FORENSIC SCIENCE
FULL-YEAR CURRICULUM

TPT PREVIEW

Grades 9-12 | 18 Units | 36-Week Course

18	36	8	18	60
CONTENT-RICH UNITS	WEEKS OF PACING	LABS	UNIT QUIZZES	VOCABULARY TERMS

This preview lets you inspect a complete instructional chapter, student materials, answer keys, laboratory content, case-study materials, assessment style, and vocabulary pages from the full curriculum.

TPT PREVIEW

TABLE OF CONTENTS

Unit 6: DNA Evidence

LEARNING OBJECTIVES

- Describe the structure of DNA and explain how it stores genetic information.
- Explain the process of DNA extraction from biological evidence.
- Describe PCR and STR analysis and their role in forensic DNA profiling.
- Explain the function and significance of the CODIS database.
- Discuss the limitations and potential sources of error in DNA evidence analysis.

TEACHER GUIDE

Unit Overview: This unit covers DNA structure, extraction, profiling techniques, and the CODIS database. Students extract DNA from strawberries, learn about PCR and STR analysis, and discuss the power and limitations of DNA evidence.

Materials Needed:

- Strawberries (frozen, 1 per group)
- Dish soap (1 bottle)
- Salt (1 container)
- Isopropyl alcohol, chilled (1 bottle)
- Zip-lock bags (30)
- Coffee filters (30)
- Test tubes and racks (15 sets)
- Wooden sticks for stirring (30)
- STR profiling activity sheets (30)

Preparation Time: 30 minutes. Freeze strawberries overnight. Chill isopropyl alcohol. Prepare lysis buffer solution (soap, salt, water). Set up extraction stations with all materials. Print STR activity sheets.

Lesson Sequence:

Day 1: Bell-ringer (5 min). DNA structure and extraction direct instruction (15 min). Strawberry DNA extraction lab (25 min). Students observe and sketch precipitated DNA (5 min). Day 2: Bell-ringer (5 min). PCR and STR analysis instruction (20 min). CODIS database overview (10 min). DNA evidence limitations

discussion (10 min). STR profile matching activity (5 min).

Bell-Ringer Activity: A single hair root found at a crime scene contains approximately 10 nanograms of DNA. Why is this enough to create a DNA profile, and what technology makes this possible?

Teaching Strategies: The strawberry DNA extraction is highly engaging and visual. Have students predict what the DNA will look like before extraction. For STR analysis, use a simplified paper-based activity where students compare STR allele numbers between samples. Discuss real cases where DNA evidence was contested.

Differentiation: Supports: Provide a step-by-step lab procedure with diagrams. Use color-coded allele charts for the STR matching activity. Extensions: Research the Innocence Project and present a case where DNA evidence exonerated a wrongfully convicted person.

Common Student Misconceptions:

- "DNA evidence is 100% foolproof." Discuss cases of contamination, lab errors, and secondary transfer.
- "A DNA match means the person definitely committed the crime." Clarify that a match proves presence, not action.

Assessment Guide: Grade the DNA extraction lab for participation and completion of the lab worksheet. Evaluate the STR matching activity for accuracy. Use Section Review questions for graded homework.

KEY VOCABULARY

Term	Definition
DNA (Deoxyribonucleic Acid)	A double-helical molecule found in nearly all living cells that carries the genetic instructions for development, functioning, and reproduction.
STR (Short Tandem Repeat)	Short, repeating sequences of 2-6 base pairs found throughout the genome that vary in length between individuals and are used for DNA profiling.
PCR (Polymerase Chain Reaction)	A laboratory technique that amplifies specific regions of DNA, creating millions of copies from a tiny sample, enabling analysis of trace evidence.
CODIS	Combined DNA Index System, a federally maintained database of DNA profiles from convicted offenders, arrestees, crime scene evidence, and missing persons.
Restriction Enzyme	A protein that cuts DNA at specific base sequences, used in older RFLP analysis to create DNA fragments of varying lengths for comparison.

INSTRUCTIONAL CONTENT

DNA Structure and Extraction

DNA Profiling: From RFLP to STR Analysis

RFLP analysis was an early forensic DNA method that required relatively large amounts of intact DNA. Modern forensic profiling generally uses PCR-amplified short tandem repeats (STRs). STRs vary in repeat number among individuals and can provide highly discriminating profiles when analyzed with appropriate statistical models.

CODIS and Interpretation

CODIS is a U.S. DNA database system that allows qualified profiles to be searched across local, state, and national levels. A database association can provide an investigative lead; it does not by itself establish that a person committed the crime. DNA findings must be interpreted in context, including transfer, contamination, mixtures, degradation, and the propositions being compared.

Statistical Language

A DNA result is typically expressed in relation to competing propositions, often using a statistic such as a likelihood ratio or a profile-frequency measure. Report DNA statistics with the population model, loci, assumptions, and calculation clearly identified; avoid unsupported universal frequency claims.

- Presence of a DNA profile does not by itself establish when, how, or why the DNA arrived at a location.
- Secondary transfer and contamination are important interpretive considerations.

STUDENT HANDOUT

Name: _____ Date: _____

Fill in the blanks using the instructional content and class discussion.

DNA profiling uses the _____ process to amplify target regions and modern forensic profiles commonly use _____ repeats. A CODIS association is an _____ lead, not proof of guilt. DNA interpretation must consider _____ transfer, contamination, mixtures, and degradation.

Reflection Question: Why can a strong DNA association still require contextual interpretation?

_____

_____

SECTION REVIEW AND REFLECTION

1. Why was STR analysis more practical than older RFLP methods for many forensic samples?
2. What does a database association provide?
3. Name two limitations that can affect DNA interpretation.

ANSWER KEY

Section Review Answer Key

1. DNA consists of two strands in a double helix, with four bases: adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G). This predictable base pairing is essential for PCR, which uses complementary primers to target and amplify specific regions. The base sequence variation between individuals is what makes DNA profiling possible, as differences in STR repeat counts create unique profiles.

2. PCR amplifies specific DNA regions by repeatedly heating and cooling a sample in the presence of DNA polymerase, primers, and nucleotides. Each cycle doubles the target DNA, creating millions of copies from a single molecule. This was a breakthrough because forensic evidence often contains only trace amounts of DNA, and PCR enables analysis of samples too small for earlier methods like RFLP.

3. STRs are short repeating sequences (2-6 base pairs) that vary in the number of repeats between individuals. They are used instead of whole-genome analysis because they are highly variable, require only short DNA fragments (making them work with degraded samples), can be amplified by PCR, and a panel of 20 STR loci provides discrimination power of less than one in quadrillions, which is more than sufficient for identification.

4. Three limitations are: (1) Contamination during collection or analysis can produce false results, so chain of custody and lab protocols are critical. (2) Secondary transfer means DNA can be deposited by innocent contact, so a DNA match does not prove the person committed the crime. (3) Mixed DNA samples from multiple contributors are complex to interpret and may not provide a clear profile, especially with low-quality samples.

LAB MANUAL

Lab 1: Fingerprint Development and Comparison Lab

Related Unit: 4 | **Duration:** 50 minutes

Objective: Develop latent fingerprints using powder and chemical techniques, then compare prints using the ACE-V methodology.

Safety

- Wear safety goggles at all times.
- Avoid inhaling fingerprint powder. Work in a well-ventilated area.
- Do not touch your face or mouth while handling powder.

Materials

Fingerprint powder (black and white); Fingerprint brushes (feather and fiberglass); Clear lifting tape; Fingerprint backing cards (white and black); Magnifying glasses or loupes; Various surfaces (glass, metal, plastic, paper); Ink pads and ten-print cards; Tissues and cleaning supplies

Procedure

Step 1: Put on gloves and select a surface from the station. Do not add your own prints to the surface.

Step 2: Apply a small amount of fingerprint powder to the brush. Tap the brush gently to remove excess powder.

Step 3: Lightly brush the powder across the surface in a circular motion. Do not press hard. The powder should adhere to the latent print residue.

Step 4: When the print becomes visible, stop brushing. Observe the ridge pattern and note the surface location.

Step 5: Cut a piece of clear lifting tape slightly longer than the print. Place it smoothly over the developed print, pressing gently from one end to avoid air bubbles.

Student Record

Surface Type	Powder Used	Print Quality (1-5)	Minutiae Found	Comparison Result
(student fills in)				

Analysis

1. Which surface produced the best-quality print? Explain why using concepts of surface texture and porosity.

2. Compare the effectiveness of black powder versus white powder on different surfaces. When would you choose each?

Scoring focus: safe technique, accurate data, evidence-based reasoning, and appropriately cautious conclusions.

Lab 2: Blood Typing and Spatter Analysis Lab

Related Unit: 5 | **Duration:** 50 minutes

Objective: Perform simulated ABO/Rh typing and investigate how surface angle and drop height affect stain morphology. Use bloodstain geometry without using stain diameter or legacy “velocity” categories to infer a weapon or event.

Safety

- Wear goggles and gloves during the simulated typing activity.
- Use only commercially prepared simulated reagents or teacher-approved non-biological classroom substitutes; never use human blood.
- Do not ingest any materials. Clean spills promptly using the teacher-approved cleanup procedure.

Materials

Simulated blood typing kit (anti-A, anti-B, anti-Rh sera); Simulated blood samples (Types A, B, AB, O); Microscope slides (4 per group); Toothpicks (per group); Simulated blood for spatter (500 ml); Butcher paper (1 sheet per group); Droppers or pipettes; Rulers and protractors; Measuring tape

Procedure

PART A: SIMULATED ABO/Rh TYPING (25 minutes)

Step 1: Label three reaction areas for each simulated sample. Add the manufacturer-provided simulated anti-A, anti-B, and anti-Rh reagents using clean applicators.

Step 2: Mix only the materials intended for each reaction area. Observe and record simulated agglutination according to the kit instructions.

Step 3: Infer the simulated ABO/Rh type from the reaction pattern and record the reasoning.

PART B: BLOODSTAIN GEOMETRY (25 minutes)

Student Record

Sample	Anti-A	Anti-B	Anti-Rh	Blood Type
1				

Sample	Anti-A	Anti-B	Anti-Rh	Blood Type
2				

Analysis

1. What relationship did you observe between drop height and stain diameter? Is this relationship linear?

2. How accurate were your calculated impact angles compared to the known angles? What sources of error exist?

Scoring focus: safe technique, accurate data, evidence-based reasoning, and appropriately cautious conclusions.

Lab 3: DNA Extraction from Strawberries Lab

Related Unit: 6 | **Duration:** 50 minutes

Objective: Extract and observe DNA from strawberry cells using a simple extraction protocol, and understand the principles behind forensic DNA analysis.

Safety

- Wear safety goggles.
- Dish soap can irritate eyes. Avoid contact.
- Isopropyl alcohol is flammable. Keep away from open flames.

Materials

Frozen strawberries (1-2 per group); Zip-lock bags (1 per group); Dish soap/shampoo (2 tablespoons); Salt (1 tablespoon); Water (distilled, 50 ml); Cold isopropyl alcohol (10 ml per group, pre-chilled); Coffee filters or cheesecloth; Test tubes and test tube racks; Wooden sticks or stirring rods; Measuring cups and spoons

Procedure

Step 1: Put on gloves and safety goggles. Remove the green stems from 2-3 strawberries and place them in the zip-lock bag.

Step 2: Seal the bag and press/smash the strawberries with your fingers for 2 minutes until they are completely pulverized.

Step 3: In a separate cup, prepare the extraction buffer by mixing 2 tablespoons of dish soap, 1 tablespoon of salt, and 50 ml of distilled water. Stir gently to avoid creating foam.

Step 4: Add 10 ml of the extraction buffer to the bag with the smashed strawberries. Seal and mix gently for 1 minute.

Step 5: Place the coffee filter over a clean cup. Pour the strawberry mixture through the filter. Allow it to drip for 3-5 minutes.

Student Record

Observation Step	What Did You Observe?	What Does This Represent?
Strawberry after smashing		
After adding buffer		

Analysis

1. Explain the role of each extraction buffer ingredient: soap, salt, and alcohol.

2. Why is this DNA extraction technique not sufficient for forensic DNA profiling? What additional steps would be needed?

Scoring focus: safe technique, accurate data, evidence-based reasoning, and appropriately cautious conclusions.

Lab 4: Chromatography: Ink and Unknown Mixtures

Related Unit: 9 | **Duration:** 50 minutes

Objective: Use paper chromatography to separate components of ink and compare questioned and known samples while distinguishing association from identification.

Safety

- Wear goggles when working with solvents.
- Use teacher-approved classroom solvents only and work with adequate ventilation.
- Keep solvents away from ignition sources.

Materials

Chromatography paper; Water-based pens/markers; Pencils; Beakers or cups; Teacher-approved solvent; Rulers; Known and questioned ink samples

Procedure

Step 1: Draw a light pencil origin line about 1–2 cm from the bottom edge of the paper.

Step 2: Place a small dot of each known and questioned ink on the origin line. Keep spots separated.

Step 3: Stand the paper in the solvent with the origin line above the solvent level.

Step 4: Allow the solvent to migrate, then remove and mark the solvent front immediately.

Step 5: Measure band positions and compare the pattern of separated components among samples.

Student Record

Scoring focus: safe technique, accurate data, evidence-based reasoning, and appropriately cautious conclusions.

CASE STUDIES

Case Study 1: The Lindbergh Baby Kidnapping (1932)

Category: Forensic Evidence Pioneers

Background

On March 1, 1932, the 20-month-old son of aviator Charles Lindbergh was kidnapped from his home in Hopewell, New Jersey. A ransom note demanding $50,000 was found on the nursery windowsill. Despite payment of the ransom, the child was found dead on May 12, 1932, approximately four miles from the home. The investigation became the most famous criminal case of the 20th century and established several forensic science precedents.

Timeline

Date	Event
March 1, 1932	Child kidnapped from home; ransom note found on windowsill
April 2, 1932	Ransom of $50,000 paid by Dr. Condon
May 12, 1932	Body discovered four miles from home
Sept 1934	Bruno Hauptmann arrested; gold ransom bills traced

Key Evidence

Evidence Type	Description
Wood evidence	The prosecution presented the ladder as an important historical comparison. Students should treat historical wood comparison as a case-study example and evaluate its limitations rather than treating it as a modern individualizing method.
Ransom money	Gold certificates from the ransom were traced to Hauptmann, who was found spending them.
Handwriting	Experts compared Hauptmann writing to the ransom notes and found similarities.

STUDENT HANDOUT

Name: _____ **Date:** _____

Case Analysis

1. What types of forensic evidence were used in this case? Which would be considered class evidence and which individual evidence today?
2. The wood grain comparison was a key piece of evidence. How reliable is this type of comparison by modern forensic standards?
3. Based on the evidence, do you find it compelling? What weaknesses exist in the forensic evidence?

ANSWER KEY

Teacher Key

1. The case involved physical evidence, handwriting comparison, and traced ransom money. The historical evidence should not be retrofitted into modern "individual evidence" categories without qualification. Students should distinguish what investigators argued in 1932–1935 from what a modern validated method could support.

2. Modern students should ask about validation, error, reproducibility, examiner subjectivity, and the limits of the comparison method. The historical ladder evidence is best analyzed as contextual/circumstantial evidence rather than as a modern DNA-style individualization.

3. Ransom money is most compelling; wood and handwriting are weaker. Defense argued money came from a third party (Fisch) who died before trial.

Case Study 2: The O.J. Simpson Murder Trial (1995)

Category: DNA Evidence and Chain of Custody

Background

On June 12, 1994, Nicole Brown Simpson and Ronald Goldman were found murdered outside Nicole's condominium in Brentwood, Los Angeles. O.J. Simpson, a famous football player and actor who was Nicole's ex-husband, became the primary suspect. The case became one of the most publicized trials in American history and highlighted both the power of DNA evidence and the consequences of procedural errors in evidence handling.

Timeline

Date	Event
June 12, 1994	Bodies discovered; crime scene processed
June 13, 1994	O.J. Simpson interviewed; blood evidence found at his estate
June 17, 1994	Low-speed Bronco chase; Simpson arrested
June 1994-Jan 1995	Pre-trial hearings on evidence admissibility

Unit 4 Quiz - Fingerprint Analysis

Circle the best answer for each question.

1. Friction ridges are found on all of the following EXCEPT:

a) Fingers b) Palms c) Elbows d) Soles of feet

2. The most common fingerprint pattern is:

a) Arch b) Loop c) Whorl d) Double loop

3. ACE-V stands for:

a) Analysis, Comparison, Evaluation, Verification b) Assessment, Classification, Examination, Verification c) Analysis, Collection, Evaluation, Verification d) Assessment, Comparison, Examination, Verification

4. AFIS is used to:

a) Analyze blood types b) Store and search fingerprint records c) Perform DNA analysis d) Detect drugs

5. Fingerprints form during fetal development between weeks:

a) 1-4 b) 5-8 c) 10-16 d) 20-30

6. Ninhydrin is used to develop prints on:

a) Metal surfaces b) Glass c) Paper and cardboard d) Skin

7. Identical twins have different fingerprints because:

a) They have different DNA b) Random micro-environmental factors in the womb c) They develop at different rates d) One twin is dominant

8. A fingerprint with no delta is called a(n):

a) Loop b) Whorl c) Arch d) Composite

ANSWER KEY

1. c | 2. b | 3. a | 4. b | 5. c | 6. c | 7. b | 8. c

Score: _____ / 8 **Review:** _____

Sixty essential terms span the curriculum. Terms are organized alphabetically.

Term	Definition
ACE-V Methodology	A structured fingerprint-comparison framework: Analysis, Comparison, Evaluation, and Verification.
AFIS	Automated Fingerprint Identification System used to store and search fingerprint records and generate candidate associations.
Area of Convergence	The two-dimensional region where the long axes of appropriate bloodstains intersect on a surface.
Area of Origin	The three-dimensional space in which the spatter-producing event is estimated to have occurred.
Antibody	A protein that binds a specific antigen; in simulated ABO typing it is used to demonstrate agglutination reactions.
Antigen	A surface marker that contributes to blood-group classification.
Arson	A fire deliberately set to burn property; investigators must distinguish intentional fire-setting from accidental and natural causes.
Autopsy	A systematic medical examination of a body that may include external and internal examination to help determine cause and manner of death.
BAC	Blood alcohol concentration, commonly expressed as grams of ethanol per 100 mL of blood.
Bindle	A folded paper packet used to secure small trace-evidence items.
Caliber	A measurement associated with the bore or ammunition size of a firearm; exact definitions depend on the firearm/ammunition system.
Chain of Custody	Documentation showing who collected, transferred, stored, and examined evidence and when those events occurred.
Chromatography	A separation technique based on differential movement of substances through stationary and mobile phases.
Class Evidence	Evidence whose observed characteristics are shared by a group and therefore cannot, by themselves, establish one unique source.
CODIS	The FBI-supported Combined DNA Index System program for criminal-justice DNA databases.
Contamination	The unwanted introduction of material that can alter, complicate, or mislead an examination.
Cross-Examination	Questioning of an opposing witness intended to test testimony, methodology, credibility, or limitations.
Daubert Standard	A U.S. legal framework used in federal evidence decisions to evaluate the reliability and relevance of expert testimony.
DNA	Deoxyribonucleic acid, the molecule that carries hereditary information in living organisms.
Expert Witness	A witness qualified by specialized knowledge, training, education, or experience to provide expert testimony under applicable rules.

Term	Definition
Fire Tetrahedron	A model describing four elements required for sustained combustion: fuel, heat, oxygen/oxidizer, and a chemical chain reaction.
Fire Pattern	A physical change or recognizable shape produced by a fire effect or group of effects.
Forensic Science	Application of scientific knowledge and methods to questions arising in law or legal investigations.
Forensic Toxicology	Application of toxicology to legal questions, including the detection and interpretation of drugs, alcohols, and poisons.
Frye Standard	A U.S. evidentiary approach emphasizing general acceptance of a scientific method in the relevant field.
Gunshot Residue (GSR)	Particles associated with firearm discharge that may be deposited on people or objects; detection alone does not prove who fired a weapon.
Hearsay	An out-of-court statement offered for the truth of the matter asserted, subject to rules and exceptions under the applicable jurisdiction.
Ignitable Liquid Residue (ILR)	Volatile compounds that may remain in fire debris and can be analyzed for consistency with ignitable-liquid products.
Individual Characteristics	Features that may arise through random or acquired processes and can be more discriminating than shared design or class features.
Latent Fingerprint	A fingerprint that is not readily visible and requires development or enhancement.

WHAT'S INCLUDED

Forensic Science Full-Year Curriculum | Grades 9-12

18-UNIT COURSE SCOPE

01 Introduction to Forensic Science

02 Crime Scene Investigation Basics

03 Evidence Types and Collection

04 Fingerprint Analysis

05 Blood and Blood Spatter Analysis

06 DNA Evidence

07 Forensic Toxicology

08 Forensic Anthropology and Entomology

09 Questioned Documents and Handwriting

10 Digital Forensics

11 Firearms and Toolmark Analysis

12 Trace Evidence: Hair, Fiber, Soil, and Glass

13 Forensic Chemistry and Unknown Substances

14 Arson and Explosion Investigation

15 Forensic Psychology and Criminal Profiling

16 Death Investigation and the Medical Examiner

17 Bloodstain Pattern Analysis

18 Mock Trial Capstone

MAJOR INCLUDED COMPONENTS

- Teacher guides with lesson sequences, materials, differentiation, misconceptions, and assessment notes
- Student handouts, guided notes, section reviews, and answer keys
- 8 classroom-safe forensic labs with procedures, safety, data collection, analysis, and rubrics
- 2 case studies with evidence analysis, student handouts, and teacher keys
- 18 unit quizzes with answer keys + mock-trial capstone materials
- 60-term forensic-science vocabulary wall + full-year 36-week pacing framework

PREVIEW

TPT PREVIEW

Teacher-ready forensic science instruction, practice, investigation, and assessment in one full-year curriculum.