|  |
| --- |
| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Law, Public Safety, Corrections, and Security |
| **Course Name** | Principles of LPSCS |
| **Lesson/Unit Title** | Math and Science in LPSCS |
| **TEKS Student Expectations** | **130.332.(c) Knowledge and Skills**(2) The student achieves academic knowledge and skills required for career and postsecondary education opportunities associated with the career field. The student is expected to: (A) apply English language arts knowledge and skills required for career and postsecondary education opportunities;(B) apply mathematics knowledge and skills required for career and postsecondary education opportunities; and (C) apply science knowledge and skills for career and postsecondary education associated with the career field. |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** |

|  |
| --- |
| The student will be able to: |
| 1. Identify the types of math and science skills used in the LPSCS field. |
| 2. Demonstrate how math and science skills are used in specific situations  |
| and jobs. |
| 3. Create a resume for a LPSCS job posting relating to math and science. |
| 4. Evaluate another student’s resume. |

 |
| **Rationale** | Math and Science skills are used frequently in Law, Public Safety, Corrections, and Security (LPSCS) careers. It is important for students to make this connection early while they are learning math and science subjects. |
| **Duration of Lesson** | 3 to 4 hours |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * Computers with Internet access
 |
| **Anticipatory Set**(May include pre-assessment for prior knowledge) |

|  |
| --- |
| Use the following scenario and questions for a class discussion. Use the possible |
| answers to guide the students and the Discussion Rubric for assessment. |
| *Scenario:* Imagine yourself as a criminal investigator. You are working a case in |
|
| which a patrol officer discovered a car that ran into a creek. There are skid marks on |
| the road leading to the location where the car ran off the road and into the creek. |
| There is a decomposing, dead body in the driver’s seat. |
|  |
| *Questions:* What needs to be determined by you and what type of math and science |
| skills do you think you will be using? |
| *Possible answers:* Math to measure the skid marks to determine how fast the |
| vehicle was traveling when it ran off the road, science to determine how long ago this |
| accident occurred based on the stage of decomposition of the dead body, and |
| science to determine if there are any alcohol or drugs in the driver’s blood. |

 |
| **Direct Instruction \*** | 1. Definitions
	1. Math – the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions; and of space configurations and their structure, measurement, transformations, and generalizations
	2. Science – knowledge or system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method
	3. College – institution that many agencies in the criminal justice system require a person to go to that requires a person to graduate from high school and take tests that cover math and science skills
2. Math and Science in Law Enforcement Services

 A. General ideas* 1. Math and science can be an integral part of the criminal justice system
	2. Suspects can be identified and guilt can be assigned based on how criminal justice professionals implement math and science
	3. Math and science are most often implemented in the process of investigating a crime, whether it is a crime that occurs in public or in a prison cell
	4. All findings must hold up in court. This may require math and science experts to testify
1. Traffic Accident Investigations
	1. Officers can determine how fast vehicles were travelling at the moment of impact by measuring the skid marks. They use the formula S=15.9√df
		1. S = speed
		2. D = the distance of the skid marks
		3. F = the coefficient of friction
	2. The coefficient of friction is
		1. The amount of force acting upon the tires
		2. The influence of the weight of the vehicle
		3. The type of surface
		4. The weather conditions
	3. Officers must use more algebraic formulas to determine the coefficient of friction, such as
		1. The Law of Conservation of Momentum
			1. Says that energy is neither created nor destroyed
			2. If specialists know the weights and angles of the incoming vehicles they can determine the speeds at which the vehicles were moving
	4. Investigators can also use formulas to determine the driver of a vehicle that has rolled over and thrown the occupants out. This is done by
		1. Looking at where the victims landed
		2. Measuring and then deducing the angles
2. Math and Blurred Images

(http://plus.maths.org/content/os/issue37/features/budd/index)* 1. Math can be used to unscramble digitally blurred images such as a bad photo of a suspect’s license plate or a blurred fingerprint
	2. This formula is based on the various pixels in an image
		1. describes the various pixels in the image
		2. Each pixel has its own number (*pixel value)* which gives information on its color and brightness
		3. The function  gives the pixel value of each pixel  before blurring
		4. is the pixel value after blurring?

e) Running the formula above backwards will give us the unblurred image given by  from the blurred image * + 1. This formula only works if the blurring function  is known
1. Measurement and Police Work
	1. Officers routinely must measure confiscated drugs to determine the quantity of the drug and the level of punishment
	2. This may include converting units of measurements since the unit of measurement on a scale may be different than the unit of measurement described in the law
	3. At a crime scene with a dead body, officers will take two measurements from two different corners of the room to show exactly where the body was located on a diagram
	4. Officers measure the distance cars are from nearby intersections in accident investigations
	5. Blood splatter at a crime scene may be measured to determine the location of a violent confrontation
	6. Different types of bullets found at a crime scene may be matched to different guns depending on their weight and unique markings (this is known as ballistics)
2. Measurement and Traffic Enforcement
	1. Tractor trailers and commercial vehicles are routinely weighed at various checkpoints and weigh stations to determine their legality
	2. Headlights and tail lights must be within a certain height range from the ground. Officers may be required to measure them if/when they are suspected of being in violation
3. Math and Science in Traffic Enforcement
	1. A radar that police use to detect the speed of vehicles uses frequencies and concepts such as the Doppler Effect
		1. A Doppler shift is a scientific principle that an audio, radio, or light wave will increase or decrease in frequency upon movement of the source
		2. In the case of police radar, the transmitted signal’s frequency will increase if the target is moving toward the radar transmitter and decrease if it is moving away from it
4. Math and Speeding Tickets
	1. In most jurisdictions, the amount a person must pay for a speeding ticket is based on how fast he or she was going
	2. A court official (or sometimes the officer) must be able to calculate the amount of a violator’s fine based on his or her speed
	3. Court costs and other fees may need to be considered in the final sum
5. Statistics and Probability in Police Work
	1. Police use statistics and probability to analyze crime rates and the effectiveness of crime fighting programs
	2. Programs are kept or cut based upon positive or negative statistical results
	3. A patrol officer will determine at the beginning of his or her shift where to patrol using crime reports from the previous shift
	4. The officer is predicting where crime is likely to occur based on the numbers
	5. Probability is also useful in criminal profiling
		1. Investigators attempt to construct a profile of the type of person likely to have committed certain crimes or a class of crime
		2. Math helps investigators determine the characteristics of likely suspects and perpetrators
6. Patterns and Comparisons in Police Work
	1. Officers can use fingerprints left at a crime scene to solve crimes
		1. This is done by lifting the fingerprint and comparing it with other fingerprints that are already on file
		2. Officers are looking for similar patterns, ridges, loops, and distinguishing marks to make a positive identification
	2. Shoeprints and tire tracks are handled in the same manner
	3. These positive identifications are unique; uniqueness is recognized as a single solution in math
	4. Glass can be compared by considering its type and how exposure to the elements may affect it
7. Math and Science in Driving While Intoxicated (DWI) Cases
	1. The legal drinking limit for an adult is a Blood Alcohol Content (BAC) of

.08%* 1. The measurement of .08 means .08 grams of alcohol per 100 milliliters (ml) of blood
	2. The mouth absorbs alcohol, so the alcohol on the driver’s breath is related to the amount of alcohol in his or her blood
	3. The ratio of breath alcohol to blood alcohol is 2100 to 1
	4. This means that the alcohol content of 2100 ml of exhaled air is the same as the amount of alcohol in 1 ml of blood
	5. Alcohol is then expressed as a percentage amount in the blood, where the legal limit is .08%
	6. A breathalyzer is used to determine the BAC of a driver suspected of

DWI1. Math and Poison
	1. Math formulas can be used to determine the location that someone has poisoned a drinking supply
	2. Investigators must determine
		1. The amount of time that the poison has been in the water
		2. The pipe structure including the volume that the pipes hold
	3. The formulas will take into consideration pipe decay and chemical reactions
	4. Investigators can then pinpoint the exact location of contamination or, if the water supply is large, give a range of possible locations
	5. After the location is known, investigators can view video that is taken of the areas or interview possible witnesses to discover the identity of and try to apprehend the suspect
	6. Forensic Science – has become a major field in criminal justice; it uses many forms of science and math; the following are just a few examples:
		1. Deoxyribonucleic acid (DNA)
			1. DNA is an important factor in solving many cases
			2. Every person (except identical twins) has his or her own DNA that can be matched with evidence that is left at a crime scene
			3. DNA is found in hair and many bodily fluids that may be found at crime scenes
			4. Biology is the main science used to decipher DNA evidence
		2. Drugs and Toxicology
			1. Investigators and scientists may have to determine what legal or illegal drugs were in a person’s body at the time of death
			2. This is determined by running tests on the body and the blood
		3. Forensic Anthropology
			1. The study of physical anthropology as it applies to human skeletal remains in a legal setting
			2. It is used to determine the identity of unidentified bones
		4. Forensic Entomology
			1. The study of insects as they pertain to legal issues
			2. It is often used to determine the time of death
				1. This is done by observing the types of insects that are on the body while it decomposes
				2. Different types of insects are attracted to different stages of the decomposition process
				3. A scientist must be able to properly identify the insects found on a body to determine the stage of decomposition and to deduce the time of death
		5. Soil
			1. Different locations and environments have different types of soil
			2. A body found with a different type of soil on it than is native to that location can help an investigator determine where the murder location
			3. this skill requires knowledge of geology

III. Math and Science in Security and Protective Services* 1. Internet Security
		1. The Internet draws heavily on a wide variety of mathematical tools ranging from data and error compression techniques and methods for routing messages to security issues
		2. Examples
			1. Safety of Internet financial transactions
			2. Protecting emails from third party monitoring
			3. Protection from malware such as worms and viruses
	2. Decrypting messages over the Internet (such as emails or financial interactions) relies heavily on:

1. Prime numbers that are used to keep personal information secure when buying something over the Internet with a credit card. They are like the building blocks of deciphering plain text1. Factoring that is used to break down large numbers into the prime numbers that are used to translate the encryption. The larger the number, the more effort it requires to factor it. Without using the computer speed to do the factoring, breaking the codes could take millions of years
2. Algorithms and theorems
	1. The RSA algorithm is a formula used to assign meaning to the prime numbers which become the key to deciphering the original message. It is a public key that anyone has access to
	2. However, which prime numbers are being used must be known to use the key
	3. The RSA algorithm was developed in 1978 and uses Fermat’s Little Theorem, developed by Pierre de Fermat in the 17th century, which is the foundation of modern number theory
	4. Fermat’s Little Theorem is xn + yn = zn
	5. Other theorems, like Euler’s Theorem and Chinese Remainder Theorem, can also be used in place of Fermat’s Little Theorem
	6. The theorems consist of mathematical proofs
	7. Proofs are proven to be true and can be used to prove other things and concepts
	8. So once the factoring of the prime numbers has been accomplished, the numbers can be plugged in the theorem to generate the key which will be an accurate way to decrypt the message

IV. Math and Science in Legal Services* 1. Math and Science are used in trials when
		1. Expert witnesses are called to testify
		2. The attorneys and witnesses must explain math and science concepts to the jury or judge so they can make an informed judgment
	2. Many of the concepts in this lesson are things that would be explained in court by the witnesses
1. Math and Science in Correction Services
	1. Many of the concepts discussed already may also be applied to math and science in the corrections. They come into play when crimes are investigated in the correctional facilities like they are in the public
	2. In addition to this, math and science are used when doing inmate counts or when probation officers are examining drug tests their subjects have had

VI. Math and Science in Emergency and Fire Management Services1. Science in Firefighting
	1. Firefighters must understand the chemistry of a fire to stop it
		1. It takes three elements for a fire to work
	2. Oxygen
	3. Heat
	4. Fuel
2. At least one of these elements must be taken away to stop the fire.
3. Firefighters must understand the nature of the fire they are fighting to know which one of the elements they can safely take away. This can occur through extinguishing agents or methods such as
	1. Water – acts like a sponge by absorbing heat from the fire
	2. Firefighting Foam
		1. The foam contains carbon dioxide which pushes the oxygen away from the fire
		2. Example: a gasoline fire cannot be extinguished with water because it does not mix with oil-based fuels.

Water would spread the gasoline, thus spreading the fire. In this situation, the oxygen needs to be removed from the fire by spraying it with firefighting foam* + - 1. Starving a Fire – cutting off the fuel source, such as propane
			2. Breaking up the Fuel – breaking up the fuel into smaller, more manageable chunks, like a group of tires
			3. Counterburning – a controlled burning technique used to destroy dry shrubs or vegetation before the fire reaches them
1. Math in Firefighting
	1. When fighting a tall structure fire, the correct ladder angle is essential to reach the fire with the spray safely. This is done by using right triangles and trigonometric functions
		1. The firefighters determine
			1. How high the ladder needs to be to disperse water effectively on the structure
			2. What angle to extend the ladder using the sine, cosine, and tangent functions
	2. When fighting a fast spreading fires such as a grass fire
		1. Example: grass fires can spread up to 30 or 40 miles per hour. Firefighters use this information to calculate the amount of distance in front of the fire they need to implement techniques such as counterburning

VII. Math and Science in Postsecondary Education1. Most criminal justice agencies’ job requirements include a minimum of some college experience
2. To get into college, students must
	1. Achieve or surpass a minimum score on their SAT and/or ACT tests, which includes the math and science components
	2. Graduate high school (or the equivalent), which requires the completion of math and science courses
3. Almost all college degrees require that a student take a certain number of math and science courses in order to graduate, regardless of the degree

D. In addition, most law enforcement agencies require applicants to take a test that covers general knowledge including English, Math, and Science*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 \*** | *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 \*** | 1. Completion of the Math and Science in LPSCS Quiz. The quiz may be open-note and used as a study guide for the Math and Science in LPSCS Exam. Use the Math and Science in LPSCS Quiz Key for assessment.
2. Have students select an LPSCS career. Have students research and present how math and/or science is used in the career and the hiring requirements for the occupation. Use the Presentation Rubric for assessment.
3. Have students research college entrance requirements and give a brief summary of the types of math and science that the SAT and ACT exams assess. Use the Summary Rubric for assessment.
4. Have students create a job opening for an LPSCS career that relies heavily on math or science. Then have them create mock résumés to apply for another student’s job posting. The résumés must show how the mock applicant’s math or science education, or experience aligns with the job requirements. The students may assess each other using the Résumé Rubric.

*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 \***  | Math and Science in LPSCS Exam and KeyMath and Science in LPSCS Quiz and KeyDiscussion RubricPresentation RubricRésumé RubricSummary 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** | * 0131961411, Forensic Science an Introduction, Richard Saferstein, Prentice Hall, 2008
* Webster’s Dictionary
* http://mathcentral.uregina.ca/beyond/articles/RCMP/traffic.html
* http://plus.maths.org/content/os/issue37/features/budd/index
* http://www.ams.org/samplings/feature-column/fcarc-internet
* http://en.wikipedia.org/wiki/Radar\_gun
* http://www-gap.dcs.st-and.ac.uk/~history/HistTopics/Fermat's\_last\_theorem.html
* http://en.wikipedia.org/wiki/RSA\_(algorithm)
* Do an Internet search for the following:
* How are Math & Criminal Justice related by Shane Hall
* RSA Security
* How does a laser speed gun work to measure a car’s speed
* Forensic Anthropology Definition by K Kris Hirst
* Discovery education
* How Breathalyzers work by Craig Freudenrich Ph.D.
 |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | Mathematics StandardsVIII. Problem Solving and ReasoningA. Mathematical problem solving* 1. Analyze given information.
	2. Formulate a plan or strategy.
	3. Determine a solution.
	4. Justify the solution.

B. Logical reasoning* 1. Use various types of reasoning.
 |
| **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 enrichment, students will read an article about the breathalyzer test and summarize how science is used to make it work. To find an article do an Internet search for the following: How Breathalyzers work by Craig Freudenrich Ph.D. 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)