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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** | DNA - Deoxyribonucleic Acid |
| **TEKS Student Expectations** | **130.339. (c) Knowledge and Skills** (12) The student analyzes deoxyribonucleic acid (DNA) laboratory procedures in forensic science. The student is expected to: (A) describe the structure of a DNA molecule and its function; (B) describe the steps used in extraction of DNA; (C) explain the analytical procedure for forensic DNA typing, including electrophoresis, polymerase chain reaction, and short tandem repeat; and (D) interpret the components of an electropherogram. |
| **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. Diagram the DNA molecule.
2. Explain the polymerase chain reaction laboratory procedure.
3. Demonstrate how to package, collect, and analyze DNA from a simulated crime scene.
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| **Rationale** | Based upon its individualized characteristics, DNA is one of the most valuable tools to verify identities, exclude suspects, and ultimately solve crimes. |
| **Duration of Lesson** | Teacher’s Discretion |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | Please see outline |
| **Materials/Specialized Equipment Needed** | * *DNA Extraction from Strawberries Lab*
	+ DNA Extraction from Strawberries Lab Teacher’s Notes
	+ DNA Extraction from Strawberries Lab Student Response Sheet
	+ Strawberries (fresh or frozen)
	+ Resealable plastic freezer bags
	+ Small plastic cups
	+ Plastic pipettes
	+ Coffee filters (cone shaped #2 work best) or cheesecloth
	+ Extraction Buffer
	+ Ethanol
	+ Ice
	+ Coffee stirrers
* Computers with Internet access
* DNA Quiz and Key
* DNA Extraction from Strawberries Lab and Key
* Understanding the Steps of Polymerase Chain Reaction (PCR) Lewinsky/Clinton Scandal
* Discussion Rubric
* Individual Work Rubric
* Research Rubric
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Do an Internet search for the following article: The Murder Trial of O.J. Simpson by Thomas L. Jones. Read the article as a class. Discuss the role that DNA evidence played in the OJ Simpson case. Use the Discussion Rubric for assessment. |
| **Direct Instruction \*** | **Key Points**I. Deoxyribonucleic Acid (DNA)1. Introduction
	1. Like fingerprints, DNA is unique to everyone
	2. The primary unit is called a gene
	3. Each gene contains DNA that controls our genetic traits
2. Structure of DNA
	1. DNA is a molecule comprised of repeating units called nucleotides
	2. A nucleotide consists of
		1. Deoxyribose sugar
		2. Phosphate
		3. Nitrogen base (adenine, guanine, cytosine, thymine)
	3. DNA is a double helix with sides consisting of alternating sugars and phosphates and the rungs representing the nitrogen bases
	4. The nitrogen bases
		1. Adenine bonds only to thymine and guanine bonds only to cytosine
		2. Base pairing is when the bonding of the corresponding base pairs joins two DNA strands
		3. The order of the bases determines the genetic code
3. DNA Typing
	1. The process of DNA typing converts DNA into a series of bands that can distinguish an individual
	2. Only a small percentage of DNA differs from one person to the next
	3. These parts of one’s DNA are used to create a DNA profile
	4. The majority of DNA is repetitive and does not code for specific proteins, repeating the same sequence over and over
4. Polymerase Chain Reaction (PCR)
	1. PCR is a technique for making many copies of a specific piece of

DNA* 1. PCR can amplify very minute quantities of DNA millions of times
	2. The steps of PCR are
		1. The DNA is heated to separate and “unzip” it
		2. Primers are added to combine with DNA strands
		3. DNA polymerase (enzymes) and free nucleotides are added to rebuild separated strands
		4. The DNA is cooled
		5. The process is repeated several times
1. Short Tandem Repeats (STR)
	1. STR is the latest method of DNA typing
	2. There are locations (loci) on a chromosome that contain short segments of 3 – 7 bases that repeat themselves
	3. STR’s are less susceptible to degradation and can be recovered from bodies or stains that have been subject to extreme decomposition
	4. With the technology of PCR, one can extract and amplify a combination of different STR’s
2. Mitochondrial DNA
	1. It is another method of typing used for individual characterization
	2. It is located outside a cell’s nucleus and is inherited only from the mother
	3. It is not as useful as STR and is costlier than another DNA testing
3. Visualizing DNA through Electrophoresis
	1. In the lab, DNA molecules are cut by restriction enzymes into fragments of various sizes
	2. With electrophoresis, the resulting fragments are forced to move along a gel-coated plate under the influence of an electrical potential
	3. After the fragments have “migrated” across the gel, the gel can be stained to show the bands or fragments easily
	4. Comparisons can then be made such as comparing a suspect’s DNA to the DNA found on a crime scene
	5. *Note:* The electrophoresis apparatus is costly, but if the budgetpermits, it is suggested to utilize an electrophoresis/DNA kit obtainable through most scientific supply companies. However, there are also many virtual labs available on the internet
4. Combined DNA Information System (CODIS)

CODIS maintains a database of DNA profiles from convicted offenders, unsolved crime scene evidence, and profiles of missing persons1. Sources of DNA
	1. Skin
	2. Sweat
	3. Blood
	4. Mucus
	5. Saliva
	6. Tissue
	7. Semen
	8. Urine
	9. Hair
	10. Ear Wax
	11. Vaginal or rectal cells
2. Collecting and Packaging Biological Evidence
	1. Photograph evidence first
	2. Wear gloves always
	3. Package each stained article separately in paper or a well-ventilated box
	4. Avoid using plastic or airtight containers because moisture could contribute to harmful bacteria and fungi growth
	5. Remove dried blood by using a sterile swab moistened with distilled water
	6. Store biological evidence in the refrigerator or a cool location until it is delivered to the lab

*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 \*** | DNA Extraction from Strawberries Lab. Students will extract and observe DNA from strawberries by mashing them and mixing them with a buffer to separate the DNA. When complete, DNA can be seen on the end of a coffee stirrer.**Accommodations for Learning Differences**For reinforcement, students will construct a simple DNA model using common household items. Use the Individual Work Rubric 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 \*** | Lewinsky/Clinton Activity. Have students read and then analyze the reports about the Lewinsky/Clinton scandal at [law2.umkc.edu/faculty/projects/ftrials/clinton/lewinskydress.html](http://law2.umkc.edu/faculty/projects/ftrials/clinton/lewinskydress.html). Then have students complete the Understanding the Steps of Polymerase Chain Reaction Lewinsky/Clinton Scandal questions. As a class, discuss the students’ answers. Use the Lewinsky/Clinton Scandal Key (answers will vary) and the Discussion Rubric 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 \***  | *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** | Use the DNA Extraction from Strawberries Lab Teacher’s Notes to prepare for the lab. Use the DNA Extraction from Strawberries Lab Student Response Sheet for the activity. Use the DNA Extraction from Strawberries Lab Key for the assessment.**Resources**Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey:Pearson Prentice Hall, 2008Saferstein, Richard. *Forensic Science: An Introduction.* 2nd ed. NewJersey: Pearson Prentice Hall, 2011Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science.*8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004<http://law2.umkc.edu/faculty/projects/ftrials/clinton/lewinskydress.html> Do an Internet search for the following: The Murder Trial of O.J. Simpsonby Thomas L. Jones |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | Science Standards1. Foundation Skills: Scientific Applications of Mathematics F. Scientific measurement
	* 1. Select and use appropriate Standard International (SI) units

and prefixes to express measurements for real world problems.1. Foundation Skills: Scientific Applications of Communication B. Scientific reading
	* 1. Set up apparatuses, carry out procedures, and collect specified data from a given set of appropriate instructions.
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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 research a local crime that involves DNA evidence. Use the Research 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)