

## Theme

*How can we find, evaluate, and use a variety of sources of evidence to construct explanations?*

### STEM Innovation Academy Unit 1 Plan

Subject: Principles of Biomedical Science Unit Title: Medical Investigation Grade: 9	Teacher: Macri Duration: 9 weeks
<b>Summary of Unit</b> <p>Unit 1 sets the stage for the theme of the Principles of Biomedical Science™ course and is meant to introduce students to the world of biomedical and forensic science. Students will be introduced to a college student, Anna Garcia, who is found dead in a lab on campus. In the first lesson (10-11 blocks), students will investigate the scene, gather evidence, and then move to the lab to analyze their findings in order to determine her manner of death. Evidence investigated will include witness testimony, hair, fingerprints, and blood found at the scene, and digital evidence. Students will also analyze the DNA found at the scene to definitively identify persons of interests through the use of extraction, restriction enzyme digestion, and gel electrophoresis. This lesson will culminate in students creating a status report regarding their initial findings and explanations for what happened to Anna Garcia. In the second lesson (8-9 blocks) students will be taken through the steps of performing an autopsy to learn more information about the death of Anna Garcia. They will learn how to measure time of death using markers such as algor mortis, rigor mortis, and livor mortis. They will also explore the digestive, nervous, and circulatory systems in more depth through various investigations, including analyzing the contents of Anna's stomach, reviewing brain scans, and dissecting a heart. By the end of this lesson, students will have a finalized autopsy report and can use that in conjunction with what they learned in the first lesson to create a forensic report detailing the events surrounding the death of Anna Garcia. Students will put together all of the evidence collected and analyzed regarding Anna's mysterious death throughout the unit in order to draw conclusions and create a report detailing the suspected manner of death. In the third lesson (2-3 blocks) students will investigate use the knowledge and procedures they have learned throughout the unit to analyze a second mysterious death. They will work through each step of the forensic and medical examination and present their findings as an evidence board.</p>	
<b>Stage 1 – Desired Results</b>	
<p>Standards and Outcomes National Standards covered in each lesson included in the following link: <a href="https://drive.google.com/file/d/1hUgD4cfwwrXH3YIKGdX-amU4qy0ZqNB/view?usp=sharing">https://drive.google.com/file/d/1hUgD4cfwwrXH3YIKGdX-amU4qy0ZqNB/view?usp=sharing</a></p> <p><b>Science and Engineering Practices</b> Asking questions and defining problems Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations and designing solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information</p> <p><b>Crosscutting Concepts</b> Patterns</p>	

Cause and Effect  
Scale, Proportion, and Quantity  
Systems and System Models  
Structure and Function  
Stability and Change

### **New Jersey Student Learning Standards – Science**

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.  
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.  
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

### **Disciplinary Core Ideas – Life Science**

LS1A: Structure and Function  
LS3B: Variation of Traits

### **Progress Indicators for Reading Science and Technical Subjects**

RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  
RST.9-10.4. 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 9-10 texts and topics.  
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.  
RST.9-10.8. Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

### **Progress Indicators for Writing History, Science and Technical Subjects**

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.  
WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  
WHST.9-10.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  
WHST.9-10.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.  
WHST.9-10.6. Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.  
WHST.9-10.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

**Progress Indicators for Speaking and Listening**

SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

SL.9-10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.

SL.9-10.4. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

SL.9-10.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.

**Progress Indicators for Language**

L.9-10.4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.

L.9-10.6. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**Technology Standards**

8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.

8.1.12.A.3 Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.

8.1.12.E.1 Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

**Career Ready Practices**

CRP1. Act as a responsible and contributing citizen and employee.

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

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.

CRP11. Use technology to enhance productivity.

CRP12. Work productively in teams while using cultural global competence

**Career and Technical Education Standards**

9.3.HL.2 Explain the healthcare workers' role within their department, their organization and the overall healthcare system.

9.3.HL.4 Evaluate the roles and responsibilities of individual members as part of the healthcare team and explain their role in promoting the delivery of quality health care.

9.3.HL.5 Analyze the legal and ethical responsibilities, limitations and implications of actions within the healthcare workplace.

9.3.HL-DIA.1 Communicate key diagnostic information to healthcare workers and patients in an accurate and timely manner.

9.3.HL-DIA.5 Select, demonstrate and interpret diagnostic procedures.

9.3.HL-THR.2 Communicate patient/client information among healthcare team members to facilitate a team approach to patient care.

9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.

9.3.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.

9.3.ST-ET.2 Display and communicate STEM information.

9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

9.3.ST-ET.6 Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

9.3.ST-SM.1 Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

### **Essential Questions:**

#### Unit 1 lesson 1

1. What are different forms of evidence, how infallible are they, and how are they useful in resolving potential criminal cases?
2. How can varying forms of evidence be evaluated for meaning?
3. How does technology help bring resolution to forensic cases? Or how does technology advance the understandings in forensic science?

#### Unit 1 lesson 2

1. How can the cause, mechanism, and manner of death be established?
2. What information can be collected from an autopsy?
3. How can information collected during an autopsy lead to an understanding of disease and/or cause of death?
4. In what ways are the careful evaluation of evidence and accurate recording of data critical to establishing legitimate testimony?

#### Unit 1 lesson 3

1. How can individual pieces of evidence, evaluated against the whole, be used to resolve questions?
2. In what ways can scientific writings and presentations be utilized to present evidence and justify conclusions?
3. To what extent can current understandings be reinforced through practice?

### **Stage 2 – Assessment Evidence**

#### **Unit Pre-Assessment:**

1. Start-of-year Diagnostic Assessment: Students will be given a 20 question assessment to evaluate prior knowledge and information retained from previous years.
2. Modeling Activity: Students will create a concept map outlining what they believe happens in a forensic/medical examination to assess prior knowledge and preconceptions.

#### **Performance Task(s):**

\*Investigative Notes: At the crime scene, students compile a living document they revisit and maintain throughout Unit 1. The investigative notes should include clues from the witness report, crime scene

evidence including a scaled drawing, theories which are subject to revision, person of interest documents, models, diagrams, and charts, as well as laboratory results from all laboratory activities.

**\*Career Journal Entries:** At various points throughout the unit, students research and report on professionals involved in the case of Anna Garcia (EMT, blood spatter analyst, crime scene investigator etc.) They must find reliable APA cited sources, document the training required/ daily responsibilities, and write a reflection on their personal interest in the career and why.

*Differentiation of Content:* Students will be able to select to research relevant careers that are of interest to them.

### **Lesson 1.1: Investigating the Scene**

**\*Blood Spatter Analysis Lab Report:** Students design their own controlled experiment, write their own procedure, collect data, and write a conclusion to determine what height the blood droplets at the crime scene fell from.

*Differentiation of Process:* Students will be allowed to receive feedback on their reports prior to submission.

*Differentiation of Product:* Students can handwrite or type their lab reports.

*Differentiation of Content:* Tier I students will be asked to consider how sources of error and research limitations affect their data.

**\*DNA Structure:** Students assemble 3 Dimensional DNA structures using a magnetic kit. From their experiences and from the data available to Watson and Crick, students derive the bonding rules that dictate DNA structure

*Differentiation of Process:* Students will receive tiered instructions with varying levels of support.

*Differentiation of Content:* Tier I students can use their models to predict how DNA might be replicated and what would happen if a mistake was made.

**\* Gel Electrophoresis Simulation:** Students receive DNA sequences for each suspect and Anna Garcia. They cut the sequences into fragments following RFLP protocol and place them in the appropriate lane/ base pair length on a poster which represents an agarose gel. From their findings, they determine who was present at the crime scene and add the data to their investigative notes

*Differentiation of Process:* Students will be allowed to receive feedback on their reports prior to submission.

*Differentiation of Product:* Students can handwrite or type their lab reports.

*Differentiation of Content:* Tier I students will be asked to consider how sources of error and research limitations affect their data.

**\*Status Report:** Students create a video summarizing the information they have gathered so far, including information about the decedent, the scene, persons of interest, and analysis of evidence collected. They will draw initial conclusions as to what what happened to Anna and describe next steps needed to answer questions that still remain.

*Differentiation of Product:* Students can select which form they would like to use to visually represent their information (eg. poster, slideshow, video, virtual model, etc.)

*Differentiation of Process:* Tier II or III students will receive a more in-depth checklist of tasks with the option of adding conferences with the teacher as needed.

### **Lesson 1.2: Master the Morgue**

\*Time of Death lab: Students identify a hypothesis, independent/ dependent variables based on a procedure which is provided. They carry out the investigation and apply Galister's equation to their data in order to determine what time Anna Garcia died.

*Differentiation of Process:* Students will be allowed to receive feedback on their reports prior to submission.

*Differentiation of Product:* Students can handwrite or type their lab reports.

*Differentiation of Content:* Tier I students will be asked to consider how sources of error and research limitations affect their data.

\*Identify the Pill Lab: Students will use a series of lab tests to determine the the identity of a pill found in Anna Garcia's stomach. They will submit a lab report, including hypothesis, data, analysis, and conclusions.

*Differentiation of Process:* Students will be allowed to receive feedback on their reports prior to submission.

*Differentiation of Product:* Students can handwrite or type their lab reports.

*Differentiation of Content:* Tier I students will be asked to consider how sources of error and research limitations affect their data.

\*Heart Dissection Model: Students will perform an external and internal examination of a sheep heart, labeling the anatomical structures as they work. They will also diagram a model on paper showing the parts of the heart and the ways in which they are connected.

*Differentiation of Product:* Students can select which materials they would like to use to create their models.

\*Anna Garcia Autopsy Report: Students will fill in an autopsy report for Anna Garcia as they work through Lesson 2. The report will include information about the decedent, diagrams/summaries of an internal and external examination, lab results, and a summary of the case as well as any conclusions that can be drawn.

*Differentiation of Process:* Tier II and III students can receive chunked versions with added check-ins, fill-in-the-blanks, and guiding questions as needed.

\*Case Closed Final Report: Students will complete a final written forensics report detailing a summary of the Anna Garcia case, the evidence analyzed, the autopsy findings, a timeline of events, and any conclusions and recommendations that could be made with justification.

*Differentiation of Product:* Students can select which form they would like to use to visually represent their information (eg. poster, slideshow, video, virtual model, etc.)

*Differentiation of Process:* Tier II or III students will receive a more in-depth checklist of tasks with the option of adding conferences with the teacher as needed.

### **Lesson 1.3: Crack the Case**

\*Crack the Case Evidence Board: Students will analyze a second mysterious death and will visually represent all of their findings from the case on an evidence board. Connections between evidence are represented with yarn. Evidence boards are presented with theories based on the evidence. The formal case report includes an investigative plan, a case overview, a timeline of death, a summary of the scene, a summary of the evidence analyzed, conclusions regarding the case, and recommendations for next steps.

*Differentiation of Product:* Students can select which form they would like to use to visually represent their information (eg. poster, slideshow, video, virtual model, etc.)

*Differentiation of Process:* Tier II or III students will receive a more in-depth checklist of tasks with the option of adding conferences with the teacher as needed.

Authentic Experiences:

\*Virtual autopsy

\*Laboratory activities: Identifying an unknown substance, blood spatter analysis, determining time of death, DNA extraction

\*Virtual heart dissection

\*Analysis of histological imaging and gross examination for evidence of pathology: MRI scans, microscope slides, dissection

Extensions (Tier I):

- Optional clotting factor blood wet lab
- Experimental critique extended with more complex examples
- Analysis of sources of error and limitations of investigations (Blood Spatter Lab, Gel Electrophoresis Simulation, Time of Death Lab, Identify the Pill Lab)
- Research conditions that might show up as a negative autopsy

Differentiation (Tiers 2 and 3)

- Group work
- Feedback on pre-labs prior to start of labs (Blood Spatter Lab, Gel Electrophoresis Simulation, Time of Death Lab Identify the Pill Lab)
- Chunked assignment with embedded checkpoints (can be applied to any assignment as needed by student)
- Checklists with added conferences with teacher (Status Report, Case Closed Final Report, Crack the Case Evidence Board)
- Student choice in selecting how the form in which they would like to present their final products (Status Report, Case Closed Final Report, Crack the Case Evidence Board)

**Stage 3 – Learning Plan**

Principles of Biomedical Science: Unit 1 Digital Access (Password Required):

<https://pltw.read.inkling.com/a/b/ce82cc7c43544b399db84bd4cc6cd498/p/34abdd33ddce4bc1bb4cf47f26c78a70>

*Vocabulary*

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|--|--|---|
| <ul style="list-style-type: none"><li>• Forensic Scientist</li><li>• Heart Rate</li><li>• Vital Signs</li><li>• Pulse</li><li>• Respiratory Rate</li><li>• Control</li><li>• Experiment</li><li>• Hypothesis</li><li>• Experimental Design</li><li>• Iterative</li><li>• Independent Variable</li><li>• Dependent Variable</li><li>• Trace Evidence</li><li>• Forensic Science</li><li>• Erythrocyte</li></ul> | <ul style="list-style-type: none"><li>• Helix</li><li>• Adenine</li><li>• Thymine</li><li>• Guanine</li><li>• Cytosine</li><li>• Genetics</li><li>• Gene</li><li>• Genome</li><li>• Cell</li><li>• Organelle</li><li>• Eukaryotic cell</li><li>• Prokaryotic cell</li><li>• Chromosome</li><li>• Histone</li><li>• Precipitate</li></ul> | <ul style="list-style-type: none"><li>• Digestive system</li><li>• Nutrient</li><li>• Molecule</li><li>• Chemical Reaction</li><li>• Metabolism</li><li>• Forensic Chemistry</li><li>• Histology</li><li>• Tissue</li><li>• Organ</li><li>• Magnetic Resonance Imaging (MRI)</li><li>• Traumatic brain injury</li><li>• Chronic traumatic encephalopathy</li><li>• Concussion</li></ul> |
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<ul style="list-style-type: none"> <li>• Leukocyte</li> <li>• Thrombocyte</li> <li>• Plasma</li> <li>• Hemoglobin</li> <li>• Antigen</li> <li>• Positive Control</li> <li>• Negative Control</li> <li>• ABO System</li> <li>• Antibody</li> <li>• Agglutination</li> <li>• DNA</li> <li>• Protein</li> <li>• Nucleotide</li> </ul>	<ul style="list-style-type: none"> <li>• Polymerase Chain Reaction</li> <li>• Restriction Endonuclease</li> <li>• Recognition Site</li> <li>• Restriction Digestion</li> <li>• Gel Electrophoresis</li> <li>• Restriction Fragment Length Polymorphism</li> <li>• Morgue</li> <li>• Autopsy</li> <li>• Organ system</li> <li>• Algor mortis</li> <li>• Rigor mortis</li> <li>• Livor mortis</li> <li>• Personal protective equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Cardiovascular System</li> <li>• Atrium</li> <li>• Ventricle</li> <li>• Valve</li> <li>• Artery</li> <li>• Vein</li> <li>• Pulmonary Circulation</li> <li>• System Circulation</li> <li>• Aorta</li> <li>• Superior and Inferior Vena Cava</li> <li>• Tricuspid Valve</li> <li>• Bicuspid (Mitral) Valve</li> <li>• Pulmonary Valve</li> <li>• Aortic Valve</li> </ul>
<i>Extensions: Expert/Field Experience(s)</i>		
Potential guest speakers: Crime scene photographer, crime scene investigator, EMT, medical examiner, pathologist, histologist, forensic scientist Potential field trips: 'Unlocking your DNA' Liberty Science Center lab		
<i>Literacy Connections/Research</i>		
- Formal case reports - Career journal entries - Ethics analysis - Evidence analysis activities  <a href="#">"Molecular Structure of Nucleic Acids"</a> by Watson and Crick, 1953 <a href="#">"Historical Anatomies on the Web"</a> <a href="#">"Virtues of the Virtual Autopsy"</a> by Maryn McKenna, 2012		

## Modifications

Special Education/504:	English Language Learners:
-Adhere to all modifications and health concerns stated in each IEP. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Utilize program translations (if available) for L1/ L2



<p>Concrete- Pictorial- Abstract spectrum by using manipulatives</p> <ul style="list-style-type: none"> <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>	<p>students</p> <ul style="list-style-type: none"> <li>- Reword questions in simpler language</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>
<b>Gifted and Talented:</b>	<b>Students at Risk for Failure:</b>
<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> <li>● Are you ready for more?</li> </ul> </li> <li>- Provide opportunities for science competitions</li> <li>- Alternative instruction pathways available</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>- Parental/ guardian contact</li> <li>- Provide academic contracts to students &amp; guardians</li> <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>