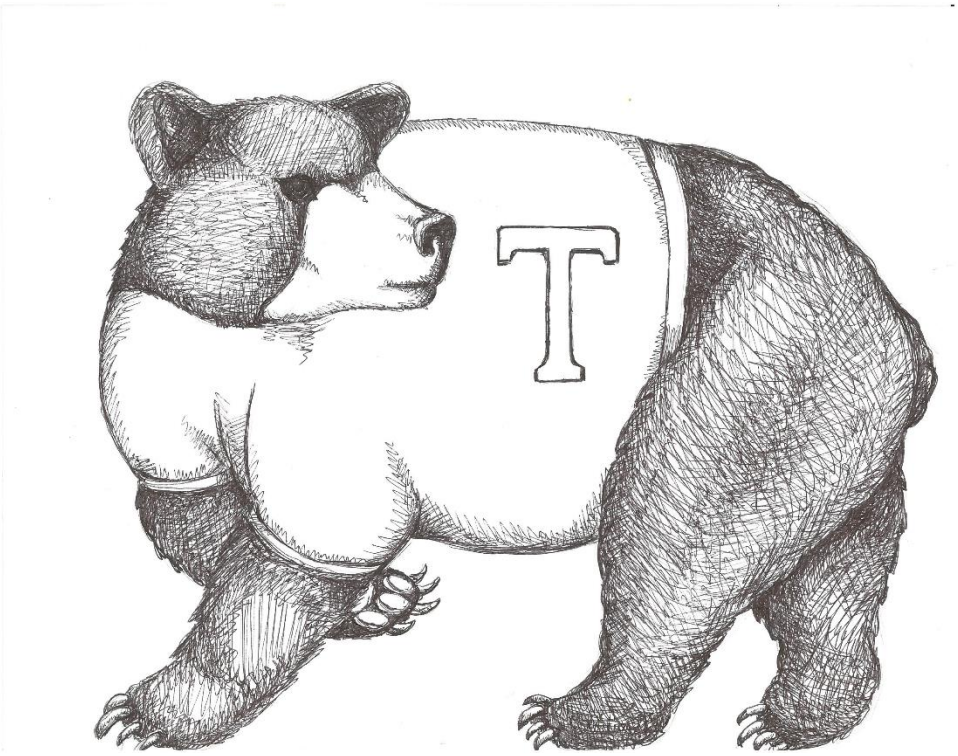
Thomaston Public Schools

158 Main Street
Thomaston, Connecticut 06787
www.thomastonschools.org – 860-283-4796



Thomaston Public Schools Curriculum
Thomaston High School
Grade(s): Forensic Science-Grades 11 and 12

Learn to Live, Live to Learn

Acknowledgements

Curriculum Writer(s):
Chris McMullen

We acknowledge and celebrate the professionalism, expertise, and diverse perspectives of these teachers. Their contributions to this curriculum enrich the educational experiences of all Thomaston students.

_____*Alisha DiCorpo*_____
Alisha L. DiCorpo
Director of Curriculum and Professional Development

Date of Presentation to the Board of Education: August 2015

(Forensics Curriculum: Grades 11 and 12 THS)

Board of Education Mission Statement:

IN A PARTNERSHIP OF FAMILY, SCHOOL AND COMMUNITY, OUR MISSION IS TO EDUCATE, CHALLENGE AND INSPIRE EACH INDIVIDUAL TO EXCEL AND BECOME A CONTRIBUTING MEMBER OF SOCIETY.

Departmental Philosophy:

Throughout their years at Thomaston High School, students explore life, physical, earth, and environmental sciences, and the connections between science and technology, and the nature of science. Science is primarily concerned with understanding how the natural world works. It is fueled by our curiosity and asking of questions. Our willingness to investigate leads to evidence-based answers, explanations, and new questions to investigate. Evidence comes from observations, hands-on investigations, and research of current scientific knowledge. We communicate in Science by talking and listening, and by reading and writing – text and drawings – in order to demonstrate prior knowledge and the development of new idea (Michaels *et al*, 2008.) Students are encouraged to work collaboratively and independently, and to evaluate each other's claims, question assumptions, and weigh the validity of conclusions. The ability to think like a scientist about our world will prepare our students to be responsible citizens and critical thinkers ready to take on the challenges of our changing planet.

Michaels, Sarah, Andrew W. Shouse, and Heidi A. Schweingruber. Ready, Set, Science! Washington, D.C.: The National Academies Press, 2008

Course Description:

Forensic Science is the application of science to those criminal and civil laws that are enforced by police agencies in a criminal justice system. This class incorporates Biology, Chemistry, Physics, Entomology, Earth Science, Human Anatomy and Molecular Biology. Major topics include processing a crime scene, collecting and preserving evidence, identifying types of physical evidence, organic and inorganic analysis of evidence, hair, fibers, and paint, toxicology, serology, DNA, fingerprints, ballistics, forensic pathology and tissue degeneration. The main focus of this course will be to emphasize the evidential value of crime scene and related evidence and the services of what has become known as the crime laboratory.

Expectations: Students will be expected to participate in group work; to follow directions and safe laboratory protocol; to complete all homework assignments and lab reports and turn in on time; to conduct themselves in a professional and mature manner with respect to subject material; to complete and/or make up all quizzes, tests, and projects on time; to employ deductive and critical thinking skills in case studies and labs; to set up a crime scene for other students; to solve a crime scene.

PROCESS SKILLS

Applying Probability and Statistics
Applying Scientific Method
Appreciating Art and Music

Creating
Designing
Graphing
Inventing
Listening
Maintaining Physical Fitness
Performing
Problem Solving
Quantifying
Reading (Analyzing)
Reading (Appreciating)
Reading (Comprehending)
Reading (Decoding)
Reasoning and Reflecting
Speaking
Studying
Understanding Number Operations
Using and Creating Formulas
Using Learning Resources and Technology
Using Maps and Globes
Viewing
Working Independently and Collaboratively
Writing and Language Mechanics

GRADING GUIDELINES

Homework	5%
Tests	30%
Quizzes	20%
Labs	20%
Projects	25%

NATIONAL SCIENCE STANDARDS FOR SECONDARY EDUCATION

The National Standards for science state that the goals for students are to be able to:

- Understand the nature of the world around them
- Use the scientific method and other scientific techniques, for problem solving
- Discuss topics of a scientific nature intelligently
- Use their knowledge of science to pick appropriate career paths and become productive citizens

Specifically, the following standards are incorporated into this curriculum:

- **Content standard A**: all students should develop abilities to do scientific inquiry and understandings about scientific inquiry.

- **Content standard B**: develop an understanding of the structure of atoms, structure and properties of matter, chemical reactions, motions and forces, conservation of energy, and interactions of energy and matter
- **Content standard C**: develop an understanding of the cell, molecular basis of heredity, biological evolution, interdependence of organisms, matter, energy, and organization in living systems, behavior of organisms
- **Content standard F**: develop understanding of personal and community health, population growth, natural resources, environmental quality, natural and human-induced hazards, and Science and technology in local, national and global challenges
- **Content standard G**: develop an understanding of Science as a human endeavor, nature of scientific knowledge and historical perspectives

K-12 CURRICULUM GOALS AND STANDARDS

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.
- Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data.
D INQ.7 Assess the reliability of the data that was generated in the investigation.
D INQ.8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.
D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.
D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

SUMMARY OF UNITS

Unit	Topic
Unit 1	Intro. To Forensic Science
Unit 2	The Crime Scene and Evidence
Unit 3	Fingerprinting and Impressions
Unit 4	DNA Fingerprinting
Unit 5	Serology (Blood Typing & Pattern Analysis)
Unit 6	Forensic Anthropology, Pathology & Tissue Decomposition
Unit 7	Forensic Entomology
Unit 8	Trace Evidence (Hair, Fibers, Glass, Pollen, Spores, etc.)
Unit 9	Forensic Toxicology & Drugs
Unit 10	Document Analysis & Ballistics

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 1

Subject: Biology

Grade/Course: Grade 11-12/ Forensic Science

Pacing: 8/28 to 9/18

Unit of Study: Lab Safety & Introduction to Forensic Science

Priority Standards:
STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

· Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
· Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. · Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

· Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

· Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A: As a result of activities in grades 9-12, all students should develop:

· Abilities necessary to do scientific inquiry
· Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E: As a result of their activities in grades 9-12, all students should develop an understanding of:

· Abilities of technological design
· Understandings about science and technology

History and Nature of Science: CONTENT STANDARD G: As a result of their activities in grades 9-12, all students should develop an understanding of:

· Science as a human endeavor
· Nature of scientific knowledge
· Historical perspectives

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● Basic framework of scientific method ● Probabilities. ● Various disciplines of forensic science ● Electron microscopy ● Laboratory safety procedures	● Define Forensic Science (DOK 1) ● Demonstrate lab safety (DOK 2) ● Learn to operate a compound microscope, and know the theory and be able to identify scanning electron and transmission electron microscopic images (DOK 3) ● Use the steps of the scientific method to problem solve (DOK 1) ● Calculate and analyze probability of a suspect being similar to another (DOK 4)

Essential Questions	Big ideas
● What is forensic science? ● How is the scientific method applied to forensic investigation for purposes of criminal investigations? ● How was the first crime lab developed? ● How has forensic science changed since its inception? ● What are the different facilities and services that a crime lab provides? ● How has science become integrated into the practice of law?	● Forensic science applies to both law and science. ● The scientific method is an important protocol for studying forensics. ● Science is not static, it is always changing.

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● History of forensic science ● Key individuals in forensic science ● vocabulary	● Quiz (materials up to date, history, statistical analysis) ● Lab: Observation and Eyewitness Evidence (Appendix 1)	● Class project: Forensic science timeline ● Individual presentation: Careers in Forensic Science (Appendix 2, Performance Task) ● Final unit test

Performance Task
Oral Presentation- Various careers in Forensic Science (see Performance Task for Unit 1) Introduction to Performance Task Your Task: You are the hiring manager for the FBI Department of Forensic Science and Evidence Analysis. Your superior has granted you funds to expand your lab and you need to recruit qualified forensics experts for your team. You must design a presentation for perspective college graduates who majored in forensic science and entice them to apply for the positions in your lab.

Classroom Activity

- Teacher led instruction about the various careers in forensic science. This will serve to provide students with the opportunity to discuss contextual information and key terms and/or ideas on the topic they will encounter while preparing their presentations.
- Students will use online resources to create an oral presentation of a career in forensics science.
- They will need to include several sources of information and provide evidence (MLA references) for the sources.

In addition to the *presentation rubric* the students presentation needs to be:

- Creative- you should have several diagrams, pictures and tables that are applicable to your job description
- Make it visually appealing (you need qualified people to apply!)
- Explain background needed for the forensic science specialty
    - basic purpose of forensic science and its role in society
- Explain the job description for the forensic science specialty
    - type of degree needed
    - salary
    - outlook (future job opportunities)
    - explanation of duties/responsibilities

Performance Assessment

- Students will be assessed on their task by using the oral presentation rubric
- In addition to the rubric, the students will also be assessed on the information provided above.

Engaging Learning Experiences

Exploration Activities:

- Characterizing Your Shoes
- Matching Pieces of Paper
- Comparison of paper matches

Forensic Activity:

- Solve Robbery

Math Background Activity:

- Probability and Statistics

Exploration Activity: Statistics

Handouts:

- Introduction to Physical Evidence
- Detailed Sketch of Crime Scene

Suggested activities and practicums

- o Timelines of the history of forensic science
- o Career investigations of forensic science
- o Concept mapping of the functions and tools of a crime lab
- o Deductive reasoning, logic and lateral-thinking development activities

Instructional Resources

Journals

- Buckhout, R. “Eyewitness Testimony,” Scientific American, 231 (June 1974), 23-31.
- Nordby, J. J. “Can we believe what we see, if we see what we believe? Expert disagreement,” Journal of Forensic Science 37(4): 1115-1124, 1992.

Websites

Gale Forensic Sciences eCollection, school.cengage.com/forensicscience
Faculty.ncwc.edu/toconnor/425/425lect02.htm (Frye & Daubert)
www.pathguy.com/autopsy.htm (autopsy info)
www.tncrimlaw.com/forensic/fsbindx.htm (forensic science topics)
www.crimezzz.net/forensic_history/index.htm (history of forensic science)
www.crf-usa.org/bria/brial33.html#how (eyewitness testimony)
www.crimeandclues.com/testimony.htm (testimony and evidence)
www.drhenrylee.com www.fedstats.gov/programs/crime.html
www.crimelibrary.com http://forensic-evidence.com
www.bioforensics.com/Kruglaw/forensic.html
www.forensicpage.com www.criminalprofiling.ch/introduction.html
http://forensicto/forensic.html
www.users.bigpond.net.au/anzfss (Australian/New Zealand Forensic Science)
www.forensic-science-society.org.uk www.csfs.ca (Canadian Forensic Science)
www.iafs.org (International Assoc. of Forensic Science)
www.nifs.com/au/home.html (Australia)
www.aafs.org (American Academy of Forensic Sciences)
www.ascld.org (crime lab directors)
www.state.ct.us/dps/DSS/forensic.htm (CT state crime lab)

Instructional Strategies	Meeting the Needs of All Students
1. Critical thinking and problem solving 2. Effective oral and written communication 3. Accessing and analyzing information 4. Collaborating and leadership 5. Summarizing and Note Taking 6. Homework and Practice 7. Nonlinguistic Representations (Graphic Organizers) 8. Cooperative learning 9. Generating and testing hypothesis	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Analytical Skills Anthropology Arraignment August Vollmer Ballistics Booking Calvin Goddard Case/CommonLaw Civil Law Criminal Law Deductive Reasoning Entomology Evidence Expert Witness Felony Forensic Science Francis Galton Frye Standard Grand Jury Hearsay Henry Faulds Indictment Juan Vucetich Karl Landsteiner Locard‟s Exchange Miranda Rights Misdemeanor Odontology Palynology	Refer to Tier 1 instructions	● Web search for additional data and information on the history of forensic science. ● Literature research on current papers on forensic science ● Concept mapping of the functions and tools of a crime lab ● Deductive reasoning, logic and lateral-thinking development activities (evidence analysis activity)

Pathology Plea Bargain Probable Cause Statutory Law		

Click on the link to see a Sample Lesson Plan for Unit 1

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 2

Subject: Biology

Grade/Course: Grade 11-12/ Forensic Science

Pacing: 9/21-11/2

Unit of Study: History of Forensic Science, Crime Scene and Evidence

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

· Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.

· Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. · Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

· Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

· Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A: As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E: As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
• What are the parts of a crime scene? • Various types of evidence • Proper Good Laboratory Practices (GLP) • Proper data recording procedures	• Approach and the initial investigation of a crime scene (DOK 3) • Identify primary and secondary crime scenes and evidence (DOK 2) • Preservation of evidence (DOK 2) • Document and record evidence and data (DOK 1) • Diagram, reconstruct and analyze a crime scene (DOK 4)

Essential Questions	**Big ideas**
• How is a crime scene identified and processed? • What types of evidence might be found at a crime scene, and how is each recognized, collected, stored, and processed?	• A crime scene is a complex environment that needs to be analyzed in a methodical and procedural manner. • The proper identification and storage of evidence is key in a criminal investigation. • Poor evidence collecting can result in perpetrators walking free.

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups • Types of evidence • Parts of a crime scene • vocabulary	• Lab – Locard's Principle • Lab – Mock crime scene investigation • Quiz (materials up to date)	• Activity – Crime scene photography, sketching and documentation • Student research, discussion and presentations on case studies

		• Unit Test

Performance Task
• Student research, discussion and presentations on case studies. • Students will research various cases studies such as the OJ Simpson case and the Dr. John Schneeberger case in Canada. • Students will debate the results of both cases and determine if the verdicts were just based on the method the crime scenes were analyzed.
Engaging Learning Experiences
• Locard's Exchange Principle Activity – collection of trace evidence off of clothing worn over the course of a school day with analysis of evidence done in groups • Crime scene diagramming & photographing • Staging intrusions & events in class and evaluating eyewitness accounts vs. second-hand accounts • Role-playing activities and simulated crime scenes

Instructional Resources
Journals • Crime Scene Response Guidelines," in the CA Commission on Peace Officer Standards and Training's" Workbook for the Forensic Technology for Law Enforcement Telecourse, 1993. • L.A. Dept. of Public Safety and Corrections, Office of State Police, Crime Laboratory, "Evidence Handling Guide." Los Angeles, CA Websites www.crime-scene-invesigator.net www.fbi.gov/hq/lab/handbook/intro16.htm (FBI steps in crime-scene protocol) www.fbi.gov/hq/lab/fsc/backissu/july2000/deedric4.htm www.feinc.net/sketch.htm (sketching and software) www.crimeandclues.com/crimescene.htm www.ncjrs.gov/pdffiles1/nij/178280.pdf (guide for law enforcement) www.ncjrs.gov/pdffiles/167568.pdf (death investigation) Hencken, Jeannette. "Evidence Collection: Just the Basics."

Instructional Strategies	Meeting the Needs of All Students
1. Critical thinking and problem solving 2. Effective oral and written communication 3. Accessing and analyzing information 4. Collaborating and leadership 5. Summarizing and Note Taking 6. Homework and Practice 7. Nonlinguistic Representations (Graphic Organizers) 8. Cooperative learning 9. Generating and testing hypothesis	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Accelerant Algor Mortis Autopsy Chain of Custody Circumstantial Evidence Class Reconstruction Survey Detective Direct Evidence Edmund Locard First Responder Individualized Evidence Livor Mortis Medical Examiner Modus Operandi Paper Bindle/Druggist‟s Fold Physical Evidence Primary Crime Scene Rigor Mortis Search Patterns Secondary Crime Scene Standard/Reference Trace Evidence Transient Evidence	Refer to Tier 1 instructions	● Case study comparison of student choice ● Chain of custody activity ● Determining the stages mortis

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 3

Subject: Biology

Grade/Course: Grade 11-12/ Forensic Science

Pacing: 11/3 – 11/30 (27 Days)

Unit of Study: Fingerprinting and Impressions

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data.

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E:

As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology

History and Nature of Science: CONTENT STANDARD G:
As a result of their activities in grades 9-12, all students should develop an understanding of: Science as a human endeavor; Nature of scientific knowledge, Historical perspectives

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
• How fingerprints are formed • How to identify latent, patent and plastic fingerprints • Various fingerprint location, collection and preservation techniques • Types of fingerprints	• Use international and national computer databases for identifying and analyzing fingerprints (DOK 4) • Use the techniques for collecting, identifying and comparing impression evidence (DOK 3) • Define the various parts of a fingerprint (DOK 1) • Distinguish between different fingerprints and impressions (DOK 2)

Essential Questions	**Big ideas**
• What is a fingerprint? • How is fingerprint evidence created at a crime scene? • What are the methods used to collect fingerprints from a crime scene? • Explain the methods of detecting fingerprints: superglue, powder both white, black , magnetic, and by use of modern technology, such as, Reflected ultraviolet imaging system(RUVIS) • What are the various defining ridge patterns of fingerprints? • How are fingerprints at a crime scene analyzed to determine the source individual? • What characteristics are used to distinguish between various tire tread, tool and shoe sole marks? • What methods are used to collect impression evidence?	• A fingerprint is an individual characteristic that is not duplicated from person to person • A fingerprint remains unchanged during a person's lifetime • Fingerprints have general ridge patterns that permit them to be systematically classified • All objects have distinguishing physical characteristics that can be identified in an impression • Objects can be identified by their impression through comparing key physical characteristics

Assessments

Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● Types of fingerprints and impressions ● Methods for collecting impression evidence ● vocabulary	● Lab: The Missing Midterm ● Lab: Fingerprint Analysis ● Lab: Visible, Latent, and Plastic Prints ● Quiz (materials up to date)	● Create a school fingerprint database for future reference in investigations (release form) ● Lab: Unknown Fingerprint Classification & Identification ● Unit test

Performance Task
● Create a school fingerprint database for future reference in investigations (release form). The class will work over the course of the unit to fingerprint as many individuals as possible to compile a fingerprinting database of the THS population. Release forms will be provided to the students so that fingerprints can be attained. If the school population is to daunting then we will reduce it to the grade 11 and 12 class.
Engaging Learning Experiences
● Individual comparative fingerprint analysis – identify, classify and categorize personal fingerprint features using ink ● Frequency of fingerprint features within the class ● Create a school fingerprint database for future reference in investigations (release form) ● Balloon fingerprint to enhance and examine fingerprint minutiae features ● Methods of developing fingerprints – dusting, lifting, fuming for latent prints ● Shoe sole analysis – photography, casting (plaster & foam), inkless ● Observation & comparison of tire & tool impressions ● Simulated crime scene investigation relating to unit objectives

Instructional Resources
<u>Journals</u> ● Almag, J., Y. Sasson & A. Anati, "Chemical Reagents for the Development of Latent Fingerprints II: Controlled Addition of Water Vapor to Iodine Fumes – A Solution to the Aging Problem," *Journal of Forensic Sciences* 24 (1979): 431. ● Fregeau, C. J. et al., "Fingerprint Enhancement Revisited and the Effects of Blood

Enhancement Chemicals on Subsequent Profiler Plus ™ Fluorescent Short Tandem Repeat DNA Analysis of Fresh and Aged Bloody Fingerprints," *Journal of Forensic Sciences* 45 (2000): 354.

- Grubweiser, P. et al., "Systematic Study on STR Profiling on Blood and Saliva Traces after Visualization of Fingerprints," *Journal of Forensic Sciences* 48 (2003): 733.

Jones, T. "Inherited Characteristics in Fingerprints (or Theory of Relativity), *The Print*, 4(5), 1991.

- Kendall, F. G. & B. W. Rehn, "Rapid Method of Super Glue Fuming Application for the Development of Latent Fingerprints," *Journal of Forensic Sciences* 28 (1983): 777.
- Lafontaine, Ryan. "Man Found without Fingerprints," *The Sun Herald*, Biloxi, MISS, May 31, 2006, http://www.truthinjustice.org/fingerprints.htm.
- McCann, J. S. "A Family Fingerprint Project," *Identification News*, May 1975, 7-11.
- Noble, D. "The Disappearing Fingerprints," *Chem Matters*, February 1997, pp. 9-12.
- Roux, C et al, "A Further Study to Investigate the Effect of Fingerprint Enhancement Techniques on the DNA Analysis of Bloodstains," *Journal of Forensic Identification* 49 (1999): 357.
- Shahan, Gaye. "Heredity in Fingerprints," *Identification News*, XX(4): 1, 10-14, April 1970.

Websites

http://safety-identification-products.com/fingerprint-information.html
"The Wrong Man Arrested for Madrid Bombings,"
http://www.msnbc.msn.com/id/5092810/site/newsweek
"Wrongly Charged with Perjury on Fingerprint „Evidence‟,"
http://www.shirleymckie.com
http://www.fbi.gov/hq/cjisd/iafis.com
http://www.fbi.gov/hq/cjisd/takingfps.html
http://www.americanmafia.com/Feature_Articles_168.html
http://www.livescience.com/humanbiology/041102_fingerprint_creation.html
http://galton.org/fingerprints/books/henry/henry-classification.pdf
www.crimelibrary.com/forensics/fingerprints: the "Night Stalker" case
www.crimeandclues.com/fingerprints.htm
whyfiles.org/133crime_lab/3.html
www.cornwallis.kent.sch.uk/intranet/elearn/science/crime/crimebusters/1finger.htm
www.fbi.gov/hq/lab/fsc/backissu/jan2001/1pu.pdf
www.xs4all.nl/~dacty/minu.htm
www.ridgesandfurrows.homestead.com/early_pioneers
www.detectoprint.com/article.htm, "Super Glue to the Rescue"
www.interpol.int/Public/Forensic/IFSS/meeting13/SpecialPresentation.pdf
www.policenws.com/info/fingerprints/finger07.html
www.criminaljustice.state.ny/us/ojis/history/fp_sys.htm
www.onin.com/fp/lpfaq.html
www.onin.com/fp/fphistory.html

Instructional Strategies	Meeting the Needs of All Students

1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Summarizing and Note Taking 7. Homework and Practice 8. Nonlinguistic Representations (Graphic Organizers) 9. Cooperative learning 10. Generating and testing hypothesis 11. Cues, questions and advanced organizers	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
AFIS Alphonse Bertillon Amino Acids Anthropometry Arch Basal Layer Bifurcation Core Cyanoacrylate Dermis Digital Imaging Epidermis Fingerprint Fingerprint Powders Fluorescence Friction Ridge Hair Follicle Henry System IAFIS Iodine Fuming Latent Print Livescan Loop Pattern Minutiae (Ridge Characteristics) Ninhydrin Oil Gland Patent Print Physical Developer Plastic Print Ridge Patterns Silver Nitrate Sir William Herschel	Refer to Tier 1 instructions	● Examination of fingerprints from decomposed tissue ● Explore new technologies for collecting fingerprints and impressions ● Case studies of fingerprint anomalies

Sir. E. R. Henry Sublimation Ten Card Whorl Pattern		

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 4

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 12/1 – 01/04

Unit of Study: DNA Fingerprinting

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.2. Describe the general role of DNA and RNA in protein synthesis.
D INQ.8. Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.
D INQ.9. Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD C:
As a result of their activities in grades 9-12, all students should develop an understanding of

- The cell
- Molecular basis of heredity
- Matter, energy, and organization in living systems

History and Nature of Science: CONTENT STANDARD G: As a result of their activities in grades 9-12, all students should develop an understanding of

· Science as a human endeavor
· Nature of scientific knowledge
· Historical perspectives

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● The structure and function of nitrogen bases ● The bodily fluids that can be used to locate DNA evidence ● How Locard's Exchange Principle is applied to DNA evidence ● That PCR is used to amplify the amount of DNA in a sample ● That DNA evidence has statistical factors to maintain reliability	● Create a complementary DNA strand based of a template (DOK 4) ● Explain PCR and compare the process of DNA amplification to cloning (DOK 3) ● Perform gel electrophoresis and analyze the DNA on the gel (DOK 4) ● Identify the different types of nitrogenous bases (DOK 1) ● Analyze a AFLP and RFLP and identify the polymorphisms between DNA samples (DOK4) ● Hypothesize how DNA evidence can be thrown out of court (DOK 3)

Essential Questions	**Big ideas**
● What is the structure of DNA? ● How does the nitrogen base structure provide an identifying characteristic to DNA? ● Where can DNA evidence be located? ● How is DNA evidence related to Locard's Exchange Principle? ● How is PCR used to produce more DNA evidence to be analyzed? ● How is DNA evidence analyzed? ● How is the reliability of DNA evidence achieved? ● How is mitochondrial DNA used in DNA analysis? ● What is the CODIS system and how is it used?	● DNA is unique for every individual on the planet. ● Genetic information is located in various parts of the body and in different tissues ● DNA evidence needs to be preserved and amplified for future assays. ● Genetic evidence is often the first piece defense attorneys will try to discredit

Assessments

Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● DNA structure and function ● PCR process ● vocabulary	● Lab: PCR forensic simulation activity ● Lab: DNA extraction, cleavage and analysis ● Quiz (materials up to date)	● CASE READINGS-PAGE 384 The O.J. Simpson Verdict ● Lab: DNA fingerprinting activity (RFLP, and AFLP) ● Unit test

Performance Task
● Lab: DNA fingerprinting activity (RFLP, and AFLP) Students will need to isolate DNA in the lab and then use visual aids to describe how they would go about doing an RFLP or AFLP. They will need to research the two processes and describe using a visual aid (poster/ PowerPoint, Prezi, pamphlet) how DNA fingerprinting is able to distinguish between individuals. ● The lab rubric will be used to evaluate the students' performance
Engaging Learning Experiences
● Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips ● Quizzes & assessment on concepts and relevant terminology ● Student research, discussion and presentations on case studies ● Cooperative learning and group work activities ● Guest speakers from the science field Suggested activities and practicums ● DNA fingerprinting activity (RFLP) ● PCR forensic simulation activity ● Field-trip to college to conduct DNA extraction, cleavage and analysis

Instructional Resources
Journals ● Gross, A. M. et al., "The Effect of Luminol on Presumptive Tests and DNA Analysis Using the Polymerase Chain Reaction," *Journal of Forensic Sciences* 44 (1999): 837. ● Hanson, E. K. and J. Ballantyne, "Whole Genome Amplification Strategy for Forensic Genetic Analysis Using Single or Few Cell Equivalents of Genomic DNA," *Analytical Biochemistry* 346 (2005): 246.

- Wickenheiser, R. A., "Trace DNA: A Review, Discussion of Theory, and Application of the Transfer of Trace Quantities through Skin Contact," *Journal of Forensic Sciences*, 47 (2002): 442.

Web Sites

www.dna.gov/training/otc
www.ncjrs.gov/pdffiles1/nij/194197.pdf, for cold cases
www.ncjrs.gov/pdffiles1/jr000249c.pdf, DNA and exoneration
molvis.sdsc.edu/dna/index.htm, structure
www.scientific.org/tutorials/articles/riley/riley.html, DNA testing for nonscientist
faculty.ncwc.edu/toconnor/425/425lect15.htm, lecture notes
www.pbs.org/wgbh/aso/tryit/dna/index.html#, DNA interactive
www.cstl.nist.gov/biotech/strbase/
http://science.howstuffworks.com/dna-evidence.htm.
http://www.usdoj.gov/ag/dnapolicybook_cov.htm
http://www.ornl.gov/sci/techresources/Human_Genome/elsi/forensics.shtml
http://www.fbi.gov/hq/lab/handbook/intro6.htm#dna, revised 2003
www.medicalnewstoday.com/medicalnews.php?newsid=40670, "Hopkins Genetics Experts Aid Efforts to Identify Hurricane Katrina Victims"
http://www.forensicevidence.com/site/EVID/EL_DNAerror.html, mistaken DNA
http://www.usatoday.com/tech/science/2005-12-11-katrina-mystery-deaths_x.htm
www.isfg.org, International Association of Forensic Genetics
www.theiai.org, International Association for Identification
www.afdaa.org, Association of Forensic DNA Analysts and Administrators
http://allserv.rug.ac.be/~avierstr/principles/pcr.html, PCR analysis
www.ctsl.nist.gov/div831/strbase, STR DNA database

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Summarizing and Note Taking 7. Homework and Practice 8. Nonlinguistic Representations (Graphic Organizers) 9. Cooperative learning 10. Generating and testing hypothesis 11. Cues, questions and advanced organizers	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard

Allele Amelogenin Gene Amino Acids Buccal Cells Chromosome CODIS Complementary Base Pairing DNA DNA Fingerprint DNA Probe Electrophoresis Epithelial Cells Gene Human Genome Project Hybridization Innocence Project Mitochondrial DNA Nuclear DNA Nucleotide PCR Polymer Primer Protein Replication Restriction Enzyme RFLP Sequencing STR Substrate Control Tandem Repeat Transcription VNTR Y STR	Refer to Tier 1 instructions	• Examination of advance SSDP, YSTR & VNTR fingerprints • Explore new technologies for isolating and sequencing DNA • Case studies of genetic fingerprinting anomalies (i.e. identical twins)

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 5

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 01/05 – 02/01

Unit of Study: Serology

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.4. Explain the role of the cell membrane in supporting cell functions.
D INQ.7. Describe how structural and behavioral adaptations increase the chances for survival
D INQ.10. Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.
D INQ.11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

CONTENT STANDARD B:
As a result of their activities in grades 9-12, all students should develop an understanding of
• Chemical reactions

CONTENT STANDARD C:

As a result of their activities in grades 9-12, all students should develop an understanding of
• Behavior of organisms

CONTENT STANDARD F:
As a result of their activities in grades 9-12, all students should develop an understanding of
• Personal and community health
• Science and technology in local, national, and global challenges

CONTENT STANDARD G:
As a result of their activities in grades 9-12, all students should develop an understanding of
• Science as a human endeavor
• Nature of scientific knowledge
• Historical perspectives

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● Components and functions of the human cardiovascular system. ● Composition of blood ● ABO Blood Type System ● The difference between of antigens and antibodies ● Forensic characteristics of bloodstains ● Stain patterns • Principles of heredity	● Explain how oxygen is carried by a red blood cell (DOK 2) ● State the characteristics and function of each part of human blood (DOK 1) ● Assess the physical characteristics and behavior of blood, and how these make blood an important source of evidence in crime-scene reconstruction (DOK 3) ● Demonstrate why blood typing is class evidence, and not individual evidence, and relate this to human genetics (DOK 3) ● Explain how blood evidence must be collected and stored, and why (DOK 1) ● Prioritize the usefulness of each component of blood in forensic investigation (DOK 2) ● Evaluate different patterns in blood spatter (DOK 3) ● Calculate/investigate impact angles, points of convergence and origin for blood spatter patterns (DOK 3)

Essential Questions	**Big ideas**

● What is the definition of a blood type? ● What are basics of the A-B-O blood typing system? ● How is serology used in forensic science? ● How are various bodily fluid identified, collected and analyzed? ● What are the different patterns of bloodstains and spatters and what conclusions can be drawn from these observations?	● Although specific blood typing has its limitations and is often disputed in court. ● Blood spray patterns can determine the force of trauma and type of weapon used on the victim. ● There are various components to whole blood. ● Antigens and antibodies are the basis of many medical based medications and serological techniques.

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● DNA structure and function ● PCR process ● vocabulary	● Lab: Blood Typing ● Lab: Determining Point of Convergence ● Quiz (materials up to date)	● Lab: Investigating relationship between bloodstains and impact angles (Luminol Lab) ● Unit test

Performance Task
● Lab: Investigating relationship between bloodstains and impact angles Students will perform an investigation to determine the angle of impact from a weapon at a crime scene and also determine the type or weapon used to inflict the trauma. Any additional resources of information need to be cited in proper MLA format ● The lab rubric will be used to evaluate the students' performance
Engaging Learning Experiences
● Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips ● Quizzes & assessment on concepts and relevant terminology ● Student research, discussion and presentations on case studies ● Cooperative learning and group work activities ● Suggested activities and practicums o Blood typing analysis with antiserums o Simulated urine, blood and saliva analysis o Blood stain and spatter analysis o Identification of human blood vs. animal blood, paint, other stains o Use of Luminol to detect cleaned bloodstains o Simulated crime scene involving collection and analysis of serology evidence

Instructional Resources

Journals

- Cox, M., "A Study of the Sensitivity and Specificity of Four Presumptive Tests for Blood," *Journal of Forensic Sciences*, 36 (1991): 1503.
- Gottfried, S. and M. Sedotti, "Blood Markers," Mystery Matters in *Chem Matters*, April 1992, pp. 4-6.
- Gross, A. M. et al., "The Effect of Luminol on Presumptive Tests and DNA Analysis Using the Polymerase Chain Reaction," *Journal of Forensic Sciences* 44 (1999): 837.
- Sweet, D. et al., "An Improved Method to Recover Saliva from Human Skin: The Double Swab Technique," *Journal of Forensic Sciences* 42 (1997): 320.

Web Sites

wayne‟s word.palomar.edu/aniblood.htm, animated blood types
nobelprize.org/educational_games/medicine/landsteiner, blood typing game
www.pimall.com/nais/nl/n.bloodstains.html
www.bloodspatter.com/BPATutorial.htm
faculty.ncwc.edu/toconnor/425/425lect13.htm
www.howstuffworks.com/luminol.htm
www.bsd405.org/teachers/suttonk/Inheritance/Powerpoint1/humheredity/humanheredity/index.htm
www.physics.carleton.ca/~carter, computerized blood spatter analysis
anthro.palomar.edu/blood/default.htm
www.peelpolice.on.ca/FIS/Blood-Pat.html
http://www.crime-scene-investigator.net/blood.html
http://www.fbi.gov/publications/leb/2005/feb2005/feb2005.htm
www.bloodspatter.com/bloodspatter.pdf
http://www.crimelibrary.com/criminal_mind/forensics/serology/8.html
http://www.albany.edu/writers-inst/turoach_baden.html
http://www.practicalhomicide.com/bio/bioBADEN.htm
http://www.shsu.edu/~chm_tgc/JPPdir/JPP1999
http://www.bobaugust.com/answers.htm#no11
http://www.nifs.com.au/FactFiles/dynamicblood/case.asp?page=case
www.iabpa.org, International Association of Bloodstain Pattern Analysis
www.criminalistics.com, American Board of Criminalistics
http://www.abpath.org, American Board of Pathology

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Summarizing and Note Taking 7. Homework and Practice 8. Nonlinguistic Representations (Graphic Organizers) 9. Cooperative learning	Universal Design for Learning Guidelines

10. Generating and testing hypothesis 11. Cues, questions and advanced organizers	

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Acid Phosphatase Agglutination Antibody Antigen Antiserum Arterial Blood Blood Factor Blood Spatter Blood Type Cast-Off Pattern Cell-Surface Protein Chemiluminescence Confirmatory Test Contact/Transfer Pattern Directionality DNA Enzyme Erythrocyte Genotype Hemoglobin Heterozygous High-Velocity Pattern Homozygous Leukocyte Lines Of Convergence Low-Velocity Pattern Luminol Phenolphthalein Phenotype Plasma Point Of Convergence Point Of Origin Precipitin Presumptive Test Secretor Serology Serum Target Surface Terminal Velocity Venous Blood	Refer to Tier 1 instructions	● How are custom antibodies engineered and created ● Explore new technologies for collecting serological samples ● Effects of chemicals on serological analysis

White Blood Cell Wipe/Swipe Pattern		

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 6

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 02/02 – 02/29

Unit of Study: Forensic Anthropology Pathology & Tissue Decomposition

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology

History and Nature of Science: CONTENT STANDARD G:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● The bones of the human skeleton. ● Definitions of forensic anthropology, forensic pathology and odontology ● The origin and structure of human bones and teeth ● Process of muscle contraction and relaxation ● Definition of toxicology ● Definition of pharmacokinetics	● Discuss how the characteristics of bone and muscle help provide valuable clues in forensic investigation (DOK 1) ● Relate mitochondrial DNA to bone (DOK 2) ● Explain how muscles contract and relax and the role calcium in the process (DOK 2) ● Construct the various procedures performed during an autopsy (DOK 3) ● Assess time of death can be established by using core body temperature and etymological evidence (DOK 3) ● Analyze pharmacokinetic data to determine the mechanism of death by identifying possible drug and alcohol use (DOK 4) ● Analyze the evidence of livor mortis, rigor mortis, and algor mortis (DOK 4) ● Compare measurements of bones and skulls to identify a victim (DOK 3)

Essential Questions	**Big ideas**

• What are the 4 manners of death and how are they identified? • How is the mechanism of death identified? • What are the procedures performed in an autopsy? • How is core body temperature used to establish time of death? • What is toxicology & pharmacokinetics and how is it used in forensic pathology? • What is forensic anthropology and how is it used to identify skeletal remains?	• The stages of mortis can determine the age of a body and if the body has been moved post mortem. • Autopsies are a useful medical procedure and are necessary to determine cause of death if unknown. • Drugs, poisons and toxins are often used as forensic evidence to determine cause of death. • Skeletal remains of multiple victims (i.e. mass graves) can be analyzed by forensic anthropologists.

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups • Stages of mortis • Skeletal bone identification • vocabulary	Lab: Muscle Contractions Computer Activity tutorial Lab: Bertillon measurements Lab: Sherlock Bones Lab: Bite Marks Lab: Disarticulated skeleton assembly	• Stages of Mortis time line • Quiz (materials up to date) • Unit test

Performance Task
Stages of Mortis Time Line At the beginning of the years students were given a deceased mouse which they buried outback of the school. Over the course of the month students went out every several days and collected data regarding the mouse's decomposition in terms of tissue, weight loss, odor, decomposition and color (students were instructed to take pictures each time they dug up their mouse for photo evidence). The students collected this information and were instructed to keep it for analysis at a later time. Students will construct a time line of the mouse's decomposition from day 1 to day 30 and describe the information they collected during this period. The timelines will be presented to the class and the rubric used will be the Stages of Mortis Time Line rubric
Engaging Learning Experiences
• Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips • Quizzes & assessment on concepts and relevant terminology • Student research, discussion and presentations on case studies • Cooperative learning and group work activities • Suggested activities and practicums o Comparative analysis of bones for race, gender and age o Fetal pig dissection "autopsy" o Drug & toxicology analysis o Analysis of stomach contents of a corpse

o Aspects of post-mortem analysis to determine cause and time of death (core body temperature, entomology) o Simulated crime scene to reinforce concepts relating to forensic pathology

Instructional Resources
<u>Journals</u> ● Beard, B. L. and Johnson, C. M., "Strontium isotope composition of skeletal material can determine the birthplace and geographic mobility of humans and animals," *Journal of Forensic Science* 45 (5), September 2003. ● Suchey, J. M. and S. Brooks, "Skeletal Age Determination Based on the Os Pubis," *Human Evolution Journal,* vol. 5 (1990), pp. 227-238. ● Suchey, J. M. and P. A. Owings Webb. "Epiphyseal Union of the Anterior Iliac Crest and Medial Clavicle," *American Journal of Physical Anthropology,* vol. 68 (1985), pp. 457-466. ● Suchey, J. M. and L. D. Sutherland, "Use of the Ventral Arc in Pubic Sex Determination," *Journal of Forensic Sciences,* vol. 36, no. 2 (March 1991), pp. 346-355. <u>Web Sites</u> www.scuchico.edu/anth/AFBA, American Board of Forensic Anthropology. www.abfo.org, American Board of Forensic Odontology. www.asfo.org, American Society of Forensic Odontology. http://web.anthro.ufl.edu/c.a.poundlab/poundlab.htm, C.A. Pound Human Identification Laboratory. www.karenttaylor.com, Forensic artist http://depts.washington.edu/bonebio/ASBMRed/ASBMred.html, American Society of Bone and Mineral Reconstruction www.all-about-forensic-science.com/forensic-anthropology.html www.forensicanthro.com/forensic-resources/ web.utk.edu/~anthrop/FACcenter.html www.indiana.edu/~wanthro/theory_pages/forensic.htm www.txstate.edu/anthropology/field-schools/forensic.html www.kathyreichs.com/forensics.htm, TV show "Bones" is based on her! www.killgrove.org/osteo.html www.forensic.to/webhome/bitemarks/

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Summarizing and Note Taking 7. Homework and Practice 8. Nonlinguistic Representations (Graphic Organizers) 9. Cooperative learning 10. Generating and testing hypothesis	Universal Design for Learning Guidelines

11. Cues, questions and advanced organizers	

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Actin Aerobic Respiration Algor Mortis Anaerobic Respiration Anthropology Arthritis ATP Cardiac Muscle Compact Bone Diaphysis Epiphysis Extensor Flexor Forensic Anthropology Growth Plates Haversian Canals Livor Mortis Lucis Marrow Myosin Odontology Ossification Osteobiography Osteoblast Osteoclast Osteocyte Osteons Osteoporosis Post-Mortem Interval Rigor Mortis Skeletal Muscle Skeletal Trauma Sliding Filament Theory Smooth Muscle Tendon	Refer to Tier 1 instructions	● History or autopsy as a medical procedure ● Explore new technologies for pharmacokinetic analysis ● Effects of endogenous factors on toxicological analysis

Click on the link to see a Sample Lesson Plan for Unit 6

Rigorous Curriculum Design Template

Unit : 7

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 03/01 – 03/21

Unit of Study: Forensic Entomology

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.8. Describe the factors that affect the carrying capacity of the environment.
D INQ.9. Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Life Science: CONTENT STANDARD C:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Science in personal and cultural perspectives: CONTENT STANDARD F:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards

- Science and technology in local, national, and global challenges

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● Definition of forensic entomology ● Different species of insects that aid in decomposition ● Bug identification by dichotomous keys ● Morphology of bugs ● What bugs inform us about the decomposition of a body ● What stage of decomposition a body is in by visual comparison	● Compare and contrast different species of insects that aid in decomposition (DOK 2) ● Investigate the stages in the life cycle of the blowfly (DOK 3) ● Describe stages of decomposition of a corpse (DOK 2) ● Calculate/formulate estimated post-mortem interval based upon the blowfly life cycle (DOK 3) ● Explain and analyze how environmental factors may influence estimated time of death (DOK 4) ● Order different species of insects that might be found on a decomposing corpse chronologically (DOK 2) ● Synthesize how time of death may be estimated using insects, stomach contents, environmental factors, and algor, livor, and rigor mortis (DOK 4)

Essential Questions	**Big ideas**
● What is forensic entomology, and how is used in determining estimated time of death? ● What role do insects play in decomposition? ● What entomological evidence can be used to determine factors leading up to death	● Insects and other forms of life can affect a bodies decomposition rate. ● Insects have various stages in their life cycles that can be used as biological indicators of time. ● Insects can have a biogeographical distribution which is indicative of their life cycle.

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● Stages of insect morphology ● Types of insects associated with decomposition ● vocabulary	● Lab: Invertebrate life cycles of beetle and flies ● Activity: Calculating Time of Death using Insects ● Quiz (materials up to date)	● Lab: Maggots and Murder ● Activity: Insect Study ● Unit Test

Performance Task

Lab: Maggots and Murder
Students will investigate the types of maggots associated with tissue decomposition. This will consist of both microscopy and online virtual analysis of tissue samples and various insect larvae. The lab rubric will be used to evaluate student performance on this task

Engaging Learning Experiences

- Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips
- Quizzes & assessment on concepts and relevant terminology
- Student research, discussion and presentations on case studies
- Cooperative learning and group work activities
- Suggested activities and practicums
  - o Comparative analysis of maggots and tissue
  - o Study of insects found in Thomaston (student outside activity)
  - o Simulated crime scene to reinforce concepts relating to forensic entomology

Instructional Resources

Books and Journals

- Bass, Bill. *Death"s Acre: Inside the Body Farm.* New York: Ballantine Books, 1989.
- Bass, Bill and Jon Jefferson. *Death"s Acre: Inside the Legendary „Body Farm."* New York, NY: Penguin Group, Inc. (USA), 2003.
- Dix, Jay. *Death Investigator"s Manual.* Public Agency Training Council.
- Geberth, Vernon J. *Practical Homicide Investigation,* 3rd ed.. Boca Raton, FL: CRC Press, 1996.
- Goff, M. Lee. *A Fly for the Prosecution – How Insect Evidence Helps Solve Crimes.* Cambridge, MA: Harvard University Press, 2001.
- Hanzlick, Randy and Michael A. Graham. *Forensic Pathology in Criminal Cases*, 2ed. Lexis Law Publishing, 2000.
- Haskell, Neal and Robert D. Hall. "Forensic (Medicocriminal) Entomology –
- Applications in Medicolegal Investigations." *Forensic Sciences.* Cyril H. Wendt, General Editor, Matthew Bender & Company, Inc., 2005.
- Larkin, Glenn M. "Time of Death." *Forensic Sciences.* Cyril H. Wendt, General Editor, Matthew Bender & Company, Inc., 2005.
- Nickell, Joe and John Fischer. *Crime Science: Methods of Forensic Detection.* Lexington, KY: The University Press of Kentucky, 1999.
- Roach, Mary. *Stiff: The Curious Lives of Human Cadavers.* New York: W.W. Norton and Company, 2002.
- Sachs, Jessica. *Time of Death.* New York: New Arrow Books Ltd., 2003.
- Snyder Sachs, J. *Corpse: Nature, Forensics, and the Struggle to Pinpoint Time of Death.* New York: Perseus Books Group, 2002

Websites

www.forensicentomology.com
www.forensic-entomology.com
http://www.forensic-entomology.info/forens_ent/forensic_entomol_pmi.shtml
http://www.crimelibrary.com/criminal_mind/forensics/bill_bass/index.html
extension.entm.purdue.edu/topics/forensics.php

tlc.ousd.k12.ca.us/~acody/forensic.html entweb.clemson.edu/biomia/links/forensic.html www.all-about-forensic-science.com/forensic-entomology.html linkinghub.elsevier.com/retrieve/pii/S0163445303002032, Forensic entomology resources insects.tamu.edu/feature/forensic/ www.livingwithbugs.com/forensic.html www.nhm.ac.uk/nature-online/life/insects-spiders/webcastforensicentomology/forensic-entomology.html www.forensicflies.com/ forensic.to/links/pages/Forensic_Medicine/Entomology/

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Summarizing and Note Taking 7. Homework and Practice 8. Nonlinguistic Representations (Graphic Organizers) 9. Cooperative learning 10. Generating and testing hypothesis 11. Cues, questions and advanced organizers	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Autolysis Blowfly Body Farm Carrion Insects Cause Of Death Decomposition Entomologist Entomology Forensic Entomologist Larva Maggot Manner Of Death Mechanism Of Death Necrophagous Insects Omnivorous Insects Predatory Insects Pupa Puparium	Refer to Tier 1 instructions	● Virtual exploration of FBI Body Farm ● Digital Detectives Mysteries- "The Case of the Killer Bugs ● TMMC- The Case of the Water Hymph

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 8

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 03/22 – 04/8

Unit of Study: Trace Evidence (Hair, Fibers, Glass, Pollen, Spores, etc)

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry

- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology
- Science and technology in local, national, and global challenges

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● The different types of trace evidence that might be found at a crime scene ● How different types of physical evidence are collected. ● The origin and structure of human hair. ● How pollen and spores are formed. ● The origin and structure of fibers and glass	● Compare how the physical characteristics of hair, fibers, pollen, and glass make them useful pieces of evidence in a crime scene (DOK 3) ● List the steps in recognizing, collecting, and packaging trace evidence (DOK 1) ● Compare and contrast different types of glass based on density and refractive index (DOK 2) ● Distinguish/ compare between human and animal hair (DOK 3) ● Analyze natural and manmade fibers based on physical and chemical characteristics (DOK 4) ● Identify the characteristics of natural and synthetic fibers that can be used for identification (DOK 1)

Essential Questions	**Big ideas**
● What is the morphology of hair? ● What are characteristics used to distinguish between animal and human hair? ● What are the features of human hair that can be used to identify different types of hair? ● How are hair samples collected and analyzed as evidence? ● How are natural and synthetic fibers distinguished? ● What are spores/ pollen and what are the stages of spore/ pollen morphology	● The morphology of hair varies from person to person, allowing it to be examined as evidence ● Characteristics of hair vary between different species and can be used to identify them ● Fibers have characteristics that can be used to identify their originating materials ● Trace elements, metals, soil samples, paint samples, glass fragments can all be used as evidence to identify suspects in a crime

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● Stages of hair morphology ● Types of spores and pollen ● vocabulary	● Activity: Bed Sheet Thread Count ● Activity: Weave Pattern Analysis ● Activity: Textile Identification	● Lab: Microscopy of Fibers ● Lab: Hair Microscopy & Analysis ● Close Reading on Fiber Analysis ● Quiz

	● Lab: Burn Analysis of Fibers ● Lab: Pollen Examination ● Lab: Glass Fracture Patterns ● Lab: Glass Density ● Activity: Determining Refractive Index of Liquids using Snell‟s Law	● Unit Test

Performance Task
The students will be doing a close reading on fiber analysis and writing a 3-4 paragraph report on their findings. Their answers to the supporting questions will be used to help them construct their writing piece. The written summary will be assessed using the Close Reading Rubric.
Engaging Learning Experiences
● Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips ● Quizzes & assessment on concepts and relevant terminology ● Student research, discussion and presentations on case studies ● Cooperative learning and group work activities ● Suggested activities and practicums o Review compound light microscope use procedures o Analysis of human hair samples o Comparative analysis of human hair and various animal hair types o Comparative analysis of natural and synthetic fibers o Investigation and analysis of other trace evidence

Instructional Resources
Journals ● Allen, T. J., "Paint Sample Presentation for Fourier Transform Infrared Microscopy," *Vibration Spectroscopy* 3 (1992): 217. ● Beveridge, A. P. and C. Semen. "Glass Density Measurement Using a Calculating Digital Density Meter," *Canadian Society of Forensic Science Journal* 12 (1979): 113. ● Cassista, A. R. and P. M. L. Sandercock, "Precision of Glass Refractive Index Measurements: Temperature Variation and Double Variation Methods, and the Value of Dispersion," *Canadian Society of Forensic Science Journal* 27 (1994): 203. ● Chaperlin, K. and P. S. Howarth, "Soil Comparison by the Density Gradient Method – A Review and Evaluation," *Forensic Science International* 23 (1983): 161-177. ● Edmondstone, G., "The Identification of Heat Strengthened Glass in Windshields, *Canadian Society of Forensic Science Journal* 30 (1997): 181. ● Edmondstone, G., J. et al., "An Assessment of the Evidential Value of Automotive Paint Comparisons," *Canadian Society of Forensic Science Journal* 37 (2004): 147. ● Graves, W. J., "A Mineralogical Soil Classification Technique for the Forensic Scientist," *Journal of Forensic Sciences* 24 (1979): 323. ● Grieve, M. C., "Another Look at the Classification of Acrylic Fibres, Using FTIR Microscopy," *Science & Justice* 35

(1995): 179.

- Houk, M. M. and B. Budowie, "Correlation of Microscopic and Mitochondrial DNA Hair Comparisons," *Journal of Forensic Sciences* 47 (2002): 964.
- Junger, E. P., "Assessing the Unique Characteristics of Close-Proximity Soil Samples: Just How Useful is Soil Evidence?" *Journal of Forensic Sciences* 41 (1996): 27.
- King, L. A., R. Wigmore and J. M. Twibell, "The Morphology and Occurrence of Human Hair Sheath Cells," *Journal of the Forensic Science Society* 22 (1982): 267.
- Laing, D. K. et al., "The Standardization of Thin-Layer Chromatographic Systems for Comparisons of Fibre Dyes," *Journal of the Forensic Science Society* 30 (1990): 299.
- Linch, C. A. et al., "Evaluation of the Human Hair Root for DNA Typing Subsequent to Microscopic Comparison," *Journal of Forensic Sciences* 43 (1998): 305.
- Lynn, W. C. and M. J. Pearson. "The Color of Soil," *The Science Teacher*, May 2000, p.20.
- McVicar, M. J. and W. J. Graves, "The Forensic Comparison of Soil by Automated Scanning Electron Microscopy," *Canadian Society of Forensic Science Journal* 30 (1997): 241.
- McPhee, J. "The Gravel Page," *The New Yorker*, January 29, 1996, pp. 46-90. Meloan, C. E. "Fibers, Natural and Synthetic," *Chemistry*, vol. 51, April 1978.
- Stratton, David R. "Reading the Clues in Fractured Glass." *Security Management* 38(1): 56, January 2004.
- Murray, R. "Devil in the Details, The Science of Forensic Geology," *Geotimes*, February 2000, p. 14.
- Palenki, S. and C. Fitzsimons," Fiber Cross-Sections, Part I," *Microscope* 38 (1990): 187.
- Rodgers, P. G. et al., "The Classification of Automobile Paint by Diamond Window Infrared Spectrophotometry, Part I: Binders and Pigments," *Canadian Society of Forensic Science Journal* 9 (1976): 1.
- Tungol, M. W. et al., "Analysis of Single Polymer Fibers by Fourier Transform Infrared Microscopy: The Results of Case Studies," *Journal of Forensic Sciences* 36 (1992): 1027.
- Wood, C. G. "Natural Dyes," *Chem Matters*, December 1986, pp. 4-7

<u>Websites</u>

www.iactonline.org, International Association for Chemical Testing
www.iamaweb.com, International Association for Microanalysis
www.fbi.gov/hq/lab/org/labchart.htm, FBI Lab Services
http://www.fbi.gov/hq/lab/fsc/backissu/july2000/deedric1.htm, "Hair, Fibers, Crime and Evidence," "Microscopy of Hair, Part I: A Practical Guide and Manual for Human Hairs," "Microscopy of Hair, Part 2: A Practical Guide and Manual for Human Hairs"
http://fbi/gov/hq/lab/fsc/backissu/jan2004/research/2004)_01_research01b.htm
http://www.forensischinstituut.nl/NFI/en/Typen+onderzoek/Items/Forensic+examination+pf+hair.htm
http://www.policenws.com/info/forensic/forensic7a.html
http://www.teachingtools.com/HeadJam/index.htm, FBI Trace Evidence and DNA analysis
http://www.crimelibrary.com/criminal_mind/forensics/trace/1.html
http:/www.crimeandclues/com/pollen.htm;
http://www.nature.com/news/1998/981008/full/981008-2.html, "Forensic Palynology: A New Way to Catch Crooks"
http://abc.net.au/cgibin/common/printfriendly.pl?/science/news/enviro/EnviroRepublish_1105992.htm,
http://myweb.dal.ca/jvandomm/forensicbotany/palynology.html;

http://www.crimeandclues.com/palynologyus.htm, “Palynology”
http://keyetv.com/local/local_story_131221754.html, “Pollen Being Used to Track Criminals”
http://www.shroudstory.com/exhibit/maxfrei01.htm; “The Shroud of Turin Story”
http://www.actionbioscience.org/newfrontiers/salyersarticle.html; “Microbes in Court: The Emerging Field of Microbial Forensics”
http://news.bbc.co.uk/1/hi/sci/tech/3640788.stm; “Pollen Helps War Crime Forensics”
http://www.ndaa.org/publications/newsletters/silent_witness_volume_9_number_4_2005.
html; “Forensic Palynology and Plant DNA: The Evidence that Sticks”
www.hair-science.com/_en/ww/loreal-hair-science/focus-hair-science_us.aspx
www.fibersource.com/f-tutor/prods
www.fibergypsy.com/index
www.pslc.ws/macrog.htm; polymers and uses
soils.ag.uidaho.edu/soilorders; soil information
www.itc.nl/~rossiter/Docs/FM5-410/FM5-410_Ch4.pdf; soil information
www.geoforensics.com/geoforensics/art-1101a.html; forensic geologist
web.umr.edu/~rogersda/forensic_geology; case histories
www.britglass.co.uk/aboutglass/aboutglasshome.html
www.gwu.edu/~forchem/OurMainPage/mainpage.htm; refractive index
www.phy.ntnu.edu.tw/java/propagation/propagation.html; reflection-refraction
www.fbi.gov/page2/dec04/lab122204.htm; link to forensic glass examination
intro.chem.okstate.edu/ChemSource/Forensic/forechem8.htm; physical property demos
www.stfrancis.edu/ns/diab/ForensicCoursePPT/Ch4webGlass&Soil.htm
echo.forensicpanel.com/2000/10/12/thatsnot.html; “That‟s Not My Hair”
www.modernmicroscopy.com/main.asp?article=24&page=1; “A Microscopical Study of Exotic Animal Hair”
www.fbi.gov/hq/lab/fsc/backissu/july1999/painta.htm; paint analysis
www.forensicgeology.net/science.htm; “Collecting Crime Evidence from Earth”
www.interpol.int/Public/Forensic/IFSS/meeting13/Reviews/Soil.pdf; forensic examination of soil evidence

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Homework and Practice 7. Nonlinguistic Representations (Graphic Organizers) 8. Cooperative learning 9. Generating and testing hypothesis 10. Cues, questions and advanced organizers	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard

Amorphous Anagen Phase Angiosperm Becke Line Catagen Phase Class Evidence Comparison Microscope Cortex Crystalline Cuticle Density Direct Transfer Exine Fabric Fiber Fluorescence Follicular Tag Forensic Palynology Glass Gymnosperm Hair Follicle Keratin Leaded Glass Macromolecule Manufactured Fibers ineral Fiber Natural Fiber Obsidian Organic Palynology Pistil Plastic Pollen Pollen Fingerprint/Profile Pollination Polyester Refraction Refractive Index Root Secondary Transfer Soil Spore Stamen Synthetic Fiber Telogen Phase Textile Trace Evidence	Refer to Tier 1 instructions	• Examining case studies of textile and trace evidence • Exploration of new technologies for determining refractive index of light • Activity: Determining Refractive Index of Glass using Liquid Comparisons in a Submersion Test

Warp Weft/Woof		

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 9

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 04/18 – 05/06

Unit of Study: Forensic Toxicology and Drugs

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data.

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology
- Science and technology in local, national, and global challenges

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● Key properties and element of the periodic table ● Organs of the digestive system ● Glycolysis, Crebe's Cycle and Electron transport Chain ● Principles of Pharmacokinetics ● Serum and plasma	● Define forensic toxicologist (DOK 1) ● Define controlled substances (DOK 1) ● Cause and effect of five controlled substances (DOK 2) ● Summarize the role of a toxicologist in a forensic investigation(DOK 2) ● Assess the ways drugs can enter and exit a human body (DOK 3) ● Hypothesize what happens to drugs inside a human body, including overdoses of specific drugs (DOK 3) ● Investigate how a toxicologist can screen for and confirm the presence of drugs in a body (DOK 3) ● Distinguish between narcotic, drug, poison, toxin, and analgesic (DOK 2)

Essential Questions	**Big ideas**
● What is forensic toxicology, and how is used in forensic investigation? ● How does the human body metabolize and excrete drugs? ● How are drugs and metabolites measured in serum, plasma and blood	● Certain metabolites and drugs can be difficult to detect in a human body ● Measuring the metabolites of a toxin, poison or other drug can be determined using pharmacokinetics, LCMS and Thin Paper Chromatography ● Bioterrorism involves the intentional release of biological agents

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● Stages aerobic respiration ● Types of toxins, poisons and metabolites ● vocabulary	● Lab: Drug Analysis ● Lab: Urine Analysis	● Lab: Drug Identification ● Debate: Caffeine Abuse ● Unit Test

Performance Task
Debate: Caffeine Abuse Students will read the paper *Effects of Caffeine on Human Behavior* (Food Chem Toxicol. 2002 Sep; 40(9):1243-55) and additional supportive documentation that analyze the effects of caffeine on the human body. Students will gather information and have a debate whether coffee should be classified as a controlled substance and if it should only be consumed by people of legal age (18 years and older). Student performance will be assessed using the Debate Rubric
Engaging Learning Experiences
● Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips ● Quizzes & assessment on concepts and relevant terminology ● Student research, discussion and presentations on case studies ● Cooperative learning and group work activities ● Suggested activities and practicums o Review digestive system o Analysis of urine, serum or blood samples (virtual) o Comparative analysis of pharmacokinetic and toxicological data (drugs, toxins, poisons) o Investigation and analysis of other trace evidence

Instructional Resources
Journals ● Brown, G. A. et al., "The Stability of Ethanol in Stored Blood," *Analytica Chemica Acta* 66 (1973): 271. ● Cawley, J. J., "The Identification of Aspirin-Free Bayer Products," *J. Chem. Ed.* Vol. 72 (March 1995), pp. 272-273. ● Chen, Albert. "A Scary Little Pill: A powerful medicine for pain, OxyContin has quickly become a dangerous street drug," *Sports Illustrated* 101.24 (12/20/2004). ● Cormier, R. A. et al., "Thin-Layer Chromatographic Separation of Common Analgesics A Consumer Experiment" *J. Chem. Ed.* Vol. 56 (March 1979), p. 180. ● Graham, Tim. "When Good Science Goes Bad," *Chemistry Matters*, October 2004, pp. 16-18 ● Lubasch, A. H., "Reputed Mobster Guilty in Six Narcotics Murders; Death Penalty Possible Under Federal Law," *New York Times*, New York, June 26, 1992, p. B3. ● May, Meredith. "Fraternity Pledge Died of Water Poisoning. Forced Drinking Can Disastrously Dilute Blood"s Salt Content," *San Francisco Chronicle*, February 4, 2005. ● Wesley, James F. "Osmolality – A Novel and Sensitive Tool for Detection of Tampering of Beverages Adulterated with Ethanol, ~Butyrolactone, and 1,4~Butanediol, and for ● Detection of Dilution-Tampered Demerol Syringes," *Microgram Journal* 1 (2003): 8. Websites www.iactonline.org; International Association for Chemical Testing www.tiaft.org; International Association of Forensic Toxicologists www.roysocmed.ac.uk; Royal Society of Medicine (UK) www.abft.org; American Board of Forensic Toxicology www.thename.org; National Association of Medical Examiners www.soft-tox.org; Society of Forensic Toxicologists www.cal-tox.org; California Association of Toxicologists

www.sat-tox.org; Southeastern Association of Toxicologists
http://abcnews.go.com/US/story?id=2861902&page=1
http://www.thesmokinggun.com/archive/years/2007/0326071anna1.html
http://www.cnn.com/2007/SHOWBIZ/TV/03/26/smith.autopsy/index.html
http://faculty.pharmacology.ucla.edu/institution/personnel?personnel_id=45462
http://outside.away.com/outside/features/200507/drugs-in-sports-2.html
http://www.usatoday.com/sports/olympics/2007-02-28-catlin-timeline_x.htm
http://www.fdaa.com//forensicdrugabuseadvisor
www.drugabuse.gov/NIDAHome.html
www.usdoj.gov/dea/concern/concern.htm; drug information
www.ojp.usdoj.gov/bjs/dcf/contents.htm; drugs and crime statistics
www.whitehousedrugpolicy.gov/streetterms/Default.asp; drug street names
chemistry.about.com/library/weekly/aa021302a.htm; intro. to spectroscopy
science.csustan.edu/tutorial/ir/index.htm; tutorial on IR spectroscopy
chipo.chem.uic.edu/web1/ocol/spec/MS1.htm; tutorial on mass spectrometry
www.chem.arizona.edu/massspec/intro_html/intro.html; tutorial on mass spectrometry
www.chemistry.nmsu.edu/Instrumentation/GC.html; gas chromatography
www.sh.ac.uk/schools/sci/chem/tutorials/chrom/gas-chrm.htm; gas chromatography
www.chem.vt.edu/chem-ed/sep/gc/gc.html; gas chromatography
webbook.nist.gov/chemistry/name-ser.html; database on spectra
www.rxlist.com/cgi/rxlist.cgi; prescription drug id
www.intox.com/about_alcohol.asp
www.elmhurst.edu/~chm/vchembook/642alcoholmet.html; alcohol metabolism
www.nhtsa.dot.gov/people/injury/research/job185drugs/technical-page.htm; "Drugs and Human Performance"
faculty.ncwc.edu/toconnor/425/425lect14.htm; review of forensic toxicology
www.courttv.com/trials/turner/; trial of Julia Turner
www.cnn.com/2003/US/Southwest/11/17/fraternity.pledge.ap/; fraternity pledge and water poisoning
water.usgs.gov/nawqa/trace/arsenic/; arsenic in groundwater

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Homework and Practice 7. Nonlinguistic Representations (Graphic Organizers) 8. Cooperative learning 9. Generating and testing hypothesis 10. Cues, questions and advanced organizers	Universal Design for Learning Guidelines

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard

Absorption Acid Alcohol Alkaloid Alveoli Anabolic Steroids Analgesic Anticoagulant Base Bioterrorism Cannabis Sativa Capillary Catalyst Chemist Chromatography Clandestine Drug Lab Confirmation Test Controlled Substance Depressants Designer Drug Excretion False Positive Gamma Hydroxybutrate (GHB) Gas Chromatography Hallucinogen Heavy Metals Mass Spectrometer Metabolism Narcotic Oxidation Pesticides Ph Scale Plasma Poison Preservative Rohypnol Screening Test Spectrophotometry Stimulants Teratogen Thin-Layer Chromatography Toxin Vein	Refer to Tier 1 instructions	• Exploration of most lethal poisons and toxins • Case study: "Famous" Assassins http://forensicscienceeducation.org/wp-content/uploads/2011/11/Forensic-Toxicology.pdf • Exploration on the effects of alcohol poisoning (binge drinking)

Click on the link to see a Sample Lesson Plan for Unit 9

Forensic Science Unit -

Rigorous Curriculum Design Template

Unit : 10

Subject: Biology

Grade/Course: 11 & 12/ Forensic Science

Pacing: 05/06 – 05/31

Unit of Study: Document Analysis and Ballistics

Priority Standards:

STATE STANDARDS ADDRESSED IN THIS UNIT

SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.
D INQ.6 Use appropriate tools and techniques to make observations and gather data.

NATIONAL STANDARDS ADDRESSED IN THIS UNIT

Science as Inquiry: CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology: CONTENT STANDARD E:
As a result of their activities in grades 9-12, all students should develop an understanding of

- Abilities of technological design
- Understandings about science and technology
- Science and technology in local, national, and global challenges

"Unwrapped" Standards	
Concepts (What Students Need to Know)	**Skills (What Students Need to Be Able to Do)**
● Definition of handwriting analysis, forgery, counterfeiting and ballistics ● Paper characteristics of currency that help detect counterfeit bills. ● Specific bullets can be traced to the firearm that fired them	● List 12 characteristics of handwriting used in document analysis (DOK 1) ● Describe what a firearm is, and how it works (DOK 2) ● Discuss paper characteristics of currency that help detect counterfeit bills(DOK 2) ● Formulate how specific bullets can be traced to the firearm that fired them (DOK 3) ● Distinguish between forgery and fraudulence (DOK 1) ● Assess an unknown handwriting sample to an exemplar (DOK 3) ● Analyze and differentiate the differences between a handgun, rifle, shotgun, revolver, pistol, semi-automatic firearm, and automatic firearm (DOK 4)

Essential Questions	**Big ideas**
● What is document analysis, and what role does it play in forensic investigation? ● What is ballistics, and what role does it play in forensic investigation? ● What are the various methods by which documents can be prepared? ● How can typescript comparisons be used to determine the source of production of a document? ● How can chromatography be used to identify the composition of inks and pigments? ● What are the distinguishing points of similarity and difference that can be used to identify handwriting samples? ● How do firearms work and how can bullet be traced to the firearm? ● What types of trauma result from various ballistics and trajectories?	● Individuals have particular written habits that are specific to them ● Documents can be analyzed using several methods ● Counterfeit documents are made to imitate the real product. Many tests can be performed to determine their authenticity ● Certain chemicals can make "invisible ink" appear ● Spent bullets are traceable due to their jacket markings ● Not all bullets cause the same type of trauma

Assessments		
Common Formative Pre-Assessments	Progress Monitoring Checks – "Dipsticks"	Common Formative Mid and or Post-Assessments Resources
Pre Class Warm ups ● Stages of hair morphology ● Types of spores and pollen ● vocabulary	● Activity: Analysis of ransom note and expert testimony ● Activity: U.S. Currency Examination: Real or forgery? ● Activity: Firing Pin Match	● Lab: Bullet Trajectory: Where is the Shooter? ● Lab: Handwriting analysis ● Unit Test

Performance Task
The Bullet Trajectory and Handwriting Analysis labs will serve as the performance task(s). They will be graded using the Lab Rubric.
Engaging Learning Experiences
● Lecture, presented via overhead notes and PowerPoint presentation with teacher demonstrations and multimedia clips ● Quizzes & assessment on concepts and relevant terminology ● Student research, discussion and presentations on case studies ● Cooperative learning and group work activities ● Suggested activities and practicums o Individual handwriting analysis – identifying slants, lifts & separations, pen pressure, flourishes, embellishments and handwriting habits o Creation and identification of simulated document forgeries o Analysis of letter angle in handwriting analysis o Identifying counterfeit currency o Ink comparison using paper and thin-layer chromatography o Simulated crime activity relating to document and handwriting analysis

Instructional Resources
Journals ● Ellen, D. M. et al., "The Use of Electrostatic Imaging in the Detection of Indented Impressions," *Forensic Science International* 15 (1980): 53. ● Kilty, J. W., "Activity after Shooting and Its Effect on the Retention of Primer Residues,"*Journal of Forensic Sciences* 20 (1975): 219. ● Magnuson, Ed. "Hitler‟s Forged Diaries, *Time,* May 16, 1983, 36-47. ● Maiti, P. C., "Powder Patterns around Bullet Holes in Bloodstained Articles," *Journal of the Forensic Science Society* 13 (1973): 197. ● Pfefferli, P. W., "Application of Microspectrophotometry in Document Examination,"*Forensic Science International* 23 (1983): 129. ● Plummer, C. M. "The Forgery Murders," *Chem Matters,* December 1995, pp. 8-11.

- Tontarski, R. E. Jr. et al., "Automated Firearms Evidence Comparison: A Forensic Tool for Firearms Identification – An Update," *Journal of Forensic Sciences* 43 (1998): 641
- Woiten, G. M. et al., "Particle Analysis for the Detection of Gunshot Residue, I: Scanning Electron Microscopy/Energy Dispersive X-Ray Characterization of Hand
- Deposits from Firing," *Journal of Forensic Sciences* 24 (1979): 409

Websites

www.qdewill.com; document examination
www.forgeryfinder.com
www.fbi.gov/hq/lab/fsc/backissu/april2000.swgdoc1.htm; forensic document examination
www.fbi.gov/hq/lab/fsc/backissu/april2001/held.htm; handwriting and typewriting
www.fdeservices.com/Exemplars.htm; getting handwriting samples
www.faculty.ncwc.edu/toconnor/425/425lect05.htm; document examination
www.stfrancis.edu/ns/diab/Forensic1/Ballistics1_files/frame.htm
www.firearmsid.com/new_index.htm
www.faculty.ncwc.edu/toconnor/425/425lect.06,htm; ballistics tutorial
www.fbi.gov/hq/lab/fsc/backissu/april2000/schehl1.htm#FirearmsID
www.medstat.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html
www.fbi.gov/libref/historic/famcases/weinber/weinbernew.htm; Weinberger kidnapping
www.fbi.gov/libref/historic/famcases/lindber/lindbernew.htm; Lindbergh kidnapping
http://www.usatoday.com/educate/newmoney/index.thm
http://www.moneyfactory.gov/newmoney/index.cfm
http://www.lib.udel.edu/ud/spec/exhibits/forgery/wise.htm
http://ww.crimelibrary.com/criminal_mind/scams/shakespeare/6.html
http://www.secretservice.gov/money_detect.shtml
http://ww.myhandwriting.com/celebs/ransom1.html
http://www.crimelibrary.com/forensics/literary/3.htm
http://www.courttv.com/talk/chat_transcripts/2001/1025baggett.html
http://www.handwritingsherlock.com
www.abc.news.com, Oct. 30, 2003, "Uncovering Convincing Evidence"
http://www.firearms.iD.com
http://www.bis.gov/oco/ocos115.htm

Instructional Strategies	Meeting the Needs of All Students
1. Identifying similarities and differences 2. Critical thinking and problem solving 3. Effective oral and written communication 4. Accessing and analyzing information 5. Collaborating and leadership 6. Homework and Practice 7. Nonlinguistic Representations (Graphic Organizers) 8. Cooperative learning	Universal Design for Learning Guidelines

9. Generating and testing hypothesis 10. Cues, questions and advanced organizers	

New Vocabulary	Students Achieving Below Standard	Students Achieving Above Standard
Ammunition Ballistics Barrel Bore Breech Bullet Caliber Cartridge Counterfeiting Diacritics Document Analysis Document Expert Erasure Exemplar Firearm Forgery Fraudulence Gauge Gunshot Residue (GSR) Indented Writing Lands And Grooves Muzzle Obliteration Pistol Point-Blank Range Propellant Questioned Document Revolver Rifle Rifling Semiautomatic Shell Casing Striations Trajectory Watermark	Refer to Tier 1 instructions	● New technologies for identifying printer ink ● Case study http://www.forensicdocument.com.au/case-studies ● Limitations of ballistics analysis

Appendices

Appendix 1. Common Rubric for Lab Report

Student Name: _____

CATEGORY	4	3	2	1
Question/Purpose	The purpose of the lab or the question to be answered during the lab is clearly identified and stated.	The purpose of the lab or the question to be answered during the lab is identified, but is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is partially identified, and is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is erroneous or irrelevant.
Variables (IV and DV), Constants	All variables are clearly described with all relevant details.	All of the variables are clearly described with most relevant details.	Most variables are clearly described with most relevant details.	Variables are not described OR the majority lack sufficient detail.
Materials	All materials and setup used in the experiment are clearly and accurately described.	Almost all materials and the setup used in the experiment are clearly and accurately described.	Most of the materials and the setup used in the experiment are accurately described.	Many materials are described inaccurately OR are not described at all.
Procedures	Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.
Experimental Hypothesis	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated, but appears to be based on flawed logic.	No hypothesis has been stated.
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.

	experiment.			
Data	Professional looking and accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables are presented.	Data are not shown OR are inaccurate.
Spelling, Punctuation and Grammar	One or fewer errors in spelling, punctuation and grammar in the report.	Two or three errors in spelling, punctuation and grammar in the report.	Four errors in spelling, punctuation and grammar in the report.	More than 4 errors in spelling, punctuation and grammar in the report.

Appendix 2. Common Rubric for Oral Presentation

Student Name: _____

CATEGORY	4	3	2	1
Preparedness	Student is completely prepared and has obviously rehearsed.	Student seems pretty prepared but might have needed a couple more rehearsals.	The student is somewhat prepared, but it is clear that rehearsal was lacking.	Student does not seem at all prepared to present.
Time-Limit	Presentation is 5-6 minutes long.	Presentation is 4 minutes long.	Presentation is 3 minutes long.	Presentation is less than 3 minutes OR more than 6 minutes.
Speaks Clearly	Speaks clearly and distinctly all (100-95%) the time, and mispronounces no words.	Speaks clearly and distinctly all (100-95%) the time, but mispronounces one word.	Speaks clearly and distinctly most (94-85%) of the time. Mispronounces no more than one word.	Often mumbles or cannot be understood OR mispronounces more than one word.
Content	Shows a full understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.
Posture and Eye Contact	Stands up straight, looks relaxed and confident. Establishes eye contact with everyone in the room during the presentation.	Stands up straight and establishes eye contact with everyone in the room during the presentation.	Sometimes stands up straight and establishes eye contact.	Slouches and/or does not look at people during the presentation.
Comprehension	Student is able to accurately answer almost all questions posed by classmates about the topic.	Student is able to accurately answer most questions posed by classmates about the topic.	Student is able to accurately answer a few questions posed by classmates about the topic.	Student is unable to accurately answer questions posed by classmates about the topic.

Resources	Student uses several sources of information and provided proper citations (MLA)	Student uses two sources of information and provided proper citations (MLA)	Student used a single sources of information and provided proper citations (MLA)	Citations are not in proper format

Appendix 3. Unit 1- Performance Task

Job Options for Forensic Science Majors

Your Task: You are the hiring manager for the FBI Department of Forensic Science and Evidence Analysis. Your superior has granted you funds to expand your lab and you need to recruit qualified forensics experts for your team. You must design a presentation for perspective college graduates who majored in forensic science and entice them to apply for the positions in your lab.

Grading Criteria:

In addition to the *presentation rubric* your presentation needs to be:

- Creative- you should have several diagrams, pictures and tables that are applicable to your job description
- Make it visually appealing (you need qualified people to apply!)
- Explain background needed for the forensic science specialty
    - basic purpose of forensic science and its role in society

- Explain the job description for the forensic science specialty
    - type of degree needed
    - salary
    - outlook (future job opportunities)
    - explanation of duties/responsibilities

You will be creating an oral presentation to share your information with the class. You may use any visual aids you see fit (PowerPoint, Prezi, etc).

Some example careers in forensic science you may want to investigate:

Computer forensic examiner	Geneticist/molecular biologist
Medical examiner	Arson crime lab
Crime scene manager	Fingerprint criminalist

Forensic analyst
Drug chemist
Criminalist specialist/serologist
Criminalist/serologist
Senior evidence technician
Mitochondrial DNA examiner
Forensic scientist
Criminalist
Forensic toxicologist
Mortician

Intelligence officer/analyst
Forensic nurse/physician's assistant investigator
Forensic drug analyst
Crime lab technicians
Handwriting examiners
Forensic Anthropologists
Criminal Profiler
Forensic photographer
Firearms examiners
Evidence Biometrics examiners
Forensic pathologist
Forensic psychologist
DNA analyst
Forensic drug analyst

If there is another career which you would like to investigate then please run it past the teacher prior to beginning your research.

Good Luck and have fun!!!!

Appendix 4. Universal Design for Learning Guidelines

I. Provide Multiple Means of **Representation**	II. Provide Multiple Means of **Action and Expression**	III. Provide M **Enga**
1: Provide options for perception 1.1 Offer ways of customizing the display of information 1.2 Offer alternatives for auditory information 1.3 Offer alternatives for visual information	**4: Provide options for physical action** 4.1 Vary the methods for response and navigation 4.2 Optimize access to tools and assistive technologies	**7: Provide options for** 7.1 Optimize individual 7.2 Optimize relevance 7.3 Minimize threats ar
2: Provide options for language, mathematical expressions, and symbols 2.1 Clarify vocabulary and symbols 2.2 Clarify syntax and structure 2.3 Support decoding of text, mathematical notation, and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media	**5: Provide options for expression and communication** 5.1 Use multiple media for communication 5.2 Use multiple tools for construction and composition 5.3 Build fluencies with graduated levels of support for practice and performance	**8: Provide options for** 8.1 Heighten salience o 8.2 Vary demands and 8.3 Foster collaboratio 8.4 Increase mastery-o
3: Provide options for comprehension 3.1 Activate or supply background knowledge 3.2. Highlight patterns, critical features, big ideas, and relationships 3.3 Guide information processing, visualization, and manipulation 3.4 Maximize transfer and generalization	**6: Provide options for executive functions** 6.1 Guide appropriate goal-setting 6.2 Support planning and strategy development 6.3 Facilitate managing information and resources 6.4 Enhance capacity for monitoring progress	**9: Provide options for** 9.1 Promote expectatio motivation 9.2 Facilitate personal 9.3 Develop self-assess
Resourceful, knowledgeable learners	**Strategic, goal-directed learners**	**Purposeful,**

CAST

APA Citation: CAST (2011). *Universal design for learning guidelines vers*

Appendix 5. Tier 1 Interventions for Students Achieving Below Standard

Tier 1 Strategies

Management	***Assessment***
· Assign seat near teacher	· Use short, frequent quizzes
· Assign student to low-distraction area	· Review using similar test questions
· Assign seat near positive peer models	· Post-test analysis with student
· Stand near student when giving instruction	· Model and encourage use of test ta
· Provide an exemplar to help student formulate his/her own work	· Allow access to word processor
· Display constant visual cues within room	***Other Strategies***
· Teach student to monitor own behavior	· Train student in note-taking
· Implement behavior contract/reward system	· Allow student to record lessons
Instructional	· Give student outlines, study guides lecture notes
· Use visual aids with oral presentation	· Periodic review of student's class no
· Highlight essential information/directions	· Encourage proper agenda usage
· Give clear behavioral objectives	· Peer tutoring
· Explain grading criteria for assignments	· Meet with teacher for extra assista
· Ask student to repeat instructions for clarification and understanding	· Use of Student Assistance periods
· Use of engaging high-interest materials	· Encourage self advocacy
· Call on student often	· Promote active communication
· Acknowledge student effort	· Aid in organization of materials
· Give reminders for student to stay on task	· Provide consistent homework remir
· Use large type/alternative fonts	· Notes/assignments available online
· Keep page format simple	
· Divide page into clearly marked sections	
· Provide opportunities to preview materials	
· Encourage use of online resources and student review/assessment websites	

Appendix 6.

Stages of Mortis Timeline Rubric

Student Name: _____

CATEGORY	4	3	2	1
Content	Students described all the required elements for each date.	Students lacking one of the requirements for each date.	Students lacking two of the requirements for each date.	Students lacking two or more of the requirements for each date.
Graphics	All graphics are effective and balanced with text use.	All graphics are effective, but there appear to be too few or too many.	Some graphics are effective and their use is balanced with text use.	Several graphics are not effective.
Readability	The overall appearance of the timeline is pleasing and easy to read.	The overall appearance of the timeline is somewhat pleasing and easy to read.	The timeline is relatively readable.	The timeline is difficult to read.
Title	The timeline has a creative title that accurately describes the material and is easy to locate.	The timeline has an effective title that accurately describes the material and is easy to locate.	The timeline has a title that is easy to locate.	The title is missing or difficult to locate.
Learning of Content	The student can accurately describe 75% (or more) of the events on the timeline without referring to it and can quickly determine which of two events occurred first.	The student can accurately describe 50% of the events on the timeline without referring to it and can quickly determine which of two events occurred first.	The student can describe any event on the timeline if allowed to refer to it and can determine which of two events occurred first.	The student cannot use the timeline effectively to describe events nor to compare events.
Preparation	The student had notes about all the events and dates s/he wished to include on the timeline before beginning to design the timeline.	The student had notes about almost all the events and dates s/he wished to include on the timeline before beginning to design the timeline.	The student had notes about most (~75%) of the events and dates s/he wished to include on the timeline before beginning to design the timeline.	The student had not prepared adequate notes before beginning to design the timeline.

Appendix 7

Close Reading Rubric

Close Reading: Trace Evidence. Read three articles on genetic testing from multiple perspectives. Delineate information that supports and indicates the limitations of trace evidence. Then, formulate a 3-4 paragraph argument where you determine the benefits and limitations of trace evidence analysis.

	4	3	2	
Standard: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from text.	Student is able to capably read and understand complex science text, pulling ample explicit detail from it and inferring after evidence is collected. Student can skillfully cite evidence when supporting conclusions. Inferences and conclusions drawn demonstrate deep understanding of text.	Student is able to read and understand a complex text, pulling explicit details from it and inferring after evidence is collected. Student cites evidence when supporting conclusions.	Student is able to read complex text but cannot pull important detail from the text. Inferences and conclusions drawn show a growing understanding of the topic and text but do not yet demonstrate a mastery of the skill. When citing evidence in writing, more or better examples are needed.	Studen compl pull im the te conclu drawn under or top use an cited, evider argum
Standard: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.	Student crafts a well written, sophisticated argument that includes in-depth analysis and evidence that is fully relevant and supports the argument expressed.	Student crafts an argument that is clear and supported. The argument is supported with good solid evidence that is relevant to the stated argument.	Student crafts an argument that may lack some clarity and cohesion but, with revision, could be improved. Evidence is cited by may not be relevant or hold the weight needed to support the argument.	Studen craft a valid r suffici time. A clarity furthe necess maste

Appendix 8
Class Debate : Debate Rubric

Student Name: _____

CATEGORY	4	3	2	1
Respect for Other Team	All statements, body language, and responses were respectful and were in appropriate language.	Statements and responses were respectful and used appropriate language, but once or twice body language was not.	Most statements and responses were respectful and in appropriate language, but there was one sarcastic remark.	Statements, responses and/or body language were consistently not respectful.
Information	All information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear and accurate, but was not usually thorough.	Information had several inaccuracies OR was usually not clear.
Rebuttal	All counter-arguments were accurate, relevant and strong.	Most counter-arguments were accurate, relevant, and strong.	Most counter-arguments were accurate and relevant, but several were weak.	Counter-arguments were not accurate and/or relevant
Use of Facts/Statistics	Every major point was well supported with several relevant facts, statistics and/or examples.	Every major point was adequately supported with relevant facts, statistics and/or examples.	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable.	Every point was not supported.
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	All arguments were clearly tied to an idea (premise) but the organization was sometimes not clear or logical.	Arguments were not clearly tied to an idea (premise).
Understanding of Topic	The team clearly understood the topic in-depth and presented their information forcefully and convincingly.	The team clearly understood the topic in-depth and presented their information with ease.	The team seemed to understand the main points of the topic and presented those with ease.	The team did not show an adequate understanding of the topic.
Participation	The individual provided at least 5 relevant points for their teams position	The individual provided at least 4 relevant points for their teams position	The individual provided at least 3 relevant points for their teams position	The individual provided less than 3 relevant points for their teams position

Appendix 9

Sample Lesson Plan for Unit 1

Teacher: Chris McMullen	Grade Level/Course: Junior Senior Forensics Science
Lesson Date: Sep 2015	Unit/ Name of Lesson: Unit 1 -What is the origin of forensic science?

Common Core State Standard or corresponding CT State Standard:

Contents Inquiry Standards (those with the "x" will be covered in this lesson)

☒D INQ.1 Identify questions that can be answered through scientific investigation.

☒D INQ.2 Read, interpret and examine the credibility of scientific claims in different sources of information.

☐D INQ.3 Design and conduct appropriate types of scientific investigations to answer different questions.

☐D INQ.4 Identify independent and dependent variable, and those variables that are kept constant, when designing an experiment.

☐D INQ.5 Use appropriate tools and techniques to make observation and gather data.

☐D INQ.6 Use mathematical operations to analyze and interpret data.

☐D INQ.7 Identify and present relationships between variables and appropriate graphs.

☐D INQ.8 Draw conclusions and identify sources of error.

☒D INQ.9 Provide explanations to investigated problems or questions.

☐D INQ.10 Communicate about science in different formats using relevant science vocabulary, supporting evidence and clear logic.

☐ D INQ.11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Common Core State Standards (CCSS): Include the ELA and Math standards and practices that align with your unit (those with the "x" will be covered in this lesson)

1. ☒ CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. ☒CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. ☐CCSS.ELA-Literacy.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.
4. ☐CCSS.ELA-Literacy.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*.
5. ☐CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
6. ☐CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
7. ☐CCSS.ELA-Literacy.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.
8. ☐CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
9. ☐CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. ☐CCSS.ELA-Literacy.RST.9-10.10 By the end of grade 10 read and comprehends science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Student Learning Objective(s)

What is the intended learning outcome of this lesson? Be sure it is observable and includes clear criteria. Are there students who will require an accommodation or modification to meet this lesson's objective?

Students will able to: *1)* Perform a research based activity to determine the origin and key contributors to the field of forensic science

Rationale for Objective: How does this lesson support previous and subsequent learning?
The students are studying the introduction to forensic science. Studying the origins of the first crime lab is important since it is the basis for modern day forensic science analysis. It is essential that students understand how forensic data was first analyze and how it is applicable to modern methods.

Assessment

State the specific strategy (ies) and tool(s) used to collect the data for each SLO (i.e., essays, projects, quizzes, exit slip, worksheet, etc.). Are there students who will require an accommodation or modification to this lesson's assessment? Attach assessment materials and scoring criteria to lesson plan.

Assessment will consist of: ● General questioning during the lesson to determine if any material/ concepts are incoherent or unclear. ● Exit ticket- Point of Most Significance ● Graphic organizer to be completed by the students

Lesson Development

Cite how you will provide opportunities for the students to construct meaning. List the steps/process you will follow. Be sure to identify how you will check for understanding and collect formative data. Are there students who will require an accommodation or modification in order to be active participants in this lesson?

Initiation (Engage): Cite how you will engage learners, activate prior learning and present the lesson's objective. Explaining: A) What they will be doing and learning in the lesson; B) How they will demonstrate learning; C) Why it is important to their everyday lives.
5 minutes (Engagement) ● Short video showing a crime lab from the television show CSI
Lesson Development (Explore, Explain, and Elaborate): Cite how you will build upon prior knowledge and build each concept(s).
5 minutes (Explore) ● A website was shared with the students via Google Classroom. The teacher will review the website and introduce the task with the students ● Website http://www.plato.k12.mo.us/teachers/dsprouse/webquest/process.html
50 minutes (Explain) ● Students will start to work on the graphic organizer. They will need to complete it at home or during study hall since it requires then to go online to answer some of the later questions.
2 minutes (Elaborate) Lesson Development- Classroom talk out ● How/ why is studying the history of forensic science relevant to them?

Closure (Evaluate): Cite how you will measure, with evidence, if the objectives were met.
5 min (Evaluate) ● Review goals for the lesson; make sure we met our objectives. Ask students for areas of confusion or clarity. ● Exit ticket- Point of Most Significance (POM) - what part of the lesson was most significant to you and why? ● Discuss how this topic is connected to tomorrow lesson

Materials Needed For This Lesson
Paper, pen/ pencil, online device,

Reflection
Student Achievement: (Evaluates each student's learning for objective, Notes differences across performance of students, Explains follow up instruction based on results). <u>What went well</u> <u>What I would change if I were to do it again.</u> . <u>The impact I had on student learning</u>

Appendix 10

Sample Lesson Plan for Unit 6

Teacher: Chris McMullen	Grade Level/Course: Junior Senior Forensics Science
Lesson Date: Jan 2016	Unit/ Name of Lesson: Unit 6 –How is human tissue preserved?

Common Core State Standard or corresponding CT State Standard:

Contents Inquiry Standards (those with the "x" will be covered in this lesson)

☒D INQ.1 Identify questions that can be answered through scientific investigation.

☒D INQ.2 Read, interpret and examine the credibility of scientific claims in different sources of information.

☒D INQ.3 Design and conduct appropriate types of scientific investigations to answer different questions.

☐D INQ.4 Identify independent and dependent variable, and those variables that are kept constant, when designing an experiment.

☒D INQ.5 Use appropriate tools and techniques to make observation and gather data.

☐D INQ.6 Use mathematical operations to analyze and interpret data.

☐D INQ.7 Identify and present relationships between variables and appropriate graphs.

☐D INQ.8 Draw conclusions and identify sources of error.

☒D INQ.9 Provide explanations to investigated problems or questions.

☐D INQ.10 Communicate about science in different formats using relevant science vocabulary, supporting evidence and clear logic.

☐ D INQ.11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Common Core State Standards (CCSS): Include the ELA and Math standards and practices that align with your unit (those with the "x" will be covered in this lesson)

11. ☐ CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
12. ☐CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
13. ☒CCSS.ELA-Literacy.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.
14. ☒CCSS.ELA-Literacy.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*.
15. ☐CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
16. ☐CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
17. ☐CCSS.ELA-Literacy.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.
18. ☐CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
19. ☐CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

20. ☐CCSS.ELA-Literacy.RST.9-10.10 By the end of grade 10 read and comprehends science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Student Learning Objective(s)

What is the intended learning outcome of this lesson? Be sure it is observable and includes clear criteria. Are there students who will require an accommodation or modification to meet this lesson's objective?

Students will know: *1)* The process of embalming a human body for the purposes of tissue preservation *2)* Who were the first real embalmers?

Rationale for Objective: How does this lesson support previous and subsequent learning?
The students are studying forensic pathology. This is important since tissue preservations techniques are essential for proper forensic investigations. It is essential that students understand how forensic tissue is preserved and the process involved since it is a key step in forensic pathology and used to preserve data.

Assessment

State the specific strategy (ies) and tool(s) used to collect the data for each SLO (i.e., essays, projects, quizzes, exit slip, worksheet, etc.). Are there students who will require an accommodation or modification to this lesson's assessment? Attach assessment materials and scoring criteria to lesson plan.

Assessment will consist of: ● General questioning during the lesson to determine if any material/ concepts are incoherent or unclear. ● Exit ticket- Muddiest Point ● Activity to be completed by the students- Embalming graphic organizer

Lesson Development

Cite how you will provide opportunities for the students to construct meaning. List the steps/process you will follow. Be sure to identify how you will check for understanding and collect formative data. Are there students who will require an accommodation or modification in order to be active participants in this lesson?

Initiation (Engage): Cite how you will engage learners, activate prior learning and present the lesson's objective. Explaining: A) What they will be doing and learning in the lesson; B) How they will demonstrate learning; C) Why it is important to their everyday lives.
5 minutes (Engagement) ● Ask students to brainstorm and hypothesize regarding how blood is removed from a body prior to embalming ● End in a share out
Lesson Development (Explore, Explain, and Elaborate): Cite how you will build upon prior knowledge and build each concept(s).
50 minutes (Explore) ● A website was shared with the students via Google Classroom. The teacher will review the website and introduce the task with the students ● Website http://science.howstuffworks.com/science-vs-myth/afterlife/embalming4.htm Students will complete a graphic organizer of the steps involved in embalming a human body ● Students will continue to http://www.bbc.co.uk/history/interactive/games/mummy_maker/index_embed.shtml where they will need to virtually embalm an Egyptian priest and make a mummy.

5 minutes (Explain) ● Students will come back together and share any incites they had during the activity. What went well, what was confusing, etc.
2 minutes (Elaborate) Lesson Development- Classroom talk out ● Why is embalming relevant to forensic science
Closure (Evaluate): Cite how you will measure, with evidence, if the objectives were met.
5 min (Evaluate) ● Review goals for the lesson; make sure we met our objectives. Ask students for areas of confusion or clarity. ● Exit ticket- Muddiest Point) - What part of the lesson was most confusing or unclear? ● Collect embalming graphic organizers

Materials Needed For This Lesson
Paper, pen/ pencil, online device, graphic organizer

Reflection
Student Achievement: (Evaluates each student's learning for objective, Notes differences across performance of students, Explains follow up instruction based on results). <u>What went well</u> <u>What I would change if I were to do it again.</u> . <u>The impact I had on student learning</u>

Appendix 11

Sample Lesson Plan for Unit 9

Teacher: Chris McMullen	Grade Level/Course: Junior Senior Forensics Science
Lesson Date: Apr 2016	Unit/ Name of Lesson: Unit 9 –Drug Analysis Lab-Synthesis of Aspirin

Common Core State Standard or corresponding CT State Standard:

Contents Inquiry Standards (those with the "x" will be covered in this lesson)

☒D INQ.1 Identify questions that can be answered through scientific investigation.

☐D INQ.2 Read, interpret and examine the credibility of scientific claims in different sources of information.

☒D INQ.3 Design and conduct appropriate types of scientific investigations to answer different questions.

☒D INQ.4 Identify independent and dependent variable, and those variables that are kept constant, when designing an experiment.

☒D INQ.5 Use appropriate tools and techniques to make observation and gather data.

☒D INQ.6 Use mathematical operations to analyze and interpret data.

☒D INQ.7 Identify and present relationships between variables and appropriate graphs.

☒D INQ.8 Draw conclusions and identify sources of error.

☒D INQ.9 Provide explanations to investigated problems or questions.

☐D INQ.10 Communicate about science in different formats using relevant science vocabulary, supporting evidence and clear logic.

☐ D INQ.11. Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Common Core State Standards (CCSS): Include the ELA and Math standards and practices that align with your unit (those with the "x" will be covered in this lesson)

21. ☐ CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
22. ☐CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
23. ☒CCSS.ELA-Literacy.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.
24. ☐CCSS.ELA-Literacy.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*.
25. ☐CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
26. ☐CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
27. ☒CCSS.ELA-Literacy.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.
28. ☐CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
29. ☐CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

30. ☐CCSS.ELA-Literacy.RST.9-10.10 By the end of grade 10 read and comprehends science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Student Learning Objective(s)

What is the intended learning outcome of this lesson? Be sure it is observable and includes clear criteria. Are there students who will require an accommodation or modification to meet this lesson's objective?

Students will know:

1) The process of synthesizing aspirin in a laboratory environment
2) The molecular formulas for the reactants and final product

Rationale for Objective: How does this lesson support previous and subsequent learning?

The students are studying forensic toxicology. This is important since toxicological identification is a key contributor to many forensic investigations. It is essential that students understand how various drugs can be synthesized in a lab and how they can be identified from a forensic point of view.

Assessment

State the specific strategy (ies) and tool(s) used to collect the data for each SLO (i.e., essays, projects, quizzes, exit slip, worksheet, etc.). Are there students who will require an accommodation or modification to this lesson's assessment? Attach assessment materials and scoring criteria to lesson plan.

Assessment will consist of:

- General questioning during the lesson to determine if any material/ concepts are incoherent or unclear.
- Activity to be completed by the students- formal lab report on the synthesis of aspirin.

Lesson Development

Cite how you will provide opportunities for the students to construct meaning. List the steps/process you will follow. Be sure to identify how you will check for understanding and collect formative data. Are there students who will require an accommodation or modification in order to be active participants in this lesson?

Initiation (Engage): Cite how you will engage learners, activate prior learning and present the lesson's objective. Explaining: A) What they will be doing and learning in the lesson; B) How they will demonstrate learning; C) Why it is important to their everyday lives.

5 minutes (Engagement)

- Online video of the history of aspirin (origins, why is it still a relevant medicinal drug)
- End in a share out

Lesson Development (Explore, Explain, and Elaborate): Cite how you will build upon prior knowledge and build each concept(s).

50 minutes (Explore)

- Instructions for the lab activity were shared with the students via Google Classroom. The teacher will review the instructions and introduce the task with the students
- Students will continue to https://sites.google.com/site/inquiryforensicdrughs/home/common-illicit-drugs/lab-synthesis-of-aspirin for additional information

5 minutes (Explain)

- Students will come back together and share any incites they had during the activity. What went well, what was confusing, etc.

2 minutes (Elaborate)

Lesson Development- Classroom talk out

- Students will hypothesize on the level of difficulty of this activity and how it can be applied to the

manufacturing of other controlled substances
Closure (Evaluate): Cite how you will measure, with evidence, if the objectives were met.
5 min (Evaluate) ● Review goals for the lesson; make sure we met our objectives. Ask students for areas of confusion or clarity. ● Exit ticket- Finger of Five – based on the day's activity rate the level of understand on a scale of 1-5 (1 being little understanding to 5 being full understanding) ● Collect the lab reports

Materials Needed For This Lesson
Paper, pen/ pencil, online device, laboratory hand out

Reflection
Student Achievement: (Evaluates each student's learning for objective, Notes differences across performance of students, Explains follow up instruction based on results). <u>What went well</u> <u>What I would change if I were to do it again.</u> . <u>The impact I had on student learning</u>