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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 Paint Analysis |
| **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 and (3) The student uses scientific methods and equipment during laboratory and field investigations.  (G) The student is expected to analyze, evaluate, make inferences, and predict trends from data and(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.(6) The student recognizes the procedures of evidence collection while maintaining the integrity of a crime scene. (H) The student is expected to demonstrate proper techniques for collecting, packaging, and preserving physical evidence found at a crime scene. |
| **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 different components of automobile paint.
2. Characterize the microscopic examination of paint.
3. List and define the techniques used in paint comparisons.
4. Understand how to properly collect and preserve paint evidence.
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| **Rationale** | A black car is not always “just a black car.” When black paint from several different vehicles is compared, it can sometimes look as though they are all the same. If a person wanted to cover a small scratch or ding, any black paint might do. However, when the situation is more serious, such as a hit-and-run, forensic science can be used to analyze the paint and tell different shades of black from each other to solve crimes. |
| **Duration of Lesson** | *4 hours total** *45 min. lecture*
* *45 min. Paint Activity Day 1*
* *30 min. Paint Activity Day 2*
* *30 min. Review Puzzle*
* *30 min. Quiz*
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| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | * Binder
* Pigments
* Solvent
* Color
* Emission Spectrograph
* Hit-and-Run
* Infared
* Microscope
* Paint Data Query
* Paint Layers
* Pyrolysis
* Quarter-inch
* Uncontaminated Paint
* Electrocoat primer – applied to the steel body of a car for corrosion resistance; colors range from black to grey
* Primer surfacer – applied to the primer to completely smooth it out and hide any seams or imperfections; highly pigmented (light grey for lighter colored cars and red oxide under dark colors)
* Basecoat – the actual color of a vehicle
* Clearcoat – unpigmented; improves gloss, durability, and appearance
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| **Materials/Specialized Equipment Needed** | **Materials*** *Paint Layer Determination Lab*
	+ Paint Layer Determination Lab handout (one per student)
	+ Paint Layer Determination Lab Teacher’s Notes
	+ Paint Layer Determination Lab Key
	+ 4 index cards (3x5)
	+ 4 different colors of poster paint (to be shared among the 4 groups)
	+ 4 sponge paintbrushes (one for each color paint)
	+ 4 re-sealable sandwich bags (one for each group)
	+ Scissors (for each group)
	+ Forceps (for each group)
	+ Hand lenses or stereoscopic microscopes (for each group)
	+ Scrap paper or newspaper
	+ Colored pencils
* Forensic Paint Analysis Quiz and Key
* Forensic Paint Crossword Puzzle Key
* Paint Layer Determination Key
* Discussion Rubric
* Individual Work Rubric
* Presentation Rubric
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Use the following story and questions for a class discussion. Use the Discussion Rubric for assessment. <http://en.wikipedia.org/wiki/Murder_of_Vicky_Lynn_Hoskinson>* How was the bicycle (pink paint) a key piece of evidence in this case?
* Could it have been any pink bike?
* What other factors linked investigators to the suspect?
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| **Direct Instruction \*** | * Comparison of Paint
	+ Paint is composed of a binder and pigments, and other additives that are dissolved or dispersed in a solvent
	+ Auto paint is the most common type of paint examined in crime labs
	+ Layers of automobile paint
		- Electrocoat primer – applied to the steel body of a car for corrosion resistance; colors range from black to grey
		- Primer surfacer – applied to the primer to completely smooth it out and hide any seams or imperfections; highly pigmented (light grey for lighter colored cars and red oxide under dark colors)
		- Basecoat – the actual color of a vehicle
		- Clearcoat – unpigmented; improves gloss, durability, and appearance
* Microscopic Examination of Paint
	+ A microscope is the most important instrument for locating and comparing paint specimens
	+ Color is the most distinctive forensic characteristic of paint

An examiner observes color layers and tries to match the number and sequence of colors. This process can connect paints to a common origin* 1. Unfortunately, most paint specimens do not have layers that can be individualized to a single source, so a chemical analysis must be done

III. Techniques Used in Paint Comparisons* 1. Characterization of paint binders
		1. Pyrolysis gas chromatography
			1. Many solids cannot be injected into a gas chromatograph, so items must be heated, or pyrolyzed, to high temperatures so that they will decompose into gaseous products
			2. Then they are put into a chromatograph, and a pyrogram is produced showing the chemical makeup of the binder
			3. Even the smallest of paint chips can be pyrolyzed and sent through the gas chromatograph
			4. Pyrograms can distinguish one polymer from another
		2. Infrared spectrophotometry
			1. Binders absorb infrared radiation to yield a spectrum that is characteristic to that specimen
	2. Characteristics of paint pigments
		1. Emission spectrograph
			1. Can detect 15 – 20 elements in auto paint simultaneously
			2. Some are common to all paints, but others have significant forensic uniqueness

IV. Significance of Paint Evidence* 1. How to tell if two similar paints come from the same surface
		1. Paint layers beneath the surface layer offer valuable points of comparison
		2. Color charts for automobile finishes are available from manufacturers
		3. Paint Data Query (PDQ)
			1. A database that provides information on paints based on make, model, and year
			2. Maintained by the Royal Canadian Mounted Police V. Collection and Preservation of Paint Evidence
	2. Paint evidence is mostly involved in burglaries and hit-and-run incidents
	3. Paint chips should be picked up with forceps and placed in a paper druggist fold or a glass or plastic container
	4. If the paint is smeared on or embedded into something, package the entire item
	5. With hit-and-run cases, collect uncontaminated paint from an undamaged area as a reference for comparison
	6. ¼-inch square samples are sufficient, but you must go all the way to the bare metal

**Accommodations for Learning Differences**For reinforcement, students will write 3 test questions from the class notes and present them to the class. The questions must be one of each of the following: multiple choice, true/false, and completion. Use the Presentation Rubric for assessment *(Note: The students’* *questions may be used as* *additional items on the quiz or even as bonus questions).**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 \*** | * Forensic Paint Crossword Puzzle. Have students review forensic paint analysis terminology by completing the Forensic Paint Crossword. It may be helpful to allow students to use their lecture notes. Use the Forensic Paint Crossword Puzzle 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 |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | * Paint Layer Determination (this is a 2-day assignment). Prepare and distribute the materials before class. Divide the class into four groups (A, B, C, and D). Have the students create paint samples according to the procedure for Day 1 of the Paint Layer Determination Lab. For Day 2, have students analyze the samples and answer the lab questions (although they are working in groups, the students should complete the Day 2 work individually). See the Paint Layer Determination Lab Teacher’s Notes and the Paint Layer Determination Lab for details. Use the Paint Layer Determination Lab Key and/or the Individual Work Rubric for assessment.

Saferstein, Richard. *Forensic Science: An Introduction.* 2nd ed.*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 \***  | *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*For reinforcement, students will write 3 test questions from the class notes and present them to the class. The questions must be one of each of the following: multiple choice, true/false, and completion. Use the Presentation Rubric for assessment (Note: The students’ questions may be used as additional items on the quiz or even as bonus questions). |
| **References/Resources/****Teacher Preparation** | Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey:Pearson Prentice Hall, 2008Saferstein, Richard. *Forensic Science: An Introduction.* 2nd ed.New Jersey: Pearson Prentice Hall, 2011Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science.*8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004B<http://en.wikipedia.org/wiki/Murder_of_Vicky_Lynn_Hoskinson> |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | Science StandardsI. Nature of Science: Scientific Ways of Learning and Thinking C. Collaborative and safe working practices1. Collaborate on joint projects.
2. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms.
3. Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures.
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| **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 match paint chips to a crime scene sample. Obtain 3 to 4, ¼-inch sized paint chips from various items. Sources could include paint from houses, old bicycles, wrecked vehicles, etc. This activity will be more “authentic” if you use the same type of paint source (for example, three paint chips that come from 3 different red vehicles). Make sure you obtain 2 samples from each to allow for the crime scene sample. Label the crime scene sample and then label the other samples “Sample A,” “Sample B,” etc. Using the microscopes and the hand lenses, students are to try to determine which sample matches the crime scene sample. Use the Individual Work 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)