**Dr. A Castro - Science Teacher**

**Hope High School**

Tutoring hours on Thursdays from 3 to 4 pm

Classroom 320.

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**Forensics Science Syllabus for Semester Classes:** 2016-2017 academic school year.

**Textbook: *Forensic Science an Introduction* by Richard Saferstein /Pearson Prentice Hall**

 **Course Description:** Forensic science is the application of science to criminal and civil laws that are enforced by police agencies in a criminal justice system. Forensic science applies the knowledge and technology of science to the definition and enforcement of such laws. This course is going to creatively integrate a series of investigative, high-interest, hands-on, forensic lab activities into our chemistry curriculum. Techniques covered in this class include the classification of fingerprints, and using physical and chemical properties to identify substances. The students will be actively involved in collecting, analyzing, and interpreting evidence found at a crime scene. Topics covered include, the crime scene, physical evidence, properties of matter, forensic toxicology and serology, the microscope, DNA analysis techniques, trace evidence hairs and fibers, fingerprints, and documenting examination. *There may also be additional content material and laboratory activities involving DNA barcoding which is used to characterizing species of organisms using a short DNA sequences.*

Therefore this course will incorporate multidisciplinary instruction using topics from biology, chemistry and general sciences.

**What will the student learn while taking this course? / What is the purpose of this course?**

* Basic chemistry concepts such as physical and chemical properties, density, separation of mixtures, pH, chemical reactions, analyzing and identifying white solids, using paper chromatography to separate mixture, conductivity, effects of acids and bases on the color of a dye, oxidation and reduction, sources and causes of corrosion, identifying sacrificial metals.
* Students understand the nature of science by collecting and analyzing data to solve problems.
* Science process skills, which include observing and inferring, classifying, measuring and using numbers, communicating, predicting, collecting and interpreting data, using safe laboratory procedures, and manipulating scientific materials and equipment.
* Capture students’ interest by using intriguing forensic topics.

**Additional Information**: My web page DrCastro.weebly.com. The students can see more web resources in the website. The syllabus is posted on the website and the web page will be dynamically updated.

**Classroom procedures course policies**

* Come to class every day, enter class quickly and quietly.
* Be on time, punctuality is essential to doing well in this course.
* Behave in a respectful manner that does not cause problems for anyone.
* As soon as you are seated write the learning objectives and then begin your DO NOW, which will be written on the smart board. You have five minutes to complete the DO NOW.
* You may use the bathroom between classes; if you have an emergency you must completely fill out the hall pass sheet, which includes your name, date, time and destination.
* Keep a binder for all your homework, tests, DO NOWS, hands outs, projects, writing assignments, group work.
* When you are absent or late, it is your responsibility to get the notes or missed work on your time. After every 3 absences a phone call will be made. Late work is never accepted without an excused absence.
* Cutting classes will be penalized as one detention after school for each cut.
* Do not eat or drink in class ever. Only water is allowed. Follow the safety regulations during laboratory activities or procedures.
* No electronic devices in class, no hats, no coats.
* There is no talking during a test or quiz even if you are finished. A respectful volume should be maintained in the classroom at all the time. Every student deserves to have the best possible testing conditions; any disrespectful behavior will negatively impact your grade.

**Required Resources**.

Safety glasses are required for all laboratory activities, a notebook, flash drive, pen or pencil, computers (lab tops) and textbooks will be provided by teacher during classroom time.

**Grading Policy and Procedures**.

 **Your work in this class will be assessed in the following ways:**

1. Class Work and Participation (30%)

 Each day you will earn class participation points for work completed in class, successful group participation, on-time completion of homework, quizzes, discussion, focus and appropriate behavior. Absences, sleeping, lateness, unpreparedness, lack of focus and lack of respectful behavior will result in loss of credit. Asking good questions and volunteering may earn extra class participation points.

 Bring in documentation for excused absences – notes stamped by the attendance office will restore your lost class participation points– this helps your grade. Note: All work must still be made up.

2. Open Notes Tests and quizzes (35%)

 The key elements of critical and scientific thinking are asking questions and making observations. Expect homework every week, occasional quizzes, and be prepared to hand in all assignments to be graded.

 Open Notes Tests will assess class work after completing every unit. You will be asked to answer questions that should be found in class notes and completed assignments. You may also be asked to turn in randomly selected samples of your work from the period between tests. Failure to immediately make up work you have missed will result in poor scores on tests. If you haven’t done it, you can’t use it. You may use only your own work for Open Notes Tests.

3. Projects (35%).

 Major projects will comprise an important part of the assessment for this course. Treat them like important tests – failure to complete or hand in major projects may result in failing this class. Project products may include: class presentations, research papers, Lab notes, Lab reports, Prezi or PowerPoint presentations.

* Final grades are calculated on the following: class work and participation 30%; Open notes tests 35%; projects 35%.

**Course Schedule / General Course Outline/ Assignment Descriptions**.

**Unit 1.1 Introduction to forensic science**

* TO DO NOW / HOMEWORK

**LEARNING OBJECTIVES unit1.1**: Define forensic science and list the major discipline it encompasses. Describe the services of a typical comprehension crime laboratory in the criminal justice system. Explain the role and responsibilities of the expert witness. Recognize the major contributors to the development of the forensic science.

**READING unit 1.1**: Chapter 1 pages 4-32. **Possible Activities:**
**ACTIVITY 1: Video “Dead Men do Talk “analyzing and writing the information.**

**ACTIVITY 2: Observing the scene and collecting data (forensic skills). /Exit tickets**

**ACTIVITY 3: Fingerprint (forensic skills). /Exit tickets**

**ACTIVITY 4: Blood identification and the truth table. /Exit tickets**

* TEST
* PROJECT

**Unit 1.2: The-crime-scene processing**.

* TO DO NOW / HOMEWORK

**LEARNING OBJECTIVES unit 1.2:** Define physical evidence. Discuss the responsibilities of the first police officer who arrives at a crime scene. Explain the steps to be taken for thoroughly recording the crime scene. Describe proper procedures for conducting a systematic search of crime scenes for physical evidence. Describe proper techniques for packaging common types of physical evidence. Review the proper collection and packaging of common types of physical evidence. Define chain of custody. Discuss the role forensic pathologists, entomologists, and anthropologist at homicide crime scene.

**READING unit 1.2**: chapter 2 pages 42 to 75. **Possible Activities**.

**ACTIVITY 1: Locard’s exchange principle in action. Crime scene investigation: a case of deductive reasoning/Exit tickets.**

**ACTIVITY 2: Crime scene sketching and digital photography. /Exit tickets**

**ACTIVITY 3: The counterfeit coin caper. /Exit tickets**

* TEST
* PROJECT

**Unit 1.3: Physical evidence**.

* TO DO NOW / HOMEWORK.

**LEARNING OBJECTIVES UNIT 1.3**: List the common types of evidence encountered at crime scenes. Explain the differences between the identification and comparison of physical evidence. Define individual and class characteristics. Give examples of physical evidence possessing theses characteristics. Discuss the value of class evidence to a criminal investigation. List the number and types of computerized databases relating to physical evidence that is currently in existence. Explain the purpose physical evidence plays in reconstructing the events surrounding the commission of a crime.

**READING unit 1.3**: chapter 3 pages 78-111. **Possible Activities**:

**ACTIVITY 1: Read the case study of Wayne Williamas from the end of chapter 3 and discuss the importance of physical evidence. /Exit tickets**

**ACTIVITY 2: Forensic Anthropology exercise 17 (basic Lab Exercises for forensic science) pages 113-123. /Exit tickets.**

* **TEST**
* **PROJECTS DUE.**

**Unit 2.1: Fingerprints.**

* TO DO NOW / HOMEWORK

**LEARNING OBJECTIVES UNIT 2.1:** Name those individuals who have made significant contributions to the acceptance and development of fingerprint technology. Define ridge characteristics. Explain why a fingerprint is a permanent feature of the human anatomy. List the three major fingerprint patterns and their respective subclasses. Classify a set of fingerprints by the primary classification of the Henry system. Describe the concept of an automated fingerprint identification system. Explain what visible, plastic, and latent fingerprints mean. List the techniques for developing latent prints on porous objects. Describe the proper procedures for preserving a developed latent fingerprint. Explain how a latent fingerprint image can be enhanced by digital imaging.

**READING UNIT 2.1**: Chapter 14 pages 470-505. **Possible Activities**.

**ACTIVITY 1: A member of local police department or state police to talk about fingerprinting procedures. Students must be fully engaged by taking notes and asking questions.**

**ACTIVITY 2: Different procedures/methods to collect fingerprints. /Exit ticket**

**Activity 3: Classification of Fingerprints: Exercise 1- Balloon Prints; Exercise 2- Graphite Prints; Exercise 3- Inked Prints; Exercise 4- Fingerprint Comparison and classification.**

**Activity 4: Developing Latent Fingerprints: Exercise 1- Iodine Fuming; Exercise 2-Fingerprint Powder; Exercise 3- Superglue Fuming of Small Items; Exercise 4- Superglue Fuming of large Items. / Exit ticket**

**Activity 5: Lab manager- Examine Your Fingerprints/ Exit ticket**

**Activity 6: Lab manager - Can Fingerprint analysis connect a suspect to a crime scene?**

* **TEST**
* **LAB REPORTS**
* **BROCHURES.**

**Unit 2.2: Impressions.**

* TO DO NOW/HOMEWORK

**LEARNING OBJECTIVES UNIT 2.2:** Describe techniques for rifling a barrel. List the class and individual characteristics of bullets and cartridge cases. Explain the utilization of the comparison microscope for the comparison of the comparison of bullets and cartridge cases. Distinguish caliber from gauge. Explain the NIBIN data test system. Explain the procedure for determining at what distance from a target a weapon was fired. Describe the laboratory tests utilized for determining whether an individual has fired a weapon. Emphasize the limitations of the present techniques. Explain why it may be possible to restore an obliterated serial number. List procedures for the proper collection and preservation of firearm evidence. Explain how a suspect tool is compared to a tool mark. Explain the forensic significance of class and individual characteristics to the comparison of impressions. List some common field reagent used to enhance bloody footprints.

**Reading unit 2.2**: Chapter 15 pages 506- 550. **Possible Activities.**

**Activity 1: The students may want to go to Internet web site “An Introduction to Forensic Firearms Identification” [**[**http://www.firearmsid.com**](http://www.firearmsid.com)**]. This is a basic, informative web site that provides an extensive collection of information relating to the firearms. An individual can explore the details of how to examine bullets, cartridge cases, or clothing for gunshots residues, and the suspect shooter’ s hands for primer residues. Information on the latest technology involving the automated firearm search system NIBIN can also be found within this site.**

**Activity 2: Exercise 1-Comparison of tools; Exercise 2 – Casting tool marks; Exercise 3- Examination of tool mark characteristics.**

**Activity 3: Exercise 1-Making a cast/ Footwear Impressions Case History-Case study (O. J. Simpson Trial- Who left the impressions at the Crime Scene). Exercise 2- Footwear comparison; Exercise 3- Cast/footwear comparison.**

* **TEST**
* **LAB REPORTS**
* **BROCHURES**

**Unit 3.1 Forensic Serology (blood and blood spatter)**

* **TO DO NOW/ HOMEWORK.**

**LEARNING OBJECTIVES UNIT 3.1:** List the A-B-O antigens and antibodies found in the blood for each of the four blood types: A, B, AB, and O. Explain why agglutination occurs. Explain how whole blood is typed. Describe tests used to characterize a stain as blood. Explain the significance of the precipitin test to forensic serology. Explain the differences between monoclonal and polyclonal antibodies. Define chromosome and gene. How is Punnet square used to determine the genotypes and phenotypes of offspring? List the laboratory test necessary to characterize seminal stains. Explain how suspect stains are to be properly preserved for laboratory examination. Describe the collection of physical evidence related to a rape investigation.

**READING UNIT 3.1:** Chapter 8 pages 266-304. **Possible Activities.**

**Activity 1: Show the movie “A Killer’s Trail,” a story of Dr. Sam Sheppard and how blood was used in a Forensic case. Group Discussion and analyses of key terms.**

**Activity 2: Using examples from paternity cases have the students prove or disprove “true” parents and have the students explain how serology can be used in Forensic Science. Group Discussion and analyses of the data.**

**Activity 3: Blood Spatter Evidence. Case History- Stephen Scher. Exercise 11 page 72 Basic labs Exercises for Forensic Science** BLOOD PATTERN ANALYSIS (<http://www.starmgc.com/blood.html> or <http://www.reelcreations.com/store/store/>).

**Part 1** Cast-Off Spatter; **Part 2** Impact Angle; **Part 3** Calculations; **Part 4** Examining Your Work from Part 2.

**Activity 4: Bloodstain Analysis. Exercise 1- Presumptive Testing With Kastler-Meyer Reagent; Exercise 2- Presumptive Testing with Hemastix; Exercise 3- Immunoassay and Case History; Exercise 4- Blood Typing**

* **TEST**
* **LAB REPORTS**
* **BROCHURE PRESENTATIONS.**

**Unit 3.2 DNA: The indispensable Forensic Science Tool.**

* **TO DO NOW/HOMEWORK.**

**LEARNING OBJECTIVES UNIT 3.2:** Learn the parts of a nucleotide and know how they are linked together to make DNA. Understand how DNA strands coil into a double helix. Describe the concept of base pairing as it relates to the double helix structure of DNA. Explain how the sequence of bases along a DNA strand ultimately determines the structure of proteins that are synthesized within the body. Describe how a double-strand DNA replicates itself; what are the implications of this process for Forensic Science? Understand how DNA can be cut and spliced into a foreign DNA strand. Describe some commercial applications of this recombinant DNA technology. Explain the difference between DNA strands, which code for the production of proteins and those strands, which contain repeating sequences of bases. Explain what is meant by a restriction fragment length polymorphism (RFLP). Describe the process of typing DNA by the RFLP technique and explain how DNA band patterns are interpreted. Explain the technology of polymerase chain reaction (PCR) and how it is applied to forensic science. Explain the latest DNA typing technique, Short Tandem Repeat (STR) analysis. Explain the difference between a traditional STR analysis and a Y-chromosome STR determination. Explain the difference between nuclear DNA and mitochondrial DNA. Discuss the application of DNA computerized database to criminal investigation. List the necessary procedures to be taken for the proper preservation of bloodstained evidence for laboratory DNA analysis.

**READING UNIT 3.2: CHAPTER 9 Pages 306-349. Possible Activities.**

**Activity 1: Case reading- the forensic community’s response to September 11, page 349. Group discussion.**

**Activity 2: Using common household materials, the students have to construct a simple DNA helix. The students will be able to: Define the parts and functioning of DNA; explain how DNA codes for a protein; describe how DNA replicates itself; show how DNA might be cut and reassembled; include the concept of gene splicing; explain how this gene splicing can lead to recombinant genes; describe the technique of RFLP, PCR, and Short Tandem Repeats and how this is applied to DNA; explain the importance of DNA to a forensic science.**

**Activity 3: Research “Project Innocence” and describe their work with DNA and Forensics.**

**Activity 4:** **Lab manager- DNA The thread of life.**

**Activity 5: Lab manager – DNA sequencing.**

**Activity 5: DNA extraction lab.**

**Activity 7:** Suggested experiments: Using a kit such as one supplied by Lab-Aids, Inc(17 Colt Court, Ronkonkoma, NY11779), the student can build a model of DNA to see what a double helix structure looks like **(see Lab-Aids no. 71)**. The components are made of color-code plastic and are easily assembled and disassembled. The model is flexible and is twisted to form the double helix structure. **Lab-Aids kit no. 1271,** “Forensic Science: Introduction to DNA Fingerprinting,” simulates a crime scene and instructs students on how to interpret DNA X-ray films. Another **Lab-Aids kit (no. 75**) introduces students to the concept of PCR and the RFLP analysis of DNA. The kit simulates the gel electrophoresis of DNA. Another interesting experiment is based on the Feulgen reaction where DNA in plant cells can be stained purple. With the aid of a microscope, students can view DNA in a plant cell. A DNA staining kit is available from **Lab-Aids, Inc. (no. 170).**

* **TEST**
* **LAB REPORTS**
* **BROCHURES / PREZI PRESENTATION.**

**Unit 4.1 Trace Evidence I: Hairs and Fibers.**

* **TO DO NOW / HOMEWORK.**

**LEARNING OBJECTIVES UNIT 4.1**: Describe the cuticle, cortex, and medulla of hair. Describe the three phases of hair growth. Explain the distinction between animal and human hairs. List hair features are useful for the microscopic comparison of human hairs. Explain the proper collection of the hair evidence. Describe the rote of DNA typing in hair comparisons. Classify fibers. Describe the structure of a polymer. List the properties of fibers that are most useful for forensic comparisons. Describe the proper collection of fiber evidence.

**READING UNIT 4.1**: Chapter 10 pages 354-384.

**ACTIVITY 1:** Exercise 1- Casting Scale Patterns. Exercise 2- Microscopic Identification of hair. Exercise 3- Comparison of hair evidence.

* **TEST**
* **LAB REPORTS**

 **Unit 4.2 Document Examination:**

* **TO DO NOW / HOMEWORK**

**LEARNING OBJECTIVES UNIT 4.2**: Defined “questioned document.” List some common individual characteristics associated with handwriting. List some important guidelines to be followed for the collection of known writings for comparison to a questioned document. Describe the precautions to be taken to minimize deception when a suspect is requested to write exemplars for comparison to a questioned document. List some of the class and individual characteristics of a typewriter. Describe the proper collection of typewritten exemplars. List some of the techniques utilized by document examiners for uncovering alterations, erasures, obliterations, and variations in pen and inks.

**READING UNIT 4.2**: Chapter 16 pages 552-577.

**ACTIVITY 1**: Watch the movie “ Catch Me If You Can” as an introduction. Analyzing and answering the questions.

**ACTIVITY 2**: Have the students practice reading those characteristics from their own handwriting and their classmates. Read the story of Howard Hughes and see how it relates to document forgery.

**ACTIVITY 3**: Exercise 1- A famous forgery! Exercise 2- Are you a good forger? Exercise-3 disguising your handwriting.

General Comments: Students should be referred to the Internet web site “Questioned Document Examination” [http://www.qdewill.com]. This is a basic, informative Web page that answers frequently asked questions concerning document examination, explains the application of typical document examinations, and details the basic facts and theory of handwriting and signatures. There are also noted document examination cases hypertext to this website for the user to read and recognize the real-life application of forensic document examination.

**ACTIVITY 4:** PAPER CHROMATOGRAPHY OF INK: Exercise 1:Chromatography of ballpoint pen Ink.

**ACTIVITY 5**: THIN-LAYER CHROMATOGRAHY OF INK.

* TEST
* LAB REPORTS
* **FINAL TEST/ ASSESSMENT.**

Alternative Unit on DNA: DNA Barcoding Project

LEARNING OBJECTIVES DNA BARCODING UNIT: DNA barcoding is a new tool for identifying biological specimens and managing species diversity. It has inspired a global initiative dedicated to creating a library of new knowledge about species diversity, making that knowledge accessible and applying that knowledge to create tangible benefits. Students are full participants in this process.
Please see course website ([**www.drcastro.weebly.com**](http://www.drcastro.weebly.com)) for detailed objectives for each activity.

ACTIVITY 1: (**LESSON A**) Introduction to DNA Barcoding

ACTIVITY 2: (**INTRO LAB**) Microvolumetrics and micropipetting Laboratory

ACTIVITY 3: (**LESSON B**) Beyond the Barcode metaphor

ACTIVITY 4: (**LESSON C**) The COI Barcoding gene

ACTIVITY 5: (**LESSON D**) Isolating total DNA from specimen tissue

ACTIVITY 6: (**LAB 1**) Isolating total DNA (gDNA) from fish tissue (lysis)

ACTIVITY 7: (**LAB 2**) Purifying Total DNA (gDNA) from tissues Lysates

ACTIVITY 8: (**LESSON E**) Examining gDNA using Gel Electrophoresis

ACTIVITY 9: (**LAB 3**) Casting the gel to examine gDNA by Agarose Gel Electophoresis

ACTIVITY 10: (**LAB 4**) Examining purified gDNA with Agarose Gel Electrophoresis

ACTIVITY 11: (**LESSON F**) Targeted Amplification of the COI Barcode region

ACTIVITY 12: (**LAB 5**) Targeted Amplification of the COI Barcode region from a gDNA template

ACTIVITY 13: (**LESSON G**) Spin column purification of COI Amplicons

ACTIVITY 14: (**LAB 6**) Spin column purification of COI Amplicons

ACTIVITY 15: (**LESSON H**) Examining COI Amplicons using Gel Electrophoresis

ACTIVITY 16: (**LAB 7**) Casting an Agarose gel to confirm the length of COI Amplicons

ACTIVITY 17: (**LAB 8**) Confirming the length of COI Amplicons by Gel Electrophoresis \*

*\* Instructor duty: ship DNA samples to Costal Marine Bio Lab for automated sequencing*

ACTIVITY 18: (**LESSON I**) Dye Terminator Cycle Sequencing

ACTIVITY 19: (**LESSON J**) Assembling COI Contigs in BOLD-SDP

ACTIVITY 20: (**LESSON K**) Identifying STOP Codons in COI Contigs

ACTIVITY 21: (**LESSON L**) Environmental Barcoding

ACTIVITY 22: (**LAB 9**) Assembling reference DNA Barcode records in BOLD-SDP \*

*\*Instructor Duty: Computers with internet access are required for Post-Evaluation*