

### STEM Innovation Academy Unit Plan

<b>Subject:</b> NJIT FRSC 201- Introduction to Forensic Science	<b>Teacher:</b> Ms. Dy-Anni Austin
<b>Unit Title:</b> Unit 8- Blood, DNA, Spatter (Forensic Serology, DNA)	<b>Duration:</b> 6-80 min blocks (2 Weeks)
<b>Grade:</b> 12 <sup>th</sup>	15 days

#### Unit Summary

Blood is among the most common forms of evidence found at scenes of violent and brutal crimes. All suspected blood—liquid or dried, animal or human—present suggests a relationship to the offense or persons involved in a crime. Blood may be found in trace amounts, puddles, spatters, smears, or droplets. Blood samples may be collected from suspects and victims for examination and comparison. Blood evidence can help narrow a group of suspects, support identification of a suspect, and even guide the reconstruction of a crime.

This unit is also designed to allow students the opportunity to investigate how DNA has become an “indispensable forensic science tool.” Students will understand basic concepts of DNA including its structure, function, and uniqueness to each individual. Students will compare and model various types of DNA typing. Students will also explore several case studies involving DNA evidence and cite the importance of properly handling and preserving physical evidence (especially DNA evidence) in forensic investigations. Students will discuss how mishandling of DNA evidence can severely diminish its value in the courtroom. Students will discuss DNA databases and their use in solving crimes, new and old. In this unit, students will compare case studies in which the limitations of DNA evidence are discussed.

#### Stage 1 – Desired Results

Enduring Understanding <i>Students will understand that...</i>	Essential Questions
<ul style="list-style-type: none"> <li>Serology involves a broad scope of laboratory tests that use specific antigen and serum antibody reactions.</li> <li>Blood type is an inherited trait that is a permanent feature of a person’s biological makeup.</li> <li>Blood may link criminal to crime.</li> <li>Individual blood stains can convey the directionality and of impact of the blood when it struck a surface.</li> <li>Crime scene reconstruction helps to sort out the events surrounding the occurrence of a crime.</li> <li>Apply the principles of DNA as a means to identify one person with a reasonable certainty.</li> <li>Describe the differences in nuclear DNA, mitochondrial DNA</li> <li>DNA evidence is highly important as, upon proper handling, it can directly link an individual to a crime scene.</li> <li>Understand the significance of the development of DNA technology to forensic science and will be able to compare segments of DNA and describe the use of DNA profiling in the CODIS database</li> </ul>	<ul style="list-style-type: none"> <li>How is blood analyzed by forensic investigators?</li> <li>How can information be inferred based on blood spatter patterns?</li> <li>How can crime scene reconstruction assist forensic scientists in solving crimes?</li> <li>How is DNA and how is unique to each individual?</li> <li>What is the significance or value of DNA evidence to forensic investigation?</li> <li>How has DNA profiling contributed to the development of the field of forensic science?</li> <li>What DNA technologies have been developed that can be used to isolate and identify evidence.</li> </ul>

#### Student Learning Objectives

<i>What students should be able to do after instruction.</i>	<i>Evidence Statements</i>
Explain the composition of blood	HS-LS1-1 HS-LS1-2 HS-LS3-2
Describe the function of blood cells	HS-LS1-1 HS-LS1-2 HS-LS3-2

Describe the history of the use of blood and blood-spatter analysis in forensic science	HS-LS1-1 HS-LS1-2 HS-LS3-2
Describe how to determine blood type, given a sample	HS-LS1-1 HS-LS1-2 HS-LS3-2
Describe how to screen for the presence of human blood	HS-LS1-1 HS-LS1-2 HS-LS3-2
Calculate the probability of certain blood types with in a population	HS-LS1-1 HS-LS1-2 HS-LS3-2
Conduct a blood spatter analysis	HS-LS1-1 HS-LS1-2 HS-LS3-2
Use blood spatter evidence to recreate the events of a crime scene	HS-LS1-1 HS-LS1-2 HS-LS3-2
Identify the parts of a nucleotide and explain how nucleotides are linked to form DNA and explain the concept of base pairing as it relates to the double-helix structure of DNA.	HS-LS1-1 HS-LS3-1 HS-LS3-2 HS-LS3-3
Describe how the newest DNA typing techniques, like short tandem repeats (STRs) and polymerase chain reaction (PCR) are applied to forensic DNA typing and how CODIS is used to compare DNA samples	HS-LS1-1 HS-LS3-1 HS-LS3-2 HS-LS3-3
Describe the difference between nuclear and mitochondrial DNA.	HS-LS1-1
List the necessary procedures for proper preservation of biological evidence for laboratory DNA analysis.	HS-LS3-1

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
<p><b>Planning and Carrying Out Investigations:</b></p> <p>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)</p> <p><b>Constructing Explanations and Designing Solutions:</b></p> <p>Construct an explanation based on valid and reliable evidence obtained from a variety of</p>	<ul style="list-style-type: none"> <li>LS1: From Molecules to Organisms: Structures and Processes</li> <li>LS3: Heredity: Inheritance and Variation of Traits</li> </ul>	<ul style="list-style-type: none"> <li>Patterns <ul style="list-style-type: none"> <li>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.</li> </ul> </li> <li>Cause and effect <ul style="list-style-type: none"> <li>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</li> </ul> </li> <li>Structure and function <ul style="list-style-type: none"> <li>Investigating or designing new systems or structures</li> </ul> </li> </ul>

<p>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-LS1-1)</p> <p>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)</p> <p><b>Using Mathematics and Computational Thinking</b> Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)</p> <p><b>Engaging in Argument from Evidence</b> Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)</p> <p>Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)</p> <p><b>Analyzing and Interpreting Data:</b> 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)</p> <p><b>Obtaining, Evaluating, and Communicating Information:</b></p> <p>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)</p>		<p>requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</p> <p><b>Connections to Nature of Science</b></p> <ul style="list-style-type: none"> <li>• Science is a human endeavor</li> <li>• Technological advances have influenced the progress of science and science has influenced advances in technology.</li> <li>• Science and engineering are influenced by society and society is influenced by science and engineering.</li> </ul>
---	--	--

Stage 2 – Assessment Evidence		
<b>Concept</b> <ol style="list-style-type: none"><li>1. How is blood analyzed by forensic investigators?</li><li>2. How can information be inferred based on blood spatter patterns? How can crime scene reconstruction assist forensic scientists in solving crimes?</li><li>3. Collect, develop, analyze and identify DNA fingerprints</li><li>4. Compare and contrast the uses of mtDNA and nuclear DNA?</li><li>5. Using CODIS markers to identify suspects</li></ol>	<b>Formative Assessment- Students who understand the concepts are able to:</b> <ol style="list-style-type: none"><li>1. List the ABO antigens and antibodies found in the blood for each of the four blood types; Perform blood typing test (simulated) to recognize agglutination; Explain why agglutination occurs; Demonstrate how blood types are inherited</li><li>2. Identify forces of cohesion, adhesion, surface tension, gravity, directional propulsion as affecting patterns of spatter; Use measurements of blood drops on surfaces to calculate velocity, location of origin, and direction; Describe how the angle, shape and size blood stains occurred from the victim may help determine the impact, weapon, and distance of the crime; Describe viscosity and how it will affect the shape the blood takes on impact of a surface.</li><li>3. Run DNA samples using gel electrophoresis and describe if any samples match; Describe the biotech methods used to process, isolate and compare DNA samples.</li><li>4. Describe the difference between theses 2 types of DNA; Explain when and why each type can and should be used</li><li>5. Describe how STRs are used in CODIS, Identify matches and non matches using CODIS reports</li></ol>	
Other Evidence:		
<b>Before</b> <p><b>KWL</b> – Students will list what they know and what they want to know about the main topics of this unit.</p> <p><b>Brainstorming</b> – Students will discuss what they know about Scientific Inquiry by breaking down the word and coming up with various meanings.</p> <p><b>Quick Writes</b> – Before each lesson students will be asked to write their thoughts and questions for the day pertaining to the objectives.</p>	<b>During</b> <p><b>Journals</b> – Students will complete daily journal reflections and take notes when necessary.</p> <p><b>Lab Investigations</b> – Students will complete one or more lab investigation(s) exploring and utilizing chemistry principles.</p> <p><b>Daily Assignments</b> – Students will be given vocabulary assignments and calculation problems.</p> <p><b>Observations</b> – Students will write down any observations in their journals as witnessed in class or during their labs.</p>	<b>After</b> <p><b>Unit Test</b> – Students will be given a test after the unit has been completed and Presentations have been given</p> <p><b>PowerPoint Project</b> – 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”.</p>

<p><b>Pretest</b> – Students will be given an assessment to understand their knowledge on the unit before any instruction is given.</p>	<p><b>Think-Pair-Share</b> – Students will work in pairs to discuss vocabulary and reinforce rules as they are introduced.</p> <p><b>Quizzes</b> – Give short quizzes or Exit Cards - to show mastery of concepts needed before moving to the next concept.</p>	
<p><b>Student Self-Assessment and Reflection:</b></p> <p>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.</p>		
<p style="text-align: center;"><b>Stage 3 – Learning Plan</b></p>		
<p><b>Differentiated Instruction (by student readiness):</b></p> <p><b>Tiers 2-3:</b> Students who have scored a 3 or below (approaching expectations) on the ELA and Math NJSLAs</p> <ol style="list-style-type: none"> <li>1. Scaffolding</li> <li>2. Group work</li> <li>3. Peer tutoring</li> <li>4. One on one discussions</li> <li>5. Office hour appointments</li> <li>6. Laboratory Investigations</li> <li>7. Group PowerPoint Presentation</li> <li>8. Unit Test</li> </ol> <p><b>Tier 1:</b> Students who have scored a 4 or 5 (met or exceeded expectations) on the ELA and Math NJSLAs</p> <ol style="list-style-type: none"> <li>1. One on one discussions</li> <li>2. Office hour appointments</li> <li>3. Laboratory Investigations</li> <li>4. Group PowerPoint Presentation</li> <li>5. Unit Test</li> </ol>		
<p><b>Learning Activities</b></p> <ol style="list-style-type: none"> <li>1. The Science Spot <a href="http://sciencespot.net/Pages/classforsci.html">http://sciencespot.net/Pages/classforsci.html</a></li> <li>2. Blood Spatter Analysis <a href="http://www.bloodspatter.com/bloodstain-tutorial">http://www.bloodspatter.com/bloodstain-tutorial</a></li> <li>3. Blood Typing Lab <a href="http://www.mlbgd.k12.pa.us/cms/lib/PA09000085/Centricity/Domain/83/bloodtypinglab2wkst.pdf">http://www.mlbgd.k12.pa.us/cms/lib/PA09000085/Centricity/Domain/83/bloodtypinglab2wkst.pdf</a></li> <li>4. Science Channel Blood Spatter Video <a href="http://www.sciencechannel.com/tv-shows/science-channel-presents/videos/discoveries-this-week-blood-splatter/">http://www.sciencechannel.com/tv-shows/science-channel-presents/videos/discoveries-this-week-blood-splatter/</a></li> <li>5. Blood Typing Game <a href="http://www.nobelprize.org/educational/medicine/bloodtypinggame/game/index.html">http://www.nobelprize.org/educational/medicine/bloodtypinggame/game/index.html</a></li> <li>6. The Sam Shepard Case Study <a href="http://law2.umkc.edu/faculty/projects/ftrials/sheppard/samsheppardtrial.html">http://law2.umkc.edu/faculty/projects/ftrials/sheppard/samsheppardtrial.html</a></li> <li>7. The Science Spot <a href="http://sciencespot.net/Pages/classforsci.html">http://sciencespot.net/Pages/classforsci.html</a></li> <li>8. FBI Fact Sheet CODIS, <a href="http://www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-ndis-fact-sheet">www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-ndis-fact-sheet</a></li> <li>9. National Institute of Justice – <a href="http://www.nij.gov/journals/266/pages/backlogs-codis.aspx">www.nij.gov/journals/266/pages/backlogs-codis.aspx</a></li> <li>10. National Institute of Justice - <a href="http://nij.gov/topics/forensics/evidence/dna/basics/pages/analyzing.aspx">http://nij.gov/topics/forensics/evidence/dna/basics/pages/analyzing.aspx</a></li> <li>11. The Forensic Library - <a href="http://aboutforensics.co.uk/dna-analysis/">http://aboutforensics.co.uk/dna-analysis/</a></li> <li>12. DNA Evidence, How it’s Done - <a href="http://www.forensicsciencesimplified.org/dna/how.html">http://www.forensicsciencesimplified.org/dna/how.html</a></li> </ol>		
<p><b>Vocabulary:</b></p> <p><b>Allele</b> - The characteristics of a single copy of a specific gene, or of a single copy of a specific location on a chromosome.</p> <p><b>Autosomal DNA</b> - DNA found in chromosomes which are not sex chromosomes.</p>		

**Chromosome** - The biological structure by which hereditary information is physically transmitted from one generation to the next; located in the cell nucleus, it consists of a tightly coiled thread of DNA with associated proteins and RNA; the genes are arranged in linear order along the DNA.

**Combined DNA Index System (CODIS)** - The generic term used to describe the FBI's program of support for criminal justice DNA databases as well as the software used to run National DNA Index System (NDIS) databases; CODIS is made up of the National DNA Index System (NDIS), the State DNA Index System (SDIS) and Local DNA Index Systems (LDIS).

**DNA (Deoxyribonucleic acid)** - Often referred to as the "blueprint of life;" genetic material present in the nucleus of cells which is inherited from each biological parent that determines each person's individual characteristics. An individual's DNA is unique except in cases of identical twins.

**DNA Profiling** - The result of determining the relative positions of DNA sequences at several locations on the molecule; each person (except identical twins) has a unique DNA profile when used in the context of the CODIS database, which evaluates 13 specific DNA locations.

**DNA Fingerprinting** - Analyses of the lengths of the fragments reveal that when looking at multiple VNTRs (variable number of tandem repeats) within and between individuals, no two people have the same assortment of lengths, except identical twins; this technique became known to the public as "DNA fingerprinting" because of its powerful ability to discriminate between unrelated individuals.

**Epithelial cells** - Cells that cover the inner and outer linings of body cavities.

**Forensic DNA Analysis** - The process of identifying and evaluating biological evidence in criminal matters using DNA technologies.

**Genotype** - The genetic constitution of an organism, as distinguished from its physical appearance (its phenotype); the designation of two alleles at a particular locus is a genotype.

**Locus** - The specific physical location of a gene on a chromosome; the plural form is loci.

**Low Copy Number Analysis** - The analysis of samples containing a small amount of DNA (approximately 30 cells or less); analysis of samples falling into this category often requires enhanced analysis methods to increase the sensitivity of detection.

**Mitochondrial DNA (mtDNA)** - DNA located in the mitochondria found in each cell of a body; sequencing of mitochondrial DNA can link individuals descended from a common female ancestor.

**National DNA Index System (NDIS)** - Authorized by the DNA Identification Act of 1994, the FBI administers this national index. NDIS enables comparison of DNA profiles associated with a crime scene to DNA profiles collected from known convicted offenders, as well as to other crime scene profiles. DNA profiles uploaded to NDIS are searched against the other DNA profiles submitted by other participating states.

**Nuclear DNA** - DNA located in the nucleus of a cell.

**Partial DNA Profile** - DNA evidence that does not yield identifiable results in all 13 core loci.

**Quality Assurance Standards (QAS)** - Quality assurance methods developed by the Scientific Working Group of DNA Analysis and Methods (SWGDM). QAS provides guidelines to ensure the quality and integrity of data generated by the laboratory and uploaded into the CODIS database(s); published by the FBI.

**Reference Samples** - Material of a verifiable/documented source which, when compared with evidence of an unknown source, shows an association or linkage between an offender, crime scene, and/or victim.

**Short tandem repeat (STR)** - Multiple copies of a short identical DNA sequence arranged in direct succession in particular regions of chromosomes.

**Y-STR** - STR located on the Y chromosome; often examined when investigating sexual assaults involving male suspects.

<https://strbase-archive.nist.gov/training/Glossary-Forensic-DNA-Terms.pdf>

#### **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:
<ul style="list-style-type: none"> <li>-Adhere to all modifications and health concerns stated in each IEP.</li> <li>-Give students a MENU option, allowing students to pick assignments from different levels based on difficulty.</li> <li>-Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time</li> <li>-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</li> <li>-Provide breaks between tasks, use positive reinforcement, use proximity</li> <li>-Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives</li> <li>-Implement supports for students with disabilities (<a href="#">click here</a>)</li> <li>- Make use of strategies imbedded within lessons</li> <li>-Common Core Approach to Differentiate Instruction: Students with Disabilities (<a href="#">pg 17-18</a>)</li> </ul>	<ul style="list-style-type: none"> <li>- Use manipulatives to promote conceptual understanding and enhance vocabulary usage</li> <li>- Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction</li> <li>- During i-Ready lessons, click on "Español" to hear specific words in Spanish</li> <li>- Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information</li> <li>- Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems</li> <li>- Utilize program translations (if available) for L1/ L2 students</li> <li>- Reword questions in simpler language</li> <li>- Make use of the ELL Mathematical Language Routines (click <a href="#">here</a> for additional information)</li> <li>-Scaffolding instruction for ELL Learners</li> <li>-Common Core Approach to Differentiate Instruction: Students with Disabilities (<a href="#">pg 16-17</a>)</li> </ul>
Gifted and Talented:	Students at Risk for Failure:
<ul style="list-style-type: none"> <li>- Elevated contextual complexity</li> <li>- Inquiry based or open ended assignments and projects</li> <li>- More time to study concepts with greater depth</li> <li>- Promote the synthesis of concepts and making real world connections</li> <li>- Provide students with enrichment practice that are imbedded in the curriculum such as: <ul style="list-style-type: none"> <li>● Application / Conceptual Development</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum</li> <li>- Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Peer Support</li> <li>- Constant parental/ guardian contact</li> <li>- Provide academic contracts to students &amp; guardians</li> </ul>



<ul style="list-style-type: none"> <li>• Are you ready for more?</li> <li>- Provide opportunities for math competitions</li> <li>- Alternative instruction pathways available</li> <li>- Common Core Approach to Differentiate Instruction: Students with Disabilities (<a href="#">pg. 20</a>)</li> </ul>	<ul style="list-style-type: none"> <li>- Create an interactive notebook with samples, key vocabulary words, student goals/ objectives.</li> <li>- 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.</li> <li>-Common Core Approach to Differentiate Instruction: Students with Disabilities (<a href="#">pg 19</a>)</li> </ul>
--	---

<b>21st Century Life and Career Skills:</b> 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. <a href="https://www.state.nj.us/education/cccs/2014/career/9.pdf">https://www.state.nj.us/education/cccs/2014/career/9.pdf</a>	
<ul style="list-style-type: none"> <li>• <b>CRP1.</b> Act as a responsible and contributing citizen and employee.</li> <li>• <b>CRP2.</b> Apply appropriate academic and technical skills.</li> <li>• <b>CRP3.</b> Attend to personal health and financial well-being.</li> <li>• <b>CRP4.</b> Communicate clearly and effectively and with reason.</li> <li>• <b>CRP5.</b> Consider the environmental, social and economic impacts of decisions.</li> <li>• <b>CRP6.</b> Demonstrate creativity and innovation.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>CRP7.</b> Employ valid and reliable research strategies.</li> <li>• <b>CRP8.</b> Utilize critical thinking to make sense of problems and persevere in solving them.</li> <li>• <b>CRP9.</b> Model integrity, ethical leadership and effective management.</li> <li>• <b>CRP10.</b> Plan education and career paths aligned to personal goals.</li> <li>• <b>CRP11.</b> Use technology to enhance productivity.</li> <li>• <b>CRP12.</b> Work productively in teams while using cultural global competence.</li> </ul>
<b>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.</b>	

<b>Technology Standards:</b> Students 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. <a href="https://www.state.nj.us/education/cccs/2014/tech/">https://www.state.nj.us/education/cccs/2014/tech/</a>	
<b>8.1 Educational Technology:</b>  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.  <b>A. Technology Operations and Concepts:</b> Students demonstrate a sound understanding of technology concepts, systems and operations. <b>B. Creativity and Innovation:</b> Students demonstrate	<b>8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:</b>  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.  <b>A. The Nature of Technology: Creativity and Innovation-</b> Technology systems impact every

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.

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.