

Forensic Technology

8409 36 weeks

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Course Description

Suggested Grade Level: 11 or 12

Forensic science plays a crucial role in today’s civil and criminal cases by collecting, documenting, testing and analyzing crime scene evidence using state-of-the-art technologies and techniques. This course provides an introduction to students who might be interested in forensic science careers in toxicology, serology, controlled substances, latent fingerprints, firearm/tool mark, DNA and document analysis, among others.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	8409	Tasks/Competencies
Introducing Forensic Science		
39	⊕	Define the term <i>forensic science</i> .
40	⊕	Identify careers that use forensic technology.
41	⊕	Describe the applied skill of deductive reasoning in forensic analysis.
42	⊕	Defend a scientific argument.
Establishing Lab Skills and Maintaining Safety		
43	⊕	Demonstrate general lab skills necessary to the field of forensic science.
44	⊕	Describe lab safety skills related to the forensic sciences.
Exploring the Scientific Method		
45	⊕	Demonstrate the key steps of the scientific method in forensic analysis by collecting and preserving evidence from a crime scene.
46	⊕	Describe the difference between presumptive testing and confirmatory testing.

47	+	Identify questions and concepts that guide scientific investigations.
Applying Crime Scene Procedures		
48	+	Describe the historical precedents for gathering and admitting evidence.
49	+	Describe the role of the crime scene/forensic investigator.
50	+	Describe how a crime scene is investigated.
51	+	Describe the legal considerations for working in a crime scene.
52	+	Describe the services of the crime laboratory.
53	+	Document a crime scene, using a sketch or scene documentation software.
54	+	Document a crime scene, using photography.
55	+	Describe witness-interview techniques.
56	+	Describe evidence-collection techniques.
57	+	Define the terms <i>class characteristic</i> and <i>individual characteristic</i> .
Examining Trace Evidence		
58	+	Identify the two types of trace evidence.
59	+	Analyze trace evidence, using light microscopy.
60	+	Describe the testing procedure for any piece of trace evidence.
61	+	Describe sources of contamination for trace evidence and the ways to minimize that contamination.
62	+	Define <i>positive control</i> and <i>negative control</i> .
63	+	Interpret the results of a false-positive test and a false-negative test.
64	+	Generate a comparison of two pieces of physical evidence.
65	+	Describe bodily fluids.
Exploring Deoxyribonucleic Acid (DNA) Testing		
66	+	Describe how DNA technology has affected criminal justice.

67	+	Describe the extraction and isolation of DNA from living cells.	
68	+	Describe the technologies used in identifying and analyzing DNA from a crime scene.	
69	+	Interpret the results of DNA analysis.	
70	+	Demonstrate the storage procedures for DNA testing evidence.	
Analyzing Questioned Documents			
71	+	Describe the methods used to authenticate original documents.	
72	+	Demonstrate techniques in ink analysis.	
73	+	Describe the methods used in comparing handwriting samples.	
74	+	Analyze alterations made to documents.	
Collecting and Analyzing Latent Fingerprints			
75	+	Identify the anatomy of a fingerprint and the fingerprint's value in forensics.	
76	+	Describe the systems of analysis for fingerprints.	
77	+	Describe how to fingerprint subjects.	
78	+	Describe the materials used to take fingerprints from various surfaces.	
79	+	Identify fingerprint characteristics.	
80	+	Explain the procedures for analyzing latent prints.	
81	+	Describe the procedure to make casts and molds of shoe impressions.	
82	+	Describe the components of a tire impression analysis.	
Exploring Toxicology and Controlled Substances			
83	+	Describe the role of the toxicologist in the forensic laboratory.	
84	+	Compare psychological and physical dependence.	
85	+	Classify the most commonly abused drugs, including toxicity and the effects on the body.	
86	+	Perform preliminary tests in drug identification analysis.	

87	<input checked="" type="radio"/>	Demonstrate the procedure to run thin layer chromatography (TLC) tests.
88	<input checked="" type="radio"/>	Describe the utility of mass spectrometry for identification analysis.
89	<input checked="" type="radio"/>	Describe how alcohol is processed through the body.
90	<input checked="" type="radio"/>	Describe the procedure used to conduct the primary field sobriety tests.
91	<input checked="" type="radio"/>	Analyze blood-alcohol concentration levels.
Exploring Forensic Serology		
92	<input checked="" type="radio"/>	Calculate blood type probabilities, using Punnett squares.
93	<input checked="" type="radio"/>	Identify the A-B-O antigens and antibodies for each of the four blood types.
94	<input checked="" type="radio"/>	Apply test procedures to validate the presence of bodily fluid evidence.
95	<input checked="" type="radio"/>	Explain storage/preservation procedures for bodily fluid testing evidence.
96	<input checked="" type="radio"/>	Describe the types of blood-spatter patterns.
97	<input checked="" type="radio"/>	Conduct a blood spatter analysis to re-create a violent event.
Analyzing Forensic Aspects of Arson and Explosion Investigations		
98	<input type="radio"/>	Describe the chemistry of fire.
99	<input type="radio"/>	List the conditions necessary to initiate and sustain combustion.
100	<input type="radio"/>	Identify the signs of an accelerant-initiated fire.
101	<input type="radio"/>	Identify the methods used in searching a fire scene.
102	<input type="radio"/>	Describe how to collect and preserve arson evidence.
103	<input type="radio"/>	Analyze flammable residues.
104	<input type="radio"/>	Describe the types of explosives and their evidence, post-detonation.
Analyzing Tool Marks, Firearms, and Other Impressions		
105	<input checked="" type="radio"/>	Describe the significance of tool mark impressions in criminal investigations.

106	<input checked="" type="radio"/>	Analyze tool marks by matching marks to the tool that produced them.
107	<input checked="" type="radio"/>	Distinguish among firearm characteristics.
108	<input checked="" type="radio"/>	Distinguish between a bullet and a cartridge.
109	<input checked="" type="radio"/>	Describe the testing procedures used for gunshot residue.
110	<input checked="" type="radio"/>	Describe how a gun barrel affects the flight of a projectile.
111	<input checked="" type="radio"/>	Describe the relationship between barrel size and caliber.
112	<input checked="" type="radio"/>	Demonstrate ballistics recovery and examination at a crime scene.
113	<input checked="" type="radio"/>	Determine the position of the shooter, based on bullet trajectory.
114	<input checked="" type="radio"/>	Compare firing pin impressions from different sources.
115	<input type="radio"/>	Distinguish among internal ballistics, external ballistics, and terminal ballistics.
Investigating Medicolegal Death		
116	<input type="radio"/>	Describe the stages of postmortem tissue degeneration, including autolysis and putrefaction.
117	<input type="radio"/>	Define <i>cause, manner, and mechanism of death</i> .
118	<input type="radio"/>	Compare the coroner and medical examiner systems and responsibilities.
119	<input type="radio"/>	Describe causes of death and their associated injury patterns and characteristics.
120	<input type="radio"/>	Describe the legal necessity of establishing postmortem interval (PMI).
Exploring Forensic Anthropology and Forensic Entomology		
121	<input type="radio"/>	Define the terms <i>forensic anthropology</i> and <i>forensic entomology</i> .
122	<input type="radio"/>	Differentiate between a male skeleton and a female skeleton.
123	<input type="radio"/>	Determine an age range of a subject, based on the remains.
124	<input type="radio"/>	Describe the differences in skull features used to determine the race of a subject's remains.

125	<input type="radio"/>	Determine a subject's height by analyzing the long bones of the body.
126	<input type="radio"/>	Describe the stages of insect metamorphosis in estimating time of death.

Legend: Essential Non-essential Omitted

Curriculum Framework

Introducing Forensic Science

Task Number 39

Define the term *forensic science*.

Definition

Definition should include identifying forensic science as the application of science to establish facts pertaining to cases of civil or criminal law.

Process/Skill Questions

- What is the origin of the word *forensic*?
- What is the forensic scientist's role in the judicial system?
- What is a fact?

ITEEA National Standards

1. The Characteristics and Scope of Technology

TSA Competitive Events

Extemporaneous Speech

Technology Bowl

Task Number 40

Identify careers that use forensic technology.

Definition

Identification should include forensic investigators, forensic scientists, and others who may be part of the investigative team, including anthropologists, entomologists, odontologists, and cybersecurity specialists.

Process/Skill Questions

- What certifications, licenses, or degrees are available for careers in forensic science?
- What is the outlook for careers in forensic science?
- What resources have information about careers in forensic science?
- What are other areas in which forensic technology can be applied?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

TSA Competitive Events

STEM Careers

Task Number 41

Describe the applied skill of deductive reasoning in forensic analysis.

Definition

Description should include the use of logic to observe, evaluate, and develop conclusions based on critical data analysis.

Process/Skill Questions

- What are ways to improve observational skills?

- What different factors can affect the way we make observations?
- Why are observation skills important to forensic science?
- How might individuals see a crime scene differently?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Biotechnology Design

Principles of Technology (Virginia only)

Technology Problem Solving

Task Number 42

Defend a scientific argument.

Definition

Defense should include

- the formation of a hypothesis
- a summary and explanation of the data
- a list of the instrumentation and documentation used
- a presentation of the evidence
- an appropriate response to criticism of the analysis.

Process/Skill Questions

- Why is it important to document procedures when conducting experiments?
- What role does communication play in the defense of a scientific argument?
- What consequences would result from inaccurate instrumentation?

ITEEA National Standards

13. Assess the Impact of Products and Systems

TSA Competitive Events

Establishing Lab Skills and Maintaining Safety

Task Number 43

Demonstrate general lab skills necessary to the field of forensic science.

Definition

Demonstration should reflect the proper use of

- compound, dissecting, and comparison microscopes
- slide preparation
- micropipettes
- sterile technique
- handling and dispensing chemicals
- chemical apparatus in toxicology.

Process/Skill Questions

- What are the specific safety rules and procedures in the lab?
- What are the possible consequences of not following procedures?
- What is the procedure for handling hazardous materials?
- What apparatus might be used in toxicology?
- What is Personal Protective Equipment (PPE)?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 44

Describe lab safety skills related to the forensic sciences.

Definition

Description should include Personal Protective Equipment (PPE), the handling of glass or hot glass, and working with caustic chemicals, live tissue products, and other biological products.

Process/Skill Questions

- What are specific guidelines for lab safety in forensic science?
- What type of PPE should you use when coming into contact with biological products?
- What type of PPE should you use to prevent contamination of a crime scene?
- What methods could be used to protect yourself from exposure to chemicals?
- What resources have information on lab safety related to forensic science?

ITEEA National Standards

2. The Core Concepts of Technology

Exploring the Scientific Method

Task Number 45

Demonstrate the key steps of the scientific method in forensic analysis by collecting and preserving evidence from a crime scene.

Definition

Demonstration of the scientific method should include

- observation and description
- hypothesis
- experimentation (i.e., testing the hypothesis)
- collection and analysis of data
- conclusion.

Process/Skill Questions

- Why is it important to measure the results of a hypothesis?
- What senses are used in observation?
- What role does perception play in observation?
- Why are analytical skills so important in crime scene observation?
- How does the scientific method affect the introduction of evidence in a legal proceeding?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Biotechnology Design

Technology Bowl

Technology Problem Solving

Task Number 46

Describe the difference between presumptive testing and confirmatory testing.

Definition

Description should include the definitions of

- *presumptive testing*—chemical analysis of a sample that establishes the possibility that a substance is present
- *confirmatory testing*—identification of the specific substance through further chemical analysis.

Process/Skill Questions

- What are the differences between each test?
- When are presumptive and confirmatory tests conducted?
- Why is it necessary to conduct confirmatory tests on substances?
- What methods are used to test substances?

ITEEA National Standards

1. The Characteristics and Scope of Technology

13. Assess the Impact of Products and Systems

TSA Competitive Events

Biotechnology Design

Technology Problem Solving

Task Number 47

Identify questions and concepts that guide scientific investigations.

Definition

Identification should include applying the scientific method in the study of a question, including:

- What is the substance?
- Can we describe its origin?
- Can we describe its cause?
- Can we narrow it down to a specific source?

Process/Skill Questions

- What resources can be used to identify a substance?
- Why is it important to conduct repeatable, reliable tests on substances?
- What are the standard pieces of equipment necessary in any forensic laboratory?
- What role does logic play in applying the scientific method?
- How do our observations of a scene affect the scientific method?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Applying Crime Scene Procedures

Task Number 48

Describe the historical precedents for gathering and admitting evidence.

Definition

Description should include the Frye and Daubert standards, Locard's Principle of Exchange, and the process of admitting scientific evidence.

Process/Skill Questions

- How have the Frye and Daubert standards influenced the admissibility of scientific evidence?
- What is the difference between the Frye standard and the Daubert standard?
- Why would states choose to follow one standard but not the other?

ITEEA National Standards

7. The Influence of Technology on History

TSA Competitive Events

Extemporaneous Speech

Task Number 49

Describe the role of the crime scene/forensic investigator.

Definition

Description should include the distinction between forensic investigators (crime scene processors using current forensic evidence processing technology in the field) and forensic scientists (lab workers).

Process/Skill Questions

- What activities might a forensic investigator perform?
 - What activities might a forensic scientist perform?
 - How do the two occupations contribute to forensic technology?
-

Task Number 50

Describe how a crime scene is investigated.

Definition

Description should include

- duties of the first officer on the scene
- importance of witness separation
- importance of preventing contamination of the crime scene
- documentation of the scene (e.g., sketches, photographs, notes)
- types of search patterns
- collection and preservation of evidence.

Description could also include simulation using a mock crime scene.

Process/Skill Questions

- What is the procedure for securing a crime scene?
- What types of evidence are collected from a crime scene?
- Why is chain of custody important in the collection of evidence?
- What are the main search patterns used by crime scene investigators?
- What would happen if evidence were collected but not documented within the crime scene?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

13. Assess the Impact of Products and Systems

Task Number 51

Describe the legal considerations for working in a crime scene.

Definition

Description should include a summary of the Fourth Amendment and the legal guidelines surrounding searches with and without warrants.

Process/Skill Questions

- What is the Fourth Amendment?
- When is a warrant required?
- What is the importance of the concept of probable cause?
- When is it permissible to conduct a search without a warrant?
- How does the Fourth Amendment apply to the collection of evidence at a crime scene?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

Task Number 52

Describe the services of the crime laboratory.

Definition

Description should

- address all main disciplines of forensic science
- provide photography for all disciplines
- provide testimony for cases analyzed.

Process/Skill Questions

- What types of forensic services does a laboratory typically provide?
- Why do some laboratories focus on one or two specialties?
- Why is photography necessary in a forensic crime laboratory?
- What is the procedure for conducting a sobriety test in the laboratory?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 53

Document a crime scene, using a sketch or scene documentation software.

Definition

Documentation should include

- identifying and adhering to scale
- using the triangulation method
- using the baseline method
- using emerging technology
- using a scale for measurement
- completing a rough sketch and a finished sketch.

Process/Skill Questions

- Why would an investigator create a finished sketch from a rough sketch?
- Why is it important to include scale in a sketch?
- How many landmarks should be used when measuring distance from objects?
- How has technology influenced the documentation of crime scenes?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 54

Document a crime scene, using photography.

Definition

Documentation should include

- taking photos of the ingress, egress, and all evidence, with and without scale
- using long-range, midrange, and close-up perspectives, with and without scale
- triangulating the scene, using fixed objects.

Process/Skill Questions

- Why is it important to take photographs from different perspectives at the crime scene?
- Why should photographs include scale?
- What is the best kind of lighting for evidence photographs?
- What are the differences in photographing vs. sketching a scene?
- When should photographs be taken of the scene?

ITEEA National Standards

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Photographic Technology

Task Number 55

Describe witness-interview techniques.

Definition

Description should include

- separating witnesses and questioning individuals alone
- documenting the contact information for anyone interviewed
- describing the interview subject
- asking standard questions, including place, time, and circumstance

- documenting the entire process (e.g., questions asked, answers given, start and finish time and/or date of interview, additional observations).

Process/Skill Questions

- What are the procedures for questioning witnesses?
- How does eyewitness evidence affect a case?
- Why is it important to keep witnesses separate?
- What are some reasons that witness statements would conflict?
- What types of contact information are collected from witnesses?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Prepared Presentation

Technology Bowl

Task Number 56

Describe evidence-collection techniques.

Definition

Demonstration should include

- using appropriate packaging procedures for each piece of evidence
- labeling each piece of evidence correctly
- minimizing cross-contamination
- following chain-of-custody procedures.

Process/Skill Questions

- Why is a chain-of-custody procedure important?
- Why does evidence need to be packaged and sealed?
- What is the procedure for packaging evidence?
- What is the procedure for maintaining the chain of custody?
- Why is it important to separately package evidence?
- Why should investigators collect control samples from the victim?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 57

Define the terms *class characteristic* and *individual characteristic*.

Definition

Definition should include

- *class characteristic*—characteristic that puts an object into a certain group of persons or things (e.g., bullets to a type of weapon, blood sample to a blood group)
- *individual characteristic*—characteristic that narrows the object to a single source (e.g., fingerprints, DNA).

Process/Skill Questions

- How has individual evidence been used to reverse wrongful convictions?
- What are the differences between direct and circumstantial evidence?
- What does class evidence tell you about who may have been at the scene of a crime?

Examining Trace Evidence

Task Number 58

Identify the two types of trace evidence.

Definition

Identification should include the definition of *trace evidence*. Identification should also include objects or substances used to gather evidence (e.g., hair, fiber, fingerprints, paint, glass, soil).

Process/Skill Questions

- What category is trace evidence?
- Why is physical evidence important in forensic science?
- How are physical and biological evidence different?

Task Number 59

Analyze trace evidence, using light microscopy.

Definition

Analysis should include

- preparing a slide of trace evidence
- describing findings from the slide
- determining the characteristics of particular trace evidence.

Process/Skill Questions

- What types of light microscopy are used in forensic science?
- How does microscopic analysis help in the investigation of a crime?
- What types of evidence can be analyzed using light microscopy?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 60

Describe the testing procedure for any piece of trace evidence.

Definition

Description should include following procedures when completing a written report about trace evidence.

Process/Skill Questions

- What is the testing procedure for trace evidence?
- What role do communication skills play in the preparation of reports?
- What are the consequences of an improperly prepared report?
- What resources are available to properly write and prepare reports?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Task Number 61

Describe sources of contamination for trace evidence and the ways to minimize that contamination.

Definition

Description should include the

- type of source (e.g., other pieces of evidence, interaction with subjects not connected to the case, the technician himself/herself)
- steps taken to minimize contamination (e.g., use of proper safety measures, gloves, lab coat, clean work area, hygiene practices, proper disposal of waste).

Process/Skill Questions

- What types of procedures help prevent contamination of evidence?
 - What would happen if contaminated evidence were introduced in a court case?
 - Why is it important to follow chain-of-custody protocols?
 - Why should access to trace evidence be limited?
 - Who does laboratory safety protect?
 - How does PPE help minimize contamination?
-

Task Number 62

Define *positive control* and *negative control*.

Definition

Definitions should include

- *positive control*—a sample known to contain a particular substance, which would cause a positive result and verify that the test works.
- *negative control*—a sample known not to contain a particular substance, which would produce a negative result and verify that the test works.

Process/Skill Questions

- What do you think would happen if there were no controls in a test?
- Why is it important to have both a positive and negative control?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Biotechnology Design

Technology Problem Solving

Task Number 63

Interpret the results of a false-positive test and a false-negative test.

Definition

Interpretation should include

- definitions of false-positive and false-negative tests
- determination of test validity.

Process/Skill Questions

- How does contamination affect the validity of tests?
- How does instrumentation contribute to false-negative results?
- What can cause a false-positive result in a substance?
- What are ways to reduce or eliminate false positives and false negatives?
- What is the procedure used to validate a test result?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

4. The Cultural, Social, Economic, and Political Effects of Technology

Task Number 64

Generate a comparison of two pieces of physical evidence.

Definition

Procedure should include comparing trace evidence to determine whether the two samples have a common origin.

Process/Skill Questions

- What class characteristics of physical evidence allow them to be identified?
- What are individualizing characteristics (e.g., striations, markings) that can be used to link the evidence to a person?
- What is meant by *common origin*?
- What is the definition of the term *exemplar*?
- What are some specific tools or instruments used to compare trace evidence?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Task Number 65

Describe bodily fluids.

Definition

Description should include definitions for the terms *sweat*, *saliva*, *semen*, *blood*, and *urine*.

Process/Skill Questions

- What characteristics are needed for a substance to be considered a bodily fluid?
- In what ways can bodily fluids from a crime be used?
- What bodily fluids are most useful to solving a crime?

Exploring Deoxyribonucleic Acid (DNA) Testing

Task Number 66

Describe how DNA technology has affected criminal justice.

Definition

Describe how DNA technology has affected criminal justice. Description should include the following:

- The definition of *deoxyribonucleic acid (DNA)*
- A historical timeline of advances in DNA technology correlated to court cases
- The emergence of the Innocence Project

Process/Skill Questions

- What type of evidence contains DNA?
- What are some of the significant advances in DNA technology?
- How does DNA technology work?
- How has the Innocence Project used DNA technology to examine inmates' cases?
- What role has the Innocence Project played in the validation of forensic testing methods?

ITEEA National Standards

1. The Characteristics and Scope of Technology

13. Assess the Impact of Products and Systems

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Biotechnology Design

Debating Technological Issues

Task Number 67

Describe the extraction and isolation of DNA from living cells.

Definition

Description should include

- extraction through the use of a silica or magnetic bead process
- isolation through the use of ethyl alcohol
- filtration.

Process/Skill Questions

- What is the procedure for extracting DNA?
- Why is it important to extract and analyze DNA?
- What are the roles/functions of the solutions used in DNA extraction?

ITEEA National Standards

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Scientific Visualization (SciVis)

Task Number 68

Describe the technologies used in identifying and analyzing DNA from a crime scene.

Definition

Description should include

- polymerase chain reaction (PCR)
- short tandem repeat (STR) analysis
- electrophoresis
- Y-STR testing
- mitochondrial DNA testing.

Process/Skill Questions

- What are the appropriate uses for each of the DNA analysis techniques?
- How is mitochondrial DNA different from other DNA?
- Why has STR analysis become the preferred method of DNA analysis?
- Why is PCR analysis significant in forensic analysis of DNA?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Scientific Visualization (SciVis)

Task Number 69

Interpret the results of DNA analysis.

Definition

Interpretation should include the recognition of consistent patterns on DNA-simulated electrophoresis.

Process/Skill Questions

- How can DNA analysis be applied in our legal system?
- How does electrophoresis work?
- What are restriction enzymes?
- How are the DNA fragment bands measured?
- How is DNA typing done?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

TSA Competitive Events

Biotechnology Design

Scientific Visualization (SciVis)

Task Number 70

Demonstrate the storage procedures for DNA testing evidence.

Definition

Demonstration should include

- separating and excluding any other biological evidence from DNA test evidence
- preserving DNA material
- following standard operating procedures for forensic laboratories.

Process/Skill Questions

- What are the typical standard operating procedures for DNA evidence in forensic laboratories?
- What steps are involved in storing and protecting DNA test evidence?
- What would happen if DNA preservation methods were not followed?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Biotechnology Design

Analyzing Questioned Documents

Task Number 71

Describe the methods used to authenticate original documents.

Definition

Description should include

- comparing a document to known standards (e.g., typewriting, watermarks)
- using a microscope
- using alternate light sources
- accounting for accidental variations in writing font measurement.

Process/Skill Questions

- What is a questioned document?
- How has technology improved the detection of forgeries?
- Why is it necessary to use alternative light sources on documents?
- What types of factors can determine the source of a document?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 72

Demonstrate techniques in ink analysis.

Definition

Demonstration should include performing paper chromatography tests to separate colors and inks.

Process/Skill Questions

- What does the chemical composition of colors and inks reveal about a document?
- What procedures are used in performing paper chromatography?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 73

Describe the methods used in comparing handwriting samples.

Definition

Description should include analyzing

- line spacing
- ratio of heights from capitals to lowercase lettering

- linguistic patterns
- diacritical marks.

Process/Skill Questions

- What are the main characteristics of handwriting?
- What are the three basic steps in analyzing handwriting samples?
- What types of technology are used in handwriting analysis?
- What are some of the limitations of handwriting analysis?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 74

Analyze alterations made to documents.

Definition

Analysis should include

- evidence of tracing
- line quality (to determine whether a document has had a single or multiple authors)
- the shape of the letters in the writing.

Process/Skill Questions

- Why would someone forge a document?
- What are some ways to prevent the alteration of a document?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Collecting and Analyzing Latent Fingerprints

Task Number 75

Identify the anatomy of a fingerprint and the fingerprint's value in forensics.

Definition

Identification should include

- the two main layers (epidermis, dermis) of skin
- the definition of fingerprint—impressions, caused by the epidermal ridges of the finger, that are left on a surface
- the reasons fingerprints carry deposits (e.g., residue from natural sweat gland secretions in the skin, oils, salt, water, dirt)
- the explanation that fingerprints are a natural identifier and unique to each finger and each individual.

Process/Skill Questions

- Why are fingerprints so important to forensic investigation?
- How reliable is fingerprinting in forensic science?
- Why would criminals try to alter their fingerprints?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

TSA Competitive Events

Scientific Visualization (SciVis)

Task Number 76

Describe the systems of analysis for fingerprints.

Definition

Demonstration should include

- ten card
- Henry system—gives each finger a number according to the hand and assigns a value to fingerprint characteristics
- IAFIS—Integrated Automated Fingerprint Identification System
- AFIT—Advanced Fingerprint Identification Technology.

Process/Skill Questions

- Why is AFIT so valuable to local police agencies?
- How did the Henry system improve fingerprint classification?
- What is the purpose of a ten card?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Scientific Visualization (SciVis)

Task Number 77

Describe how to fingerprint subjects.

Definition

Description should include

- applying ink to a subject's fingers
- using an approved template to record fingerprint impressions.

Process/Skill Questions

- What is the correct procedure to fingerprint a subject?
- What is the difference between fingerprinting using a ten card and using digital systems?
- Why should a template be used to take fingerprints?
- What would happen if a subject's fingerprints were taken using another type of paper material?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 78

Describe the materials used to take fingerprints from various surfaces.

Definition

Description should include the following, based on the composition of the surface:

- Black powder
- Magnetic powder
- Ninhydrin
- Cyanoacrylate

Process/Skill Questions

- Why would you use different substances to collect fingerprints from different surfaces?
- How do ninhydrin and cyanoacrylate reveal fingerprints?
- What are other examples of chemical methods to reveal latent fingerprints?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 79

Identify fingerprint characteristics.

Definition

Identification should include general characteristics (e.g., loop, whorl, arch) and minutiae (e.g., unique ridge patterns, ridge endings, bifurcations).

Process/Skill Questions

- What is the difference between a loop and a whorl?
- Why are minutiae so important in identifying suspect fingerprints?
- What would happen if fingerprints only were identified using computer technology?

TSA Competitive Events

Task Number 80

Explain the procedures for analyzing latent prints.

Definition

Explanation should include

- identification of the pattern type (e.g., loop, whorl, arch)
- identification of minutiae
- comparison between a known and a questioned sample.

Process/Skill Questions

- How would the quality of a fingerprint affect comparison to a sample print?
- What checks and balances exist to help limit errors in fingerprint identification?

ITEEA National Standards

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 81

Describe the procedure to make casts and molds of shoe impressions.

Definition

Description should include

- producing a cast from dental stone or plaster (on a soil or sand surface)
- modeling or molding the print by stepping into a preservative, such as compressible foam (i.e., BioFoam)
- measuring the mold against the cast
- measuring the impressions against controls.

Process/Skill Questions

- What does a cast of a shoe impression tell an investigator about the subject?
- How can shoe impressions be individualized?
- What are other methods for lifting latent shoe impressions?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 82

Describe the components of a tire impression analysis.

Definition

Description should include

- measuring the width of the tread
- identifying tread pattern characteristics, including imperfections
- measuring and describing design elements
- measuring the track width and wheelbase.

Process/Skill Questions

- What type of information can a tread pattern provide about a specific car?
- What factors can affect the detail of a tire impression?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Scientific Visualization (SciVis)

Exploring Toxicology and Controlled Substances

Task Number 83

Describe the role of the toxicologist in the forensic laboratory.

Definition

Description should include

- performing forensic analyses
- studying the effects of drugs and alcohol on behavior, and the medical and legal effects of drugs and alcohol
- investigating whether drugs or poisons contributed to the manner of death
- investigating nonfatal poisonings.

Process/Skill Questions

- What is toxicology?
- What is the job outlook for forensic toxicologists?
- Where would a forensic toxicologist find employment?
- What type of education and training would a forensic toxicologist need?

ITEEA National Standards

14. Medical Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

STEM Careers

Task Number 84

Compare psychological and physical dependence.

Definition

Comparison should include

- psychological effects on mood and stress levels
- stimulatory and depressant physical effects on the central nervous system.

Process/Skill Questions

- What are some of the social effects of dependence?
- Why do some people become dependent on drugs while others do not?

TSA Competitive Events

Task Number 85

Classify the most commonly abused drugs, including toxicity and the effects on the body.

Definition

Classification should include:

- the definition of *toxicity*
- the definition of *controlled substance*
- a description of the primary effects of drugs on the body
- a description of the major classes of drugs (i.e., hallucinogens, narcotics, stimulants, anabolic steroids, depressants).

Process/Skill Questions

- What is the difference between a controlled substance and an illegal substance?
- Why is it necessary to know how substances affect the body?
- What is the difference between a narcotic and a depressant?
- How do drugs cause death?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

Task Number 86

Perform preliminary tests in drug identification analysis.

Definition

Performance should include following the procedures for available narcotics testing kits (simulated).

Process/Skill Questions

- What is the procedure for testing narcotics?
- How is a narcotics test performed in the field?
- Why are certain tests recommended for certain drugs?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 87

Demonstrate the procedure to run thin layer chromatography (TLC) tests.

Definition

Demonstration should include

- using a TLC plate and other laboratory apparatus
- adding reagents to a series of known and/or questioned chemicals
- observing and describing the interaction
- documenting the results.

Process/Skill Questions

- What are the procedures for conducting TLC tests?
- What is the purpose of a TLC test?
- What types of materials can be tested using chromatography?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 88

Describe the utility of mass spectrometry for identification analysis.

Definition

Description should include

- defining *mass spectrometry*
- identifying mass spectrometry's application to drug sampling
- explaining that the technique produces a unique spectrum for each chemical tested.

Process/Skill Questions

- How is mass spectrometry used in forensic science?
- Why is mass spectrometry important in analyzing drugs?
- How does a mass spectrometer work?

ITEEA National Standards

1. The Characteristics and Scope of Technology

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 89

Describe how alcohol is processed through the body.

Definition

Description should include

- ingestion
- diffusion through the stomach and intestines
- conversion by the liver into metabolites
- absorption into the bloodstream
- excretion.

Process/Skill Questions

- What are some of the factors that affect alcohol absorption?
- What are the physical effects of intoxication?
- What are the effects of chronic alcohol abuse?

TSA Competitive Events

Biotechnology Design

Task Number 90

Describe the procedure used to conduct the primary field sobriety tests.

Definition

Description should include the horizontal gaze nystagmus, walk-and-turn, and one-legged stand tests.

Process/Skill Questions

- How effective are field sobriety tests in confirming intoxication?
- What factors other than alcohol or drugs could contribute to a failed field sobriety test?
- What are the strengths and weaknesses of each test?

TSA Competitive Events

Extemporaneous Speech

Prepared Presentation

Task Number 91

Analyze blood-alcohol concentration levels.

Definition

Analysis should include the use of a blood-alcohol concentration chart that shows absorption levels according to subject's weight and correlating the information from the chart to Virginia law.

Process/Skill Questions

- What is the blood-alcohol concentration limit for adult drivers in Virginia?
- Why is the limit lower for juveniles?
- What factors influence blood-alcohol concentration in men and women?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Exploring Forensic Serology

Task Number 92

Calculate blood type probabilities, using Punnett squares.

Definition

Calculations should be based on a monohybrid cross, using genes for blood types to create the probabilities of blood type in offspring.

Process/Skill Questions

- To what extent do parents dictate their child's blood type?
- What role does blood typing play in forensic science?
- In what ways can one determine his/her probable blood type?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

Task Number 93

Identify the A-B-O antigens and antibodies for each of the four blood types.

Definition

Identification should include the following:

- A—A antigens and anti-B antibodies
- B—B antigens and anti-A antibodies
- AB—AB antigens but no antibodies
- O—anti-A and anti-B antibodies but no antigens

Process/Skill Questions

- What role do antigens and antibodies play in blood?
- What is the importance of identifying the antigens and antibodies found in blood?
- Why is it necessary to know the characteristics of the four blood types?

TSA Competitive Events

Biotechnology Design

Task Number 94

Apply test procedures to validate the presence of bodily fluid evidence.

Definition

Apply test procedures to validate the presence of bodily fluid evidence. Application should include the following fluid types and appropriate procedures:

- Blood—A-B-O blood-typing test/Luminol for the presence of blood
- Sweat—DNA test
- Saliva—Phadebas test
- Semen—crusty-touch test, Christmas tree stain

Process/Skill Questions

- What is the importance of bodily fluids in forensic science?
- In what ways are the characteristics of different bodily fluids similar? Different?
- To what extent can bodily fluids help solve crime?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 95

Explain storage/preservation procedures for bodily fluid testing evidence.

Definition

Explanation should include storing any wet substance in a drying chamber.

Process/Skill Questions

- Why is it important to follow proper storage procedures when working with bodily fluid evidence?
- In what ways does the storage procedure for different bodily fluids differ?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 96

Describe the types of blood-spatter patterns.

Definition

Description should include:

- Passive drop
- Cast off
- Impact spatter
- Arterial spurts
- Effect of motion on spatter
- Transfer patterns
- Void areas
- Flow patterns

Process/Skill Questions

- What actions could produce each of the spatter patterns?
- Why is it important to document the spatter patterns using photography?

TSA Competitive Events

Biotechnology Design

Task Number 97

Conduct a blood spatter analysis to re-create a violent event.

Definition

Activity should include

- simulated blood
- list of patterns to create
- trigonometry table for verification of angle of movement of blood drops.

Process/Skill Questions

- Why is it important to reconstruct a violent event?
- How can trigonometry be used to determine the angle at which blood interacted with a surface?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

13. Assess the Impact of Products and Systems

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Analyzing Forensic Aspects of Arson and Explosion Investigations

Task Number 98

Describe the chemistry of fire.

Definition

Description of the components of fire should include

- heat
- fuel
- oxygen
- chemical reaction.

Description of the processes should include

- oxidation
- pyrolysis
- vaporization.

Description of heat transmission should include

- conduction
- convection
- radiation.

Description of the products of combustion should include

- smoke
- gases (toxic)
- heat release
- light.

Process/Skill Questions

- What are the effects of fire on iron?
- How is heat energy best transported from one location to the next?
- What makes a flame blue?

- Why is it important to know the temperature thresholds at which elements change state?
- What effects does heat have on steam production?
- What are examples of endothermic and exothermic reactions?
- What do chemical suffixes (e.g., -ines, -ates, and -ides) tell us about the nature of chemicals and their composition?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 99

List the conditions necessary to initiate and sustain combustion.

Definition

List should include the presence of

- heat
- fuel (multiple types)
- oxygen.

Process/Skill Questions

- What are the four phases of fire progression?
- What role does speed play in the reaction between fuel and oxygen?
- What is the ignition source?
- What is smoldering?
- What is combustion?
- What are hydrocarbons, and what is their relationship to fire?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 100

Identify the signs of an accelerant-initiated fire.

Definition

Identification should include the following signs:

- Eye witnesses to the fire's behavior (e.g., a sudden low-pressure wave or vacuum sound just before ignition, an explosion, rate of spread was extremely fast, burned downward, rolling flames, bright orange flame with black smoke, flames burning from the floor)
- Areas of intense burn patterns
- Accelerant odor and the presence of empty accelerant containers
- Gaps in floor seams
- Rainbow-colored sheen on wet surfaces
- No discernible point of origin
- An inverted-cone pattern on the walls

Process/Skill Questions

- What types of accelerants are common to arson scenes?
- What is arson?
- What is a Molotov cocktail? How does it function?
- What is the significance of finding an inverted-cone pattern on the walls?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

20. Construction Technologies

Task Number 101

Identify the methods used in searching a fire scene.

Definition

Demonstration should include

- protecting evidence, including fingerprints
- assessing and analyzing the scene, including fire origin and trail
- documenting the process
- reporting to the fire chief

- appearing in court as needed as a material witness or expert.

Process/Skill Questions

- To whom does the fire inspector report?
- What is involved in protecting evidence at a fire scene?
- What are the main reasons for determining the cause of any fire and personal and property damage?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 102

Describe how to collect and preserve arson evidence.

Definition

Description should include

- posting guard(s) at the scene and preventing unauthorized personnel from entering
- boarding doors and windows
- marking, tagging, and photographing all evidence
- logging the names of personnel at the scene
- using special containers for preserving vapors released by charred evidence.

Process/Skill Questions

- When and why does the fire department's authority end at a fire scene?
- Why is it a good idea to record the names of personnel at a fire scene?
- Why would any unauthorized person try to gain entrance to a crime scene?
- What container preserves the head-space vapors?
- What is the absorption-elution method for containing arson evidence?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Task Number 103

Analyze flammable residues.

Definition

Analysis should include solid-phase microextraction and solvent extraction.

Process/Skill Questions

- How is a solvent extraction performed?
- How is a solid-phase microextraction performed?
- How do you read a gas chromatogram of flammable residues?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 104

Describe the types of explosives and their evidence, post-detonation.

Definition

Description should include identifying

- deflagration
- detonation
- low and high explosives
- initiating and non-initiating high explosives.

Process/Skill Questions

- What is the difference between deflagration and detonation?
- What is the difference between low and high explosives?

- What are examples of low and high explosives?
- What is the difference between initiating and non-initiating high explosives?
- What is an explosives train?
- What is the significance of burned and unburned residues of explosives?
- What is the Griess test?
- What are the necessary conditions that should be organized by the investigative team when dealing with a situation regarding explosives?

ITEEA National Standards

20. Construction Technologies

Analyzing Tool Marks, Firearms, and Other Impressions

Task Number 105

Describe the significance of tool mark impressions in criminal investigations.

Definition

Description should include the three major categories of tool marks (indentation, abrasion, and cutting). It also should take into account linking a tool to a crime scene and to the tool's owner.

Process/Skill Questions

- What are the three main types of tool marks?
- What conclusions can an examiner reach as a result of making a comparison of tool marks on a microscopic level?
- What is serial number restoration?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

8. The Attributes of Design

TSA Competitive Events

Debating Technological Issues

Principles of Technology (Virginia only)

Task Number 106

Analyze tool marks by matching marks to the tool that produced them.

Definition

Analysis should include identification of the major characteristics of the tool, as well as unique characteristics (e.g., nicks, blemishes) that would distinguish the tool from others of its type.

Process/Skill Questions

- What are the common patterns produced by tool-working surfaces?
- What is the appropriate casting material and technique for replicating tool marks?
- What is the difference between impressed and striated tool marks?

ITEEA National Standards

1. The Characteristics and Scope of Technology

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

TSA Competitive Events

Principles of Technology (Virginia only)

Technology Problem Solving

Task Number 107

Distinguish among firearm characteristics.

Definition

Distinction should be made among

- types of firearms (e.g., handguns, rifles, shotguns, machine guns)
- rifling patterns
- caliber of ammunition
- barrel sizes.

Process/Skill Questions

- What is an automatic or semiautomatic weapon?
- What is the breechblock?
- What is the choke on a shotgun?
- What is slide and lever action?
- What is bolt action?

ITEEA National Standards

1. The Characteristics and Scope of Technology

8. The Attributes of Design

Task Number 108

Distinguish between a bullet and a cartridge.

Definition

Distinction should be made among

- the material composition of a bullet (e.g., lead alloy)
- the material composition of the jacket (e.g., copper)
- the contents of the cartridge (i.e., case, primer, powder, bullet).

Process/Skill Questions

- What is the difference between centerfire and rimfire?

- What is a cannelure?
- What are wads?
- What are pellets and shot?
- What is used as propellant?
- What is the primer?
- What is the significance of the jacket?
- What are stabilizers?

ITEEA National Standards

1. The Characteristics and Scope of Technology

Task Number 108

Describe the testing procedures used for gunshot residue.

Definition

Description should include

- distance-of-fire determination tables
- stippling
- tattooing
- contusion rings.

Process/Skill Questions

- What is the common test for gunshot residue?
- Who performs this test?
- When is this test performed and who is it performed on?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

Task Number 109

Describe how a gun barrel affects the flight of a projectile.

Definition

Description should include differences in rifling (i.e., lands and grooves).

Process/Skill Questions

- What determines the number of lands and grooves found on a bullet?
- What factors can affect the deformation of the bullet?

Related Standards of Learning

Science

PH.5

The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes. Key concepts include

- a. linear motion;
- b. uniform circular motion;
- c. projectile motion;
- d. Newton's laws of motion;
- e. gravitation;
- f. planetary motion; and
- g. work, power, and energy.

ITEEA National Standards

2. The Core Concepts of Technology

8. The Attributes of Design

TSA Competitive Events

Flight Endurance

Task Number 110

Describe the relationship between barrel size and caliber.

Definition

Description should include

- internal diameter of the barrel
- diameter of the projectile used within the barrel.

Process/Skill Questions

- What is the relationship between barrel size and caliber?
- How is caliber measured?
- What is gauge?

ITEEA National Standards

1. The Characteristics and Scope of Technology

8. The Attributes of Design

Task Number 111

Demonstrate ballistics recovery and examination at a crime scene.

Definition

Demonstration should include

- documenting the original location of weapons and bullets
- packaging weapons and bullets in a rigid position
- unloading weapons prior to transport
- handling evidence in a sterile manner.

Process/Skill Questions

- Why is it important to package weapons and bullets in a rigid position?
- Why is it important to unload weapons before they are transported?
- What is the system used for unloading weapons before transport?
- Why should a detailed sketch be made of locations of cartridge cases, firearms, or bullets?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

Task Number 112

Determine the position of the shooter, based on bullet trajectory.

Definition

Determination should include using an online linear range-of-motion calculator or by using the following equation:

Range = (initial velocity squared, divided by acceleration of gravity) sin 2 times the projection angle

Process/Skill Questions

- What tools would an analyst use to determine the position of the shooter based on trajectory?
- What is the standard for determining range of fire?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

2. The Core Concepts of Technology

TSA Competitive Events

Principles of Technology (Virginia only)

Task Number 113

Compare firing pin impressions from different sources.

Definition

Comparison should include describing the ejector port and the firing pin of the weapon that created the firing pin impressions.

Process/Skill Questions

- How do you compare firing pin impressions from different pieces of ammunition fired from the same weapon?
- How is a stereoscopic microscope used to compare firing pin impressions on cartridge cases?

ITEEA National Standards

1. The Characteristics and Scope of Technology

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

Task Number 114

Distinguish among internal ballistics, external ballistics, and terminal ballistics.

Definition

Distinction should be made among

- internal ballistics—the behavior of the bullet and cartridge case inside the barrel
- external ballistics—the flight of the projectile through the air and the forces that act upon it
- terminal ballistics—the action of the projectile on the target.

Process/Skill Questions

- How does rifling affect the bullet and the cartridge case?
- What is the effect of using the wrong-sized ammunition in a weapon of a certain caliber?
- What are the forces that act on a projectile when it leaves the weapon?
- What is the normal path of flight for a projectile?
- When a projectile encounters living tissue, what are the typical patterns seen in bone? In soft tissue?

ITEEA National Standards

14. Medical Technologies

Investigating Medicolegal Death

Task Number 115

Describe the stages of postmortem tissue degeneration, including autolysis and putrefaction.

Definition

Description should include

- fresh stage (e.g., livor mortis, rigor mortis, algor mortis, first arriving flies)
- bloat stage (e.g., anaerobic bacteria leads to putrefaction [organ breakdown by bacteria] and autolysis [self-breakdown of individual cells])
- active decay stage (e.g., deflation and larvae feeding)
- advanced decay stage (e.g., most of the flesh and odor is gone, skeletonization)
- dry decay (e.g., nearly odorless, bones, mummification).

Process/Skill Questions

- Why is it important to be able to distinguish the stages of decomposition?
- What factors can affect the decomposition process?
- What does insect feeding tell us about decomposition?
- What does the location of livor mortis say about the body in death?
- How does rigor mortis tell us about the time of death?

ITEEA National Standards

14. Medical Technologies

TSA Competitive Events

Task Number 116

Define *cause, manner, and mechanism of death*.

Definition

Definition of the terms should include

- *cause*—determining the reason for a person’s death
- *manner*—the means by which someone dies, including homicide, suicide, undetermined, natural, and accidental
- *mechanism*—the specific physiological reason for a person’s death.

Process/Skill Questions

- Why can it sometimes be difficult to determine a manner of death?
- What is the difference between cause of death and manner of death?
- What is the difference between cause of death and mechanism of death?

Task Number 117

Compare the coroner and medical examiner systems and responsibilities.

Definition

Comparison should include the following:

- Coroner—roles and requirements to become a coroner vary from jurisdiction to jurisdiction, with some requiring the same qualifications as a medical examiner and others requiring no medical training. The coroner’s chief functions are to confirm, certify, and pronounce deaths.
- Medical examiner—appointed or hired, required to have significant training in medicine from an accredited institution and typically trained as a pathologist. The medical examiner’s chief functions include
 - investigation of human deaths
 - determination of the cause of death
 - issuance of death certificates
 - maintenance of death records

- response to deaths in mass disasters
- identification of unknown dead.

Process/Skill Questions

- What are the major differences between a coroner and medical examiner?
- Which responsibilities do coroners and medical examiners share?
- What are the state requirements for medical examiners?

ITEEA National Standards

13. Assess the Impact of Products and Systems

Task Number 118

Describe causes of death and their associated injury patterns and characteristics.

Definition

Description should include

- mechanical—vehicular injuries, blunt-force trauma, sharp-force trauma, gunshots, blast injuries
- electrical—electrocution, lightning strikes
- thermal—fires, burns, hypothermia, hyperthermia
- chemical—drug/poisoning, chemical exposure
- water—drowning.

Process/Skill Questions

- What are ways to determine the cause of death?
- How does “proximate cause of death” relate to the causes of death?
- How does cause of death differ from manner of death?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Task Number 119

Describe the legal necessity of establishing postmortem interval (PMI).

Definition

Description should include

- a definition of *PMI*—the approximate elapsed time since death
- an explanation of how short- and long-term PMIs are estimated
- the relevance of PMIs to insurance issues.

Process/Skill Questions

- How is the postmortem interval established?
- What changes occur in a body to help determine PMI?
- Why is PMI important in the investigation of crimes?
- Why are insects important in determining PMI?
- Why do insurers care about time since death?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

Exploring Forensic Anthropology and Forensic Entomology

Task Number 120

Define the terms *forensic anthropology* and *forensic entomology*.

Definition

Definitions should include

- *forensic anthropology*—the study of physical anthropology as it applies to human skeletal remains in a legal setting
- *forensic entomology*—the application and study of insects and other arthropod biology to legal issues.

Process/Skill Questions

- What is the purpose of forensic anthropology?
- How does forensic entomology play a role in death investigations?

ITEEA National Standards

1. The Characteristics and Scope of Technology

Task Number 121

Differentiate between a male skeleton and a female skeleton.

Definition

Differentiation should focus on the following:

- Pelvis—wider in females
- Skull—jaw is rounder in females, squarer in males; males also have a larger mastoid process, temporal line, supra-orbital border, and the nuchal crest is rough and bumpy
- Long bones—longer in males

Process/Skill Questions

- Why are the bones of the skull and pelvis so significant in determining whether a skeleton is male or female?
- What kinds of physical activity can affect the appearance of bones of the body?
- Why are male bones rougher and bumpier?

ITEEA National Standards

14. Medical Technologies

TSA Competitive Events

Task Number 122

Determine an age range of a subject, based on the remains.

Definition

Determination of age range should include the absence or presence of specific characteristics of a range of bones (e.g., the absence or presence of suture marks on the skull, the absence or presence of cartilage on joints, change in the condition of the pubic symphysis).

Process/Skill Questions

- Why is age given as a range for human remains?
- Why do bones change over the course of a lifetime? What can this tell you about the subject's age?
- What are the main differences between juvenile and adult skeletal development?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

14. Medical Technologies

TSA Competitive Events

Biotechnology Design

Task Number 123

Describe the differences in skull features used to determine the race of a subject's remains.

Definition

Description of the characteristics of the skull should include

- the shape of the eye sockets
- the absence or presence of the nasal spine
- measurements of the nasal index
- prognathism (e.g., alveolar and midfacial)
- the width of the face
- the angulation of the jaw and face.

Process/Skill Questions

- Why has it become more difficult to determine race through the examination of facial characteristics?
- What other characteristics can be determined through examination of remains?
- What role do facial landmarks play in matching remains to a subject?

ITEEA National Standards

14. Medical Technologies

4. The Cultural, Social, Economic, and Political Effects of Technology

Task Number 124

Determine a subject's height by analyzing the long bones of the body.

Definition

Determination of height should include measurements of the long bones and the application of stature estimation formulas based on race and gender.

Process/Skill Questions

- Why should a forensic anthropologist use more than one bone to determine height?
- Why would you need to determine the gender of remains before calculating height?
- What other factors could affect a person's height?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

14. Medical Technologies

Task Number 125

Describe the stages of insect metamorphosis in estimating time of death.

Definition

Description should include the metamorphic stages and an example of the succession of different insects that are found on a body as it decomposes.

Process/Skill Questions

- What environmental factors can affect insect development?
- How does the collection of insects from a crime scene help investigators more accurately determine a time of death?
- What additional training or education is needed to become a forensic entomologist?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

14. Medical Technologies

5. The Effects of Technology on the Environment

TSA Competitive Events

Biotechnology Design

SOL Correlation by Task

39	Define the term <i>forensic science</i> .	English: 11.3, 11.5, 12.3 History and Social Science: VUS.1
40	Identify careers that use forensic technology.	English: 12.5

41	Describe the applied skill of deductive reasoning in forensic analysis.	History and Social Science: VUS.1 Mathematics: G.1, DM.9*, PS.1*, PS.18, PS.2*, PS.3*, PS.4*, PS.7* Science: BIO.1, CH.1, PH.1
42	Defend a scientific argument.	English: 11.5, 11.6, 12.5, 12.6 History and Social Science: VUS.1 Mathematics: PS.1*, PS.17, PS.18, PS.2*, PS.3*, PS.4*, PS.7*, PS.10* Science: BIO.1, CH.1, PH.1, PH.2
43	Demonstrate general lab skills necessary to the field of forensic science.	Science: BIO.1, CH.1, PH.1, PH.2
44	Describe lab safety skills related to the forensic sciences.	Science: BIO.1, CH.1, PH.1
45	Demonstrate the key steps of the scientific method in forensic analysis by collecting and preserving evidence from a crime scene.	Mathematics: PS.1*, PS.17, PS.18, PS.2*, PS.3*, PS.4*, PS.7*, PS.8*, PS.10* Science: BIO.1, CH.1, PH.1, PH.2
46	Describe the difference between presumptive testing and confirmatory testing.	English: 11.8, 12.8 Science: BIO.1, CH.1, PH.1
47	Identify questions and concepts that guide scientific investigations.	English: 11.5, 12.5 Science: BIO.1, CH.1, PH.1, PH.2
48	Describe the historical precedents for gathering and admitting evidence.	English: 11.8, 12.8 History and Social Science: GOVT.10
49	Describe the role of the crime scene/forensic investigator.	
50	Describe how a crime scene is investigated.	
51	Describe the legal considerations for working in a crime scene.	English: 11.8, 12.8

		History and Social Science: GOVT.11, VUS.5
52	Describe the services of the crime laboratory.	
53	Document a crime scene, using a sketch or scene documentation software.	Mathematics: COM.1, COM.7, COM.10, COM.15
54	Document a crime scene, using photography.	
55	Describe witness-interview techniques.	English: 11.6, 12.6 History and Social Science: VUS.1
56	Describe evidence-collection techniques.	
57	Define the terms <i>class characteristic</i> and <i>individual characteristic</i> .	English: 11.3, 11.8, 12.3, 12.8 History and Social Science: VUS.14
58	Identify the two types of trace evidence.	English: 11.3, 12.3 History and Social Science: VUS.14
59	Analyze trace evidence, using light microscopy.	
60	Describe the testing procedure for any piece of trace evidence.	History and Social Science: VUS.1
61	Describe sources of contamination for trace evidence and the ways to minimize that contamination.	
62	Define <i>positive control</i> and <i>negative control</i> .	English: 11.3, 11.8, 12.3, 12.8
63	Interpret the results of a false-positive test and a false-negative test.	English: 11.5, 12.5 Mathematics: PS.5, PS.18, PS.10*
64	Generate a comparison of two pieces of physical evidence.	
65	Describe bodily fluids.	English: 11.3, 11.5, 12.3, 12.5
66	Describe how DNA technology has affected criminal justice.	English: 11.3, 11.8, 12.3, 12.8 History and Social Science: VUS.14 Science: BIO.1, BIO.5
67	Describe the extraction and isolation of DNA from living cells.	Science: BIO.1, BIO.2, BIO.5
68	Describe the technologies used in identifying and analyzing DNA from a crime scene.	English: 11.8, 12.8 History and Social Science: VUS.14 Science: BIO.1, BIO.5

69	Interpret the results of DNA analysis.	English: 11.5, 12.5 Science: BIO.1, BIO.2, BIO.5
70	Demonstrate the storage procedures for DNA testing evidence.	Science: BIO.1, BIO.5
71	Describe the methods used to authenticate original documents.	
72	Demonstrate techniques in ink analysis.	Science: CH.1
73	Describe the methods used in comparing handwriting samples.	English: 11.8, 12.8
74	Analyze alterations made to documents.	
75	Identify the anatomy of a fingerprint and the fingerprint's value in forensics.	English: 11.3, 11.5, 12.3, 12.5
76	Describe the systems of analysis for fingerprints.	
77	Describe how to fingerprint subjects.	
78	Describe the materials used to take fingerprints from various surfaces.	
79	Identify fingerprint characteristics.	
80	Explain the procedures for analyzing latent prints.	English: 11.2, 12.2
81	Describe the procedure to make casts and molds of shoe impressions.	
82	Describe the components of a tire impression analysis.	English: 11.2, 12.2
83	Describe the role of the toxicologist in the forensic laboratory.	English: 11.2, 12.2 Science: CH.1
84	Compare psychological and physical dependence.	
85	Classify the most commonly abused drugs, including toxicity and the effects on the body.	English: 11.3, 12.3 Science: CH.1
86	Perform preliminary tests in drug identification analysis.	Science: BIO.1, CH.1
87	Demonstrate the procedure to run thin layer chromatography (TLC) tests.	Science: BIO.1, CH.1
88	Describe the utility of mass spectrometry for identification analysis.	English: 11.3, 11.5, 12.3, 12.5 Science: CH.1
89	Describe how alcohol is processed through the body.	Science: BIO.4
90	Describe the procedure used to conduct the primary field sobriety tests.	
91	Analyze blood-alcohol concentration levels.	English: 11.5, 12.5
92	Calculate blood type probabilities, using Punnett squares.	Mathematics: AFDA.6, PS.14, PS.3*, PS.11*, PS.12* Science: BIO.4

93	Identify the A-B-O antigens and antibodies for each of the four blood types.	English: 11.5, 12.5 Science: BIO.4, CH.3
94	Apply test procedures to validate the presence of bodily fluid evidence.	
95	Explain storage/preservation procedures for bodily fluid testing evidence.	English: 11.1, 12.1 History and Social Science: VUS.14
96	Describe the types of blood-spatter patterns.	Science: BIO.1, PH.5
97	Conduct a blood spatter analysis to re-create a violent event.	Science: BIO.1, CH.1, PH.5
98	Describe the chemistry of fire.	Science: CH.5, ES.12, PH.7
99	List the conditions necessary to initiate and sustain combustion.	Science: CH.3, PH.7
100	Identify the signs of an accelerant-initiated fire.	Science: CH.3, PH.1
101	Identify the methods used in searching a fire scene.	Science: CH.1, PH.1
102	Describe how to collect and preserve arson evidence.	Science: CH.1, PH.1
103	Analyze flammable residues.	English: 11.3, 12.3 Science: CH.1, CH.3
104	Describe the types of explosives and their evidence, post-detonation.	English: 11.5, 12.5 Science: CH.5
105	Describe the significance of tool mark impressions in criminal investigations.	English: 11.5, 12.5 Science: PH.4
106	Analyze tool marks by matching marks to the tool that produced them.	English: 11.5, 12.5 Science: PH.4
107	Distinguish among firearm characteristics.	English: 11.8, 12.8
108	Distinguish between a bullet and a cartridge.	English: 11.8, 12.8
109	Describe the testing procedures used for gunshot residue.	Science: CH.1, CH.3
110	Describe how a gun barrel affects the flight of a projectile.	Science: PH.5
111	Describe the relationship between barrel size and caliber.	Science: PH.5
112	Demonstrate ballistics recovery and examination at a crime scene.	Science: PH.1
113	Determine the position of the shooter, based on bullet trajectory.	Mathematics: T.6, T.8, AII.3 Science: PH.5
114	Compare firing pin impressions from different sources.	Science: PH.4

115	Distinguish among internal ballistics, external ballistics, and terminal ballistics.	Science: PH.5
116	Describe the stages of postmortem tissue degeneration, including autolysis and putrefaction.	Science: BIO.2, BIO.3, BIO.4, CH.5
117	Define <i>cause, manner, and mechanism of death</i> .	English: 11.3, 11.5, 12.3, 12.5
118	Compare the coroner and medical examiner systems and responsibilities.	History and Social Science: GOVT.8
119	Describe causes of death and their associated injury patterns and characteristics.	English: 11.3, 12.3
120	Describe the legal necessity of establishing postmortem interval (PMI).	English: 11.3, 12.3 History and Social Science: GOVT.8, GOVT.9, GOVT.15
121	Define the terms <i>forensic anthropology</i> and <i>forensic entomology</i> .	English: 11.3, 12.3
122	Differentiate between a male skeleton and a female skeleton.	Science: BIO.4
123	Determine an age range of a subject, based on the remains.	
124	Describe the differences in skull features used to determine the race of a subject's remains.	
125	Determine a subject's height by analyzing the long bones of the body.	Mathematics: A.4
126	Describe the stages of insect metamorphosis in estimating time of death.	Science: BIO.4

Cyber Security and Cyber Forensics Infusion Units

Cyber Security and Cyber Forensics Infusion Units (CYBR) were designed to be infused with designated CTE courses to help students in those programs achieve additional, focused, validated tasks/competencies in personal and professional cyber security skills. These units are not mandatory, and, as such, the tasks/competencies are marked as "optional," to be taught at the instructor's discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked "optional."

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Biotechnology Foundations in Agricultural and Environmental Science (8085/36 weeks)
- Biotechnology Foundations in Health and Medical Sciences (8344/36 weeks)
- Biotechnology Foundations in Technology Education (8468/36 weeks)
- Criminal Justice I (8702/36 weeks, 140 hours)

Career Cluster: Health Science	
Pathway	Occupations
Biotechnology Research and Development	Biochemist Cell Biologist Medical, Clinical Laboratory Technician Research Assistant

Career Cluster: Law, Public Safety, Corrections and Security	
Pathway	Occupations
Emergency and Fire Management Services	Fire Investigator Hazardous Materials Removal Worker
Law Enforcement Services	Forensic Science Technician Police Officer

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	Occupations
Engineering and Technology	Biomedical Engineer Chemical Engineer Environmental Engineer Quality Engineer Quality Technician Statistician Systems Analyst
Science and Mathematics	Bioinformatics Technician Biologist Chemist Environmental Scientist Materials Scientist Microbiologists Research Chemist Secondary School Teacher Toxicologist