingerprint Laboratories:

- Brushes
- Black and gray latent powder
- Ninhydrin spray
- Black and white hinge lifters
- Transparent tape

Identifying Fingerprints: Superglue Fuming. In this demonstration, students will use the superglue fuming technique to identify questioned fingerprints. Before class, mount a lightbulb (or place a small lamp) in a clean aquarium. Cover the bulb or lamp with an aluminum can cut in half lengthwise. Seal the opening of the aquarium with a piece of wood or stiff cardboard cut to fit. At the beginning of class, distribute a clean glass slide to each student. Be sure to wear gloves when distributing the slides. Have each student label the slide with his or her name and make an impression of his or her right index finger on the slide. Collect the slides; remove the name labels from several of them; re-label them A, B, C, and so on; and place the slides in the aquarium. Now drop a little superglue on the can and turn on the lamp. In about 15 minutes you should see white prints begin to form on the slides.

While the slides are fuming, make a fingerprint ID sheet for everyone in the class. To do so, have the students pair up in teams of two. Have one member of each pair turn a pencil sideways and rub a thick spot of graphite onto a piece of clear paper. The student should then roll his or her right index finger firmly from left to right in the graphite. Have the other member of the pair then place a piece of clear tape over the finger, gently remove the tape, and stick it to another clean sheet of paper. Label the print with the name of the student. Now each member of the pair reverses roles, so that you have a record of all of the students' fingerprints.

After the prints on the slides appear, remove the slides from the aquarium and allow students to examine them. Have them compare the prints on the slides to the class fingerprint record and ask them to identify the "suspect" prints on the slides. Also have students indicate whether each of the suspect prints is a loop, whorl, or arch pattern. After identifying the suspect prints, have students classify each of the fingerprints on the student record as either a loop, whorl, or arch, then calculate the percentage of each in the sample. Referring to the text, ask students how the percentages in the student sample compare with the population at large.

DIFFERENTIATION: To accurately measure three-dimensional learning of the NGSS along with the CCSS for mathematics, modifications and/ or accommodations should be provided during instruction and assessment.

TECHNOLOGY: Chromebooks and internet. Padlet.

Performance Task 2**: **Handwriting Comparison (approximately 3- 80 min blocks)

Materials:

- Piece of paper with exemplar signature (prepared by instructor)
- Notebook paper
- Scissors
- Tape

Procedure:

Handwriting comparison is a basic tool in the arsenal of investigators looking into cases involving possible forgery. In this exercise, divide into teams of three or four. Each team member will sign his or her name on the same piece of paper. Your instructor will then give each student a piece of paper containing a signature. Working alone for 2 minutes, each student will attempt to copy the signature on a blank piece of paper. When the time has expired, use the scissors to cut your finished "forgery" from the piece of paper and fold it so no one can see it. One member of each team will collect the scraps of paper containing the team's "forgeries," mix them, then unfold and tape each to the piece of paper containing the team members' signatures. Mark the forgeries with a letter (A, B, C, etc.) to identify each. Each member now has 3 minutes to compare the signatures to the "forgeries" and determine which team member created each "forgery." Write your answers on a separate piece of paper. When all members have finished, each team member reveals which forgery he or she created. Check your answers to see how many you guessed correctly.

Questions

1. What activity is critical to the outcome of document examination, and why is it so important?
2. List three characteristics of handwriting, as well as three characteristics of writing not related to handwriting, that an examiner compares when studying a questioned document.
3. List three factors that can make it difficult for an examiner to determine the author of a questioned writing.

4. Why might a traced signature be more easily detected as a forgery than one that is copied freehand?
5. List three characteristics of exemplars that should be as alike as possible to the questioned document.
6. What individual characteristics are most valuable for proving the identity of a typewriter?
7. What kinds of marks can a document examiner use to identify the machine that produced a photocopy? What information is used to identify the machine that produced a fax copy?
8. What class characteristics can an examiner study to help identify a suspect photocopy machine?
9. What is infrared luminescence? Describe how it can be used to detect alterations or erasures in a document.
10. Describe two methods used to recover writing from charred documents.
11. Describe two methods used to read indented writing.
12. From what substances are most commercial inks made? What technique is used to compare inks? What characteristic provides points of comparison between different inks?

DIFFERENTIATION: To accurately measure three-dimensional learning of the NGSS along with the CCSS for mathematics, modifications and/ or accommodations should be provided during instruction and assessment.

TECHNOLOGY: Chromebooks and internet.

Other Evidence:

Before	During	After
KWL – Students will list what they know and what they want to know about the main topics of this unit. **Brainstorming** – Students will discuss what they know about Scientific Inquiry by breaking down the word and coming up with various meanings. **Quick Writes** – Before each lesson students will be asked to write their thoughts and questions for the day pertaining to the objectives. **Pretest** – Students will be given an assessment to understand their knowledge on the unit before any instruction is given.	**Journals** – Students will complete daily journal reflections and take notes when necessary. **Lab Investigations** – Students will complete one or more lab investigation(s) exploring and utilizing chemistry principles. **Daily Assignments** – Students will be given vocabulary assignments and calculation problems. **Observations** – Students will write down any observations in their journals as witnessed in class or during their labs. **Think-Pair-Share** – Students will work in pairs to discuss vocabulary and reinforce rules as they are introduced. **Quizzes –** Give short quizzes or Exit Cards - to show mastery of concepts needed before moving to the next concept.	**Unit Test** – Students will be given a test after the unit has been completed and Presentations have been given **PowerPoint Project** – Students will create a PowerPoint Presentation (as a group) of this unit. This will include various concepts, experimental data, vocabulary, and applications in the "real world".

Student Self-Assessment and Reflection:

Students will write down their questions and or comments of the day's events. They will write their questions about any topics or problems they may have, and they will discuss them as a class the following day. Students will also write down any observations they experienced during labs and/or lecture presentations into their Journals.

Stage 3 – Learning Plan

Differentiated Instruction (by student readiness):

Tiers 2-3: Students who have scored a 3 or below (approaching expectations) on the ELA and Math NJSLAs

1. Scaffolding
2. Group work
3. Peer tutoring
4. One on one discussions
5. Office hour appointments
6. Laboratory Investigations
7. Group PowerPoint Presentation
8. Unit Test

Tier 1: Students who have scored a 4 or 5 (met or exceeded expectations) on the ELA and Math NJSLAs

1. One on one discussions
2. Office hour appointments
3. Laboratory Investigations
4. Group PowerPoint Presentation
5. Unit Test

Learning Activities

1. The Science Spot http://sciencespot.net/Pages/classforsci.html
2. Fingerprinting labs with common household supplies http://www.hometrainingtools.com/a/forensics-science-newsletter
3. Quiz: Can you spot the matching fingerprints? https://www.newscientist.com/gallery/mg20527522600-guess-the-fingerprints
4. Test your skills- Pattern Identification http://www.azafis.gov/skills.asp
5. How to compare fingerprints- The Basics http://ed.ted.com/on/Aqvqkgjl#review
6. A simplified guide to fingerprint analysis http://www.crime-scene-investigator.net/simplified-guide-to-fingerprint-analysis.html
7. Weighing Fingerprints as Forensic Evidence http://www.cbsnews.com/news/weighing-fingerprints-as-forensic-evidence/
8. Fingerprints Webquesthttp://www.cyberbee.com/whodunnit/fp.html
9. US Secret Service, Know your Money - http://www.secretservice.gov/data/KnowYourMoneyApril08.pdf
10. Handwriting, Typewriting, Shoeprints, Tire Treads, FBI – www.fbi.gov/fsc/backissu/april2001/held.htm
11. Guidelines for Forensic Document Examination, FBI – www.fbi.gov/hq/lab/fsc/backissu/april2000/swdoc1.htm
12. Forgery Finder – www.forgeryfinder.com
13. US Treasury - http://www.newmoney.gov

Vocabulary:

anthropometry, arch, digital imaging, fluoresce, iodine fuming, latent fingerprint, livescan, loop, ninhydrin, physical developer, pixel, plastic print, portrait parle, ridge characteristics, minutia, sublimation, superglue fuming, visible print, whorl, charred document, erasure, exemplar, indented writings, infrared luminescence, natural variations, obliteration, questioned document

Literacy and Math Connections:

English Language Arts/Literacy –
RST.11-12.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.
RST.11-12.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible

Mathematics –

4.5 B. Communication

1. Use communication to organize and clarify their mathematical thinking

2. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others, both orally and in writing.

3. Analyze and evaluate the mathematical thinking and strategies of others.

4.5 C Connections

3. Recognize that mathematics is used in a variety of contexts outside of mathematics.

4. Apply mathematics in practical situations and in other disciplines.

4.5 D Reasoning

4. Rely on reasoning, rather than answer keys, teachers, or peers, to check the correctness of their problem solutions.

5. Make and investigate mathematical conjectures

4.5 E Representations

1. Create and use representations to organize, record, and communicate mathematical ideas as pictorial or symbolic.

Expert/Field Experiences:

NJIT Forensic Science Mock Apartment
David Fisher
University Heights, NJ 07102

Connection to End of Year Project:

Students will participate in a Murder in Miniature Project based on Fransis Glessner Lee's Nutshells.
For this final project, in a team of up to two students, you will design and create a diorama of a crime scene (murder). You will give your diorama a title and brief description along with a detailed crime scene sketch and autopsy report of the victim. You will then give a presentation (from the perspective of a prosecutor) linking all of the evidence to a particular suspect. This three part project will be your 'final exam' grade in this college course. It will count as ONE test grade and TWO authentic assessment grades for the 4th marking period at STEM. This project has three parts: Diorama, Written Portion, and Prosecution Presentation. Murder in Miniature Worksheet with Rubric. This unit provides opportunities for self-organization, group cooperation, and idea sharing, as well as proper research techniques, repeat trails, error analysis, and communication of results through a presentation or model.

Modifications

Special Education/ 504:	English Language Learners:
-Adhere to all modifications and health concerns stated in each IEP. -Give students a MENU option, allowing students to pick assignments from different levels based on difficulty. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - During i-Ready lessons, click on "Español" to hear specific words in Spanish

website (Google Classroom), handouts, definition list with visuals, extended time -Allow students to demonstrate understanding of a problem by drawing the picture of the answer and then explaining the reasoning orally and/or writing , such as Read-Draw-Write -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives -Implement supports for students with disabilities (click here) - Make use of strategies imbedded within lessons -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 17-18)	- Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems - Utilize program translations (if available) for L1/ L2 students - Reword questions in simpler language - Make use of the ELL Mathematical Language Routines (click here for additional information) -Scaffolding instruction for ELL Learners -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 16-17)
Gifted and Talented:	**Students at Risk for Failure:**
- Elevated contextual complexity - Inquiry based or open ended assignments and projects - More time to study concepts with greater depth - Promote the synthesis of concepts and making real world connections - Provide students with enrichment practice that are imbedded in the curriculum such as: ● Application / Conceptual Development ● Are you ready for more? - Provide opportunities for math competitions - Alternative instruction pathways available - Common Core Approach to Differentiate Instruction: Students with Disabilities (pg. 20)	- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum - Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Peer Support - Constant parental/ guardian contact - Provide academic contracts to students & guardians - Create an interactive notebook with samples, key vocabulary words, student goals/ objectives. - Plan to address students at risk in your learning tasks, instructions, and directions. Anticipate where the needs will be, then address them prior to lessons. -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 19)

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.
https://www.state.nj.us/education/cccs/2014/career/9.pdf

● **CRP1**. Act as a responsible and contributing citizen and employee. ● **CRP2**. Apply appropriate academic and technical skills. ● **CRP3**. Attend to personal health and financial well-being. ● **CRP4**. Communicate clearly and effectively and with reason.	● **CRP7**. Employ valid and reliable research strategies. ● **CRP8**. Utilize critical thinking to make sense of problems and persevere in solving them. ● **CRP9**. Model integrity, ethical leadership and effective management. ● **CRP10**. Plan education and career paths aligned to personal goals.

• **CRP5**. Consider the environmental, social and economic impacts of decisions. • **CRP6**. Demonstrate creativity and innovation.	• **CRP11**. Use technology to enhance productivity. • **CRP12**. Work productively in teams while using cultural global competence.
Students are given an opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are encouraged to reason through experiences that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, calculators, and educational websites.	

Technology Standards:

udents will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas.

https://www.state.nj.us/education/cccs/2014/tech/

8.1 Educational Technology:

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. **Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations.
B. **Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
C. **Communication and Collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
D. **Digital Citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
E. **Research and Information Fluency:** Students apply digital tools to gather, evaluate, and use of information.
F. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:

All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. **The Nature of Technology: Creativity and Innovation-** Technology systems impact every aspect of the world in which we live.
B. **Technology and Society:** Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society.
C. **Design:** The design process is a systematic approach to solving problems.
D. **Abilities in a Technological World:** The designed world in a product of a design process that provides the means to convert resources into products and systems.
E. **Computational Thinking: Programming-** Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.