

**Randolph Township Schools
Randolph High School**

Forensic Science Curriculum

“I didn’t invent Forensic Science and medicine. I just was one of the first people to recognize how interesting it is.”

-Patricia Cornwell

Department of Science, Technology, Engineering, and Mathematics
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**Randolph Township Schools
Department of STEM
Forensic Science**

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION

EDUCATIONAL GOALS

VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
Department of STEM
Forensic Science

Introduction

This course is designed for high school students who would like to pursue advanced studies in science after successfully completing a first-year course in biology. Forensic Science is a high-interest, inquiry-rich integrated science curriculum that requires critical thinking and problem solving through the use of real-world forensic science methodologies and case studies. This course integrates the techniques and knowledge from the sciences to better understand the crimes that are committed and to catch those individuals responsible for said crimes. Students will learn to explain how clues and data are recorded and preserved. Students will be expected to perform in-class analyses including blood spatter investigation, blood typing, fingerprint analysis, hair and fiber analysis, and DNA profiling.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Forensic Science

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
3 weeks	I	Fundamentals of Forensic Science
3 weeks	II	Criminal Processing
6 weeks	III	Physical Evidence
4 weeks	IV	Serology and DNA
2 weeks	V	Death: Manner, Mechanism, Cause

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Forensic Science

UNIT I: Fundamentals of Forensic Science

TRANSFER: Science is the methodical process of understanding and interpreting data and is used to solve real-world problems.		
<p>STANDARDS / GOALS:</p> <p>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.</p> <p>HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p>	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
	Forensic Science is the application of science to law. Forensic scientists rely on the scientific method for processing and evaluating evidence.	<ul style="list-style-type: none"> What is the value of forensic science in determining innocence or guilt?
	Forensic Science is a field of study that requires several different specialists working towards one goal.	<ul style="list-style-type: none"> Why do specializations exist in forensic science?
	Forensic scientists must communicate with colleagues to ensure reliable data and evidence is being evaluated.	<ul style="list-style-type: none"> What effects does bias have on an investigation?
	Accurate, truthful, and objective reporting is essential to maintaining professionalism in forensic science fields.	<ul style="list-style-type: none"> How has forensic science developed and changed over history?
	KNOWLEDGE	SKILLS
	<p>Students will know:</p> <p>Forensic science is a multifaceted discipline and requires professionals such as nurses, chemists, toxicologists, meteorologists, and accountants that utilize the scientific method correctly.</p> <p>Scientists specialize in fields such as chemistry, toxicology, pathology, entomology, and firearms.</p> <p>The scientific development of forensics including the</p>	<p>Students will be able to:</p> <p>Define forensic science and describe the significance of key contributors and disciplines to the field of forensics.</p> <p>Describe how the scientific method is used to search a crime scene.</p> <p>Identify and apply search methods used to</p>

	<p>importance of the contributions made by Orfila, Bertillon, Henry, Landsteiner, Locard, Osborn, Goddard, Franklin, Watson, Crick, and Jefferys.</p> <p>The scientific method is a series of logical steps used to solve a problem.</p> <p>Zone, spiral, line, and grid search methods are utilized according to the size and location of the crime scene.</p> <p>Eyewitness accounts are not entirely reliable due to the fact that the human brain is easily misguided.</p> <p>Physical evidence must be collected using specific techniques and guidelines set up by the crime lab to preserve the integrity of the evidence.</p> <p>The sixth amendment ensures that a person will be tried by an impartial jury of his or her peers and is to be assumed innocent until proven guilty.</p> <p>Scientific procedures to analyze evidence must be verified through peer review.</p> <p>Cases presented to forensic scientists for lab analysis are anonymous to avoid bias.</p> <p>Criminal profilers study evidence collected and analyzed by crime scene investigators to formulate a hypothesis of a perpetrator's age, personality, lifestyle, and social environment.</p> <p>KEY TERMS: Forensic Science, deductive reasoning, perception, Innocence Project, Frye Standard, physical evidence, Bill</p>	<p>investigate a crime scene.</p> <p>Explain the proper techniques for collection and packaging of physical evidence.</p> <p>Outline the steps of the judicial process from identification of a suspect through the final trial outcome.</p> <p>Evaluate the importance of a code of ethics to professional organizations.</p> <p>Analyze the importance of objectivity in report writing.</p> <p>Summarize the stages and value of the criminal profiling process.</p>
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	of Rights, probable cause, class characteristics, individual characteristics, reference sample	
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ASSESSMENT EVIDENCE: Students will show their learning by:

- Explaining the significance of the Bill of Rights to proper police investigation through a board meeting
- Properly developing and conducting an experiment in which eyewitness perception is measured and altered
- Explaining how and why cold cases exist

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested labs and performance assessments: Pick a Penny Activity, Timeline Construction, Hot Case Gone Cold, Learning to See Activity, Influence Observations and Measure Reactions (designing an experiment)

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Forensic Science
Unit I: Fundamentals of Forensic Science

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 Weeks	Scientific Method History of Forensic Science Judicial Process Observation Criminal Profiling	<i>Case Studies: Jon Benet Ramsy, Natalie Holloway, Jennifer Kesse, Trenton Duckett, and Lisa Stebic, Ernesto Miranda,</i> <i>Multimedia:</i> <i>Case Studies from Forensic Files</i> <i>Making a Murderer</i>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Forensic Science

UNIT II: Criminal Processing

TRANSFER: Every time you contact another person, place, or thing, it results in an exchange of physical materials that can be detected and analyzed through the use of several scientific techniques.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>HS-ETS1-2 Design a solution to a complex a real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>	<p>Forensic and criminal investigators must adhere to a strict code of ethics while maintaining objectivity.</p>	<ul style="list-style-type: none"> • How does the Principle of Ethics apply to forensic science?
<p>HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p>	<p>Scientific techniques must be universal and proven in functionality to be accepted in legal proceedings.</p>	<ul style="list-style-type: none"> • What is the criteria for making evidence admissible in court?
<p>HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p>	<p>An interrogation in law enforcement is when a representative from the agency collects information about a crime by questioning suspects, victims, or witnesses.</p>	<ul style="list-style-type: none"> • How will progressive lab equipment be used at future criminal trials?
<p>HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p>	<p align="center">KNOWLEDGE</p> <p>Students will know: The correct procedure for interviews and interrogation.</p> <p>The goal to an interrogation is to solve the crime.</p> <p>The different interrogation models employed by police.</p> <p>Chromatography is used to identify a substance by separating a mixture into its individual components based on their attraction to stationary liquid or solid yielding</p>	<p align="center">SKILLS</p> <p>Students will be able to: Correctly employ the cognitive approach to interviews</p> <p>Detect signs of deception.</p> <p>Detect trace evidence on crime scene evidence.</p> <p>Distinguish between physical and chemical properties, presumptive and confirmatory tests, and qualitative and quantitative analysis.</p>

	<p>quantitative evidence that can identify previously unknown physical evidence.</p> <p>Different microscopes have different uses within the forensic science labs.</p> <p>KEY TERMS: Chemical property, chromatography, confirmatory test, R_f Value, circumstantial evidence, suspect decision-making model, cognitive-behavioral model, psychoanalytical model, emotional model, interaction process model, cognitive approach</p>	<p>Calculate the retention factor through the implementation of a chromatogram.</p>
<p>ASSESSMENT EVIDENCE: Students will show their learning by:</p> <ul style="list-style-type: none"> • Calculating the retention factor of chromatograms • Developing proper appropriate interrogation models • Demonstrating proper laboratory techniques and evidence collection/analysis <p>KEY LEARNING EVENTS AND INSTRUCTION:</p> <ul style="list-style-type: none"> • Suggested labs and performance assessments: Caught by a Kiss, Drive-By Shooting, Ethical Errors, The Case of the Missing Mascot, Interrogation Role-Play, Paper Chromatography Lab, and Smooch 		

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Forensic Science
Unit II: Criminal Processing

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 Weeks	Lab Properties Microscopy Chromatography Interview and Interrogation Evidence Identification and Collection	<i>Case Studies: Laci Peterson, Susan Smith, Melendez Brothers, Daubert v. Merrell Dow Pharmaceuticals</i> <i>Multimedia: Forensic Files</i>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Forensic Science

UNIT III: Physical Evidence

TRANSFER: Everything around you can be analyzed to tell who and what has come in contact with it.		
STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
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.	Evidence helps crime constructionists establish a sequence of events as well as relationships between the scene, the victim, and the suspect.	<ul style="list-style-type: none"> • Are fingerprints found at a crime scene indicative of wrong doing?
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.	Understanding Anatomy and Physiology allows scientists to interpret information about physical trauma and the nature of the crime based on physical and biological evidence.	<ul style="list-style-type: none"> • Is it possible that more than one person’s hair is consistent with the hair found at a crime scene?
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Every time one contacts another person, place, or thing, it results in an exchange of physical materials.	<ul style="list-style-type: none"> • What makes a piece of evidence “court worthy?”
	KNOWLEDGE	SKILLS
	<p>Students will know:</p> <p>The anatomical structure of hair and skin is predictable yet unique.</p> <p>Hair found on different parts of the body have predictable variations.</p> <p>Hair from individuals of different ancestral backgrounds have predictable physical variations.</p>	<p>Students will be able to:</p> <p>Use a microscope to analyze hair samples through the comparison of medullary indexes, cuticle structure, and anatomy.</p> <p>Collect and analyze fingerprints identifying primary ridge patterns and minutiae.</p> <p>Recover latent fingerprints from various evidence samples.</p>

	<p>Fingerprints are formed in response to the environmental conditions within the womb and are unique because of this.</p> <p>Fibers are a form of class evidence used by crimes scene investigators and can be classified as natural or synthetic.</p> <p>Fingerprints left on an object are created by the naturally occurring ridges in the skin of fingertips and secretions from sweat glands that leave small amounts of oils and salts when contact is made.</p> <p>KEY TERMS: Comparison microscope, cortex, cuticle follicle, keratin, medulla, mitochondrial DNA, nuclear DNA, amorphous, crystalline, weft, arch, core, latent, plastic, patent, whorl, minutiae</p>	<p>Identify the origin of fibers using a compound microscope.</p> <p>Compare and contrast ridge patterns and minutiae.</p>
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ASSESSMENT EVIDENCE: Students will show their learning by:

- Identifying the origin of unknown hair sample
- Demonstrating proper laboratory techniques to collect and analyze hair, fiber, and fingerprint samples
- Properly link individuals with physical evidence

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested labs and performance assessments: Bedsheet Tread Count, Car Fiber Comparison, Catch the Criminal Hair Analysis, Study your Fingerprints, Is it Consistent? (a fingerprint comparison)

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Forensic Science
Unit III: Physical Evidence

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
6 Weeks	Fingerprint Analysis Fiber and Textile Analysis Hair Analysis	<i>Case studies: Richard Ramirez, Stephen Cowans, The HillSide Stranglers, Stephen Cowans</i> <i>Multimedia:</i> <i>Forensic Files</i> <i>The Real CSI</i> <i>Richard Ramirez, the night stalker</i>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Forensic Science

UNIT IV: Serology and DNA

<p>TRANSFER: DNA contains the genetic material that determines most physical and chemical components that make you who you are.</p>		
<p>STANDARDS / GOALS:</p> <p>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.</p> <p>HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</p> <p>HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p>HS-ETS1-2 Design a solution to a complex, real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based in the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical</p>	<p>ENDURING UNDERSTANDINGS</p>	<p>ESSENTIAL QUESTIONS</p>
	<p>DNA is a nucleic acid that contains the genetic information necessary for a cell to replicate and make proteins.</p>	<ul style="list-style-type: none"> • Is DNA evidence reliable in indicating innocence or guilt?
	<p>Using PCR amplification, minute amounts of DNA evidence can be used to solve crimes.</p>	<ul style="list-style-type: none"> • Should a suspect of a crime have the right to refuse the provision of his/her own biological sample?
	<p>Blood consists of cellular components and plasma containing dissolved ion, proteins, and other substances.</p>	<ul style="list-style-type: none"> • Is the practice of PCR amplification reliable enough to secure a conviction that could potentially end an individual's life? Why or why not?
	<p>The characteristics of blood drops on surfaces can show the direction of blood movement and the location of the source of blood can indicate the nature of the wound producing the blood.</p>	<ul style="list-style-type: none"> • Is blood evidence found at a crime scene the only evidence necessary to bring an individual up on charges?
	<p>KNOWLEDGE</p>	<p>SKILLS</p>
<p>Students will know: How law-enforcement agencies compare new DNA evidence to existing DNA evidence.</p> <p>How to describe the use of DNA profiling using mtDNA and Y STRs to help identify a person using the DNA of family members.</p>	<p>Students will be able to: Perform a simple DNA extraction.</p> <p>Compare and contrast DNA evidence using gel electrophoresis.</p>	

<p>properties.</p>	<p>What short tandem repeats are and its importance to DNA profiling.</p> <p>The forensic significance of the different types of blood cells.</p> <p>The different antigens that can be found on human erythrocytes and the implication of each.</p> <p>KEY TERMS: Allele, exon, intron, polymerase chain reaction, short tandem repeats, agglutination, antibodies, antigen-antibody response, satellite, spine, swipe, wipe</p>	<p>Perform a presumptive test for blood.</p> <p>Design an experiment to explain the effect height has on blood droplets.</p> <p>Identify the area of convergence of blood spatter sample.</p> <p>Calculate the angle of impact and area of origin of a blood spatter pattern.</p>
<p>ASSESSMENT EVIDENCE: Students will show their learning by:</p> <ul style="list-style-type: none"> • Calculating angle of impact of blood spatter found at a crime scene • Comparative analysis of DNA electrophoresis gels • Proper isolation of DNA from wheat germ <p>KEY LEARNING EVENTS AND INSTRUCTION:</p> <ul style="list-style-type: none"> • Suggested labs and performance assessments: Simple DNA extraction, Blood typing lab, Creating and Modeling Blood-Spatter Patterns, The Break-In Inquiry Lab, Anna Anderson or Anastasia? STR Analysis, STR Identification of September 11 Victim, Identifying of the Romanovs Using STR Profiling, Presumptive Blood Testing, Blood-Droplet Impact Angle Lab. 		

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Forensic Science
Unit IV: Serology and DNA

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
4 Weeks	DNA Profiling Blood Typing Blood-Spatter Analysis	<i>Case Studies: Colin Pichfork, Tommy Lee Andrews, Ian Simms, Kirk Bloodsworth, The Romanov Family, Ludwig Tessnow, Graham Backhouse.</i> <i>Multimedia:</i> <i>Forensic Files</i>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Forensic Science

UNIT V: Death: Manner, Mechanism, Cause

<p>TRANSFER: All organisms are composed of cells which degrade in a predictable manner after death.</p>		
<p>STANDARDS / GOALS:</p> <p>HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.</p> <p>HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p>HS-ETS1-2 Design a solution to a complex, real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p>	<p>ENDURING UNDERSTANDINGS</p>	<p>ESSENTIAL QUESTIONS</p>
	<p>Death is a process that involves both individual cell death and organism death. The medical and legal communities have been unable to agree upon a precise definition of death.</p>	<ul style="list-style-type: none"> • When is an organism officially dead?
	<p>Physical and chemical changes that occur after death, such as bloating, skin marbling, and adipocere formation, are caused by decomposition.</p>	<ul style="list-style-type: none"> • What factors influence the degradation of living tissue?
	<p>The postmortem interval is never precise as several environmental variables and other factors influence what happens to a body after death.</p>	<ul style="list-style-type: none"> • What is the most precise method of calculating the postmortem interval?
	<p>KNOWLEDGE</p>	<p>SKILLS</p>
<p>Students will know: The difference between the manner, mechanism, and cause of death.</p> <p>The difference between cellular death and the death of an organism.</p> <p>The procedure of an autopsy, and how an autopsy is used to establish cause of death, manner of death, and postmortem interval.</p>	<p>Students will be able to: Calculate the postmortem interval using rigor mortis.</p> <p>Calculate the postmortem interval using algor mortis.</p> <p>Properly fill out a death certificate with manner, mechanism, and cause of death.</p>	

	<p>The different roles of a coroner and a medical examiner.</p> <p>KEY TERMS: Algor mortis, autolysis, autopsy, cause of death, coroner, decomposition, livor mortis, manner of death, mechanism of death, medical examiner, putrefaction, rigor mortis</p>	
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ASSESSMENT EVIDENCE: Students will show their learning by:

- Calculating PI using heat temperature changes
- Calculating PI using rigor mortis
- Completing a sample death certificate after reviewing a case study
- Postmortem web quest
- Petechial hemorrhage research

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested labs and performance assessments: Calculating Postmortem Interval Using Rigor Mortis, Calculating Postmortem Interval Using Algor Mortis, Tommy the Tub, Analysis of Evidence from Death Scenes

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Forensic Science
Unit V: Death: Manner, Mechanism, Cause

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 Weeks	Manner of Death Mechanism of Death Cause of Death Decomposition Autopsy Protocol	<i>Case Studies: David Hendricks, Nicole Brown Simpson and Ron Goldman</i> <i>Digging Deeper: “Factors and Circumstances Influencing the Development of Hemorrhages in Livor Mortis”</i> <i>Multimedia:</i> <i>America Undercover: Autopsy</i> <i>American Crime Story</i> <i>The Iceman and the Psychiatrist</i>