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| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Law, Public Safety, Corrections, & Security |
| **Course Name** | Forensic Science |
| **Lesson/Unit Title** | Forensic Serology |
| **TEKS Student Expectations** | **130.339. (c) Knowledge and Skills**(2) The student, for at least 40 of instructional time, conducts laboratory and/or field investigations using safe, environmentally appropriate, and ethical practices. (A) The student is expected to demonstrate safe practices during laboratory and field investigations.(B) The student is expected to demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.(3) The student uses scientific methods and equipment during laboratory and field investigations. (F) The student is expected to collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures.(G) The student is expected to analyze, evaluate, make inferences, and predict trends from data.(H) The student is expected to communicate valid conclusions supported by the data through methods such as investigative reports, lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.(4) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. (A) The student is expected to analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, to encourage critical thinking.(D) The student is expected to evaluate the impact of scientific research on criminal investigation, society, and the environment.(E) The student is expected to evaluate models according to their limitations in representing biological objects or events.(F) The student is expected to research and describe the history of science and contributions of scientists within the criminal justice system.(9) The student analyzes blood spatter at a simulated crime scene. (A) The student is expected to analyze blood stain patterns based on course, direction, and angle of trajectory.(B) The student is expected to explain the method of chemically isolating an invisible blood stain using reagents such as luminol.(11) The student explores serology laboratory procedures in forensic science. (A) The student is expected to determine if a stain detected in a crime scene is blood.(B) The student is expected to identify the red blood cells antigens and antibodies as they relate to human blood types.(C) The student is expected to determine genotypes and phenotypes in the human red blood cell system using Punnet Squares.(D) The student is expected to research methodologies used to collect and analyze other body fluids. |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** | The students will be able to:* Identify characteristics of human blood.
* Determine genetics of the human red blood cell system.
* Analyze bloodstain patterns based on source, direction, and angle of trajectory.
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| **Rationale** | Forensic serology is the detection and the classification of various types of human bodily fluids such as blood, semen, and saliva. Serology can also involve the identification of bloodstain patterns at a crime scene, which can not only tell who was present at the scene, but possibly what happened there. |
| **Duration of Lesson** | 6 to 9 Hours |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * Punnet Square Activity Handout
* Forensic Blood Lab Teacher Instructions
* Forensic Blood Lab Worksheets
* *Blood Lab*
	+ Simulated blood
	+ Anti-A, anti-B, and anti-D (Rh) serum
	+ Cotton swabs
	+ Distilled water
	+ Blood type slides
	+ Toothpicks
	+ Kastle-Meyer solution
	+ Stained cloth
	+ Blood (such as that found in the bottom of a meat tray from ground beef or liver)
	+ Luminol
	+ Clipboard
	+ Calculator
	+ White paper
	+ Ruler
	+ Protractor
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Do an Internet search for the following article: The Case of Dr. Samuel Sheppard by Fred McGunagle. Discuss as a class the role that blood evidence played in the Sam Sheppard case (see page 5 of the article). Use the Discussion Rubric for assessment. |
| **Direct Instruction \*** | 1. The Composition of Blood
	1. Blood is a complex mixture of cells, enzymes, proteins, and inorganic substances
		1. Erythrocytes (red blood cells) – carry hemoglobin and oxygen
		2. Leukocytes (white blood cells) – fight infection and disease
		3. Platelets – clotting factors
		4. Plasma – the liquid portion of blood, mostly water
	2. Antigens, which are usually proteins, are located on the surface of red blood cells and are responsible for blood types
	3. Antibodies are proteins that recognize and bind to specific antigens
	4. There is a specific antibody for every antigen, and it will react to form clumps – this is known as agglutination
	5. The A-B-O blood system
		1. Type A blood has A antigens and B antibodies
		2. Type B blood has B antigens and A antibodies
		3. Type AB blood has both A and B antigens but no antibodies
		4. Type O blood has neither A nor B antigens, but has A and B antibodies
	6. Testing for blood type
		1. The A-B-O blood groups are identified by testing blood with anti-A and anti-B sera
			1. Type A agglutinates with anti-A
			2. Type B agglutinates with anti-B
			3. Type AB agglutinates with both anti-A and B
			4. Type O does not agglutinate with anti-A or B

G. Blood donors and recipients* + 1. Type A donates to Type A and Type AB, and receives from Type A and Type O
		2. Type B donates to Type B and Type AB and receives from Type B and Type O
		3. Type AB donates only to Type AB and receives from all Types (making it the universal recipient)
		4. Type O donates to all types but receives only from Type O (making it the universal donor)
	1. The Rh (Rhesus) factor
		1. Another important blood antigen
		2. A protein that some people carry; sometimes referred to as the D antigen
		3. People with the D antigen are said to be Rh positive (+) and those without are Rh negative (-)
		4. Important for the compatibility of donors and recipients
		5. An Rh+ person can receive Rh+ or Rh- blood, but an Rh-person can only receive Rh- blood
		6. The blood is Rh+ if it agglutinates with anti-D or Rh- if it does not

II. The Genetics of Blood* 1. To determine blood types, there are two inherited genes (one from each parent)
	2. There are three alleles for blood types: A, B, and O with six possible combinations
		1. Type A= AA, AO
		2. Type B= BB, BO
		3. Type AB= AB
		4. Type O= OO
	3. A Punnett square can be used to determine the blood types of offspring from specific parent combinations
1. The Forensics of Blood

A. Forensic investigators must answer three main questions* + 1. Is it blood?
			1. To answer, use a presumptive test which is a preliminary color test
				1. Kastle-Meyer is used for visible blood stains and causes a deep pink color in the presence of hemoglobin
				2. Luminol can be used for invisible stains where, in the presence of blood, it will produce a luminescence in a darkened area
		2. Is it human or animal blood?
			1. The precipitin test identifies the presence of proteins that are found only in human blood
				1. Human blood is injected into an animal (usually a rabbit)
				2. Antibodies neutralize the invading human blood to form human antiserum
				3. The bloodstain in question is layered on top of the antiserum in a capillary tube
				4. If human blood is present, a ring or band is formed at the interface of the two liquids
1. Whose blood is it?
	1. A DNA analysis must be performed

IV. Characterization of Blood EvidenceA. Class characteristics of blood evidence* + 1. What species does it belong to?
		2. What blood type is it?
		3. What is the Rh factor?
		4. Does the evidence have any diseases present?
	1. Individual characteristics of blood evidence from DNA analysis
1. Bloodstain Pattern Analysis
	1. The appearance, distribution, and location of blood spatter can tell a lot about a crime scene
		1. Surface texture can change the appearance of a blood drop
		2. Categories of blood sources include
			1. Passive – dripping
			2. Transfer – from one item to another
				1. Wipe – a non-bloody object comes in contact with a bloody surface
				2. Swipe – a bloody object comes in contact with a non-bloody surface
			3. Projected – shootings, blunt force trauma, etc.
		3. The direction of travel can be determined when blood strikes a surface because the pointed end of each drop faces its direction of travel
		4. The angle of impact is determined by measuring the width and the length of the drop, dividing the width by the length, then finding the inverse sin
			1. The drop will be circular at right angles to the surface
			2. As the angle decreases, the drop elongates
		5. The origin of spatter
			1. Draw straight lines through the long axis of several bloodstains
			2. The intersection, called the area of convergence, represents the origin point

VI. Other body fluids associated with serologyA. Characterization of Saliva1. Saliva is a mixture of the following
	1. Water
		1. Mucin, which aids in swallowing
		2. Amylase, an enzyme used for digestion
		3. Buccal cells, also known as cheek cells that are a good source of DNA
	2. It is particularly associated with sexual assaults and bite marks
	3. To test for saliva
		1. Mix starch, iodine, and the sample of presumed saliva
		2. Starch turns dark blue or purple in the presence of iodine
		3. However, amylase breaks down starch so the color will fade
2. Characterization of Semen
	1. Semen is made of
		1. Water
		2. Spermatozoa
		3. Enzymes
		4. Inorganic salts
	2. It is associated mostly with sexual assaults
	3. To test for semen
		1. Presumptive test
			1. Semen fluoresces under UV light
			2. Turns purple in the presence of acid phosphatase
		2. Confirmatory test
			1. Microscopic examination reveals spermatozoa
			2. DNA typing must be done to individualize the sample
3. Characterization of Urine
	1. Enzyme-Multiplied Immunoassay Technique (EMIT) analysis for detecting drugs in urine
		1. Antibodies that will bind to specific drugs are added to a urine sample

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*None |
| **Guided Practice \*** | Blood Lab. This is a three-part lab. First, students will observe the agglutination process to identify blood types. Second, they will observe and identify visible and invisible bloodstains. Finally, they will calculate angles of impact. See the Forensic Blood Lab Teacher Notes for detailed instructions. Use the Forensic Blood Lab Worksheets for the activity.Note: This activity should be based on accuracy and details at the teacher’s discretion. No set rubric is provided, but the Individual Work Rubric maybe used as appropriate.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*None |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Punnett Square Blood Type Activity. Have the students complete the Understanding Human Blood Types Using Punnett Squares Worksheet. Use the Understanding Human Blood Types Using Punnett Squares Worksheet Key for assessment.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*None |
| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | * Forensic Serology Exam and Key
* Blood Quiz and Key
* Discussion Rubric
* Individual Work Rubric
* Summary Rubric

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*None  |
| **References/Resources/****Teacher Preparation** | 0135158494, Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey: Pearson Prentice Hall, 2011.0536522820, Saferstein, Richard. *Criminalistics: An Introduction to* *Forensic Science.* 8thed. Upper Saddle River, NJ; Pearson PrenticeHall, 2004.Do an Internet search for the following: The Case of Dr. Samuel Sheppard by Fred McGunagle |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy****Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies****Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication****90 Second Speech Topics** |  |
| **Other Essential Lesson Components** |
| **Enrichment Activity**(e.g., homework assignment) | For reinforcement, students will work as a group to create their own blood typing problem using Punnet squares, such as those found in the Punnet Square Activity. This problem will be presented to the class via an interactive white board, if available. The groups will complete each other’s problems. Use the Individual Work Rubric for assessment.For enrichment, students will search the internet and summarize a notorious crime that was solved utilizing bloodstain pattern analysis. Use the Summary Rubric for assessment. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)