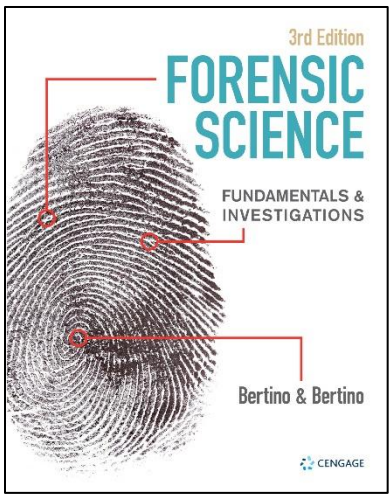

Forensic Science: Fundamentals & Investigations, 3rd Edition

Bertino/Bertino

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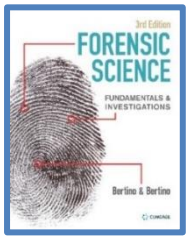
INFORMATION HANDBOOK

Handbook Table of Contents – Direct Links to Sections

Bertino & Bertino, *Forensic Science: Fundamentals and Investigations*, 3rd ed.



From the authors of *Forensic Science: Fundamentals and Investigations* 3rd ed.

Anthony (Bud) Bertino and Patricia Nolan Bertino www.BertinoForensics.com **rev.1.24.21**
National Geographic Learning/ Cengage Learning Tel: (888) 915-3276

Thank you for your interest in our high school forensic textbook ***Forensic Science: Fundamentals and Investigations*** **3rd ed**. My husband Anthony (Bud) and I are co-authors as well as veteran biology/forensic teachers each with 34 years of high school teaching experience. After retirement, we continue to be actively involved in professional education through our presentations at national, state and regional science teacher conferences as well as in-school presentations.

We love teaching forensics because it is a hands-on, real life application, problem-solving course that appeals to all students. Forensics integrates not only math, biology, chemistry, physics, earth science, and technology, but it also integrates history, politics, public speaking and more!

Taking a course in forensic science builds students' confidence in their abilities to do math and science! As teachers, we love seeing students' enthusiasm for learning forensics and applying what they learned to solving a crime. Students no longer asked "Why do we need to learn this?" They understand the direct application of the math and science to forensics.

With the purchase of a class set of books, Cengage Learning provides you with a free teacher's edition and an access code for the many teacher ancillary materials found on the Cengage website's textbook companion site.

TEACHER'S EDITION – What's New

In the new 3rd edition, we expanded the many teaching tips located in the side margins of the teacher's edition. We understand that many teachers with math or science backgrounds are being asked to teach a forensic science course *without* the benefit of any training in forensic science! To help guide teachers through each chapter and activity, and to offer suggestions on how to present the new information, we placed the teacher notes in the teacher's edition directly on the page in the textbook where the teaching tip can be applied.

Look for headings in the side margins such as:

Engage: ways to motivate and generate student interest.

Explore: suggestions for students to pursue additional information about the topic.

Enrich: suggestions for viewing different websites, tutorials or additional readings, or for bringing in experts from the field to enrich learning.

Teach: suggestions on how to introduce or present the information and highlights the main points of the lessons.

Reteach: suggestions on how to relate to previous learning.

Apply: suggestions on how the information presented in the text is used to solve crime.

Activity: where to introduce each of the many activities or capstone projects within the chapter.

Academic Connections: (Physics, Biology, Chemistry, Earth Science, Math)
Provides relevant information connecting to other discipline areas

Differentiated Learners: teaching tips to address the needs of a heterogeneously grouped forensic science class. Sub-headings for Differentiated Learners include:

a. Accelerated Learners
b. English Language Learners
c. Students in Need of Additional Support

CENGAGE WEBSITE: COMPANION SITE

The companion site contains many time-saving features along with additional support for teachers and students. An access code for the companion site is provided with a class set of books. Information on the companion site includes:

1. Worksheets (WKSTs) for Chapter Activities and Capstone Projects (CP).

Activity worksheets consist of the data tables, forms and consumables for each of the chapter activities (80 in the textbook and 23 new activities on the companion site), and the 10 Capstone Projects. No need for the instructor to create these, they are done and ready to go! Data tables and graphics are larger than the data tables that appear in the textbook. We understand that many teachers are teaching several different courses and are trying to provide instruction for both in-classroom and remote learning with very little time to spare time for preparing data tables or forms.

In your textbook, examine any of the chapter activities or Capstone Projects. Under the *Materials* list, you'll find the list of Activity worksheets needed for that particular activity or Capstone Project. (Act # WKST: Title). The companion site also includes additional worksheets that are not printed in the textbook but available for you to download. Examples include: Site and Evidence forms, sign-up forms, debate planning and pre-writing forms and more that will save you hours of preparation time!

2. Additional Activities

Not all activities would fit in the textbook! Be sure to view the 23 additional new activities found in the companion site along with the accompanying activity worksheets. A list of the textbook chapter activities is listed under each chapter in the table of contents of the textbook. A list of the *additional activities* found only on the companion site are listed on the preface page *xiv*.

3. Lesson Plans

The Lesson Plans provide detailed outlines and overviews of each chapter and correlate topics to the learning chapter learning objectives, activities, projects and PowerPoint presentations. The lesson plans are sequenced in the same order and have the same headings as the textbook and the Student Learning Objectives (SLOs). You can easily modify the lesson plans to suit your and your students' needs.

4. Student Learning objectives (SLOs).

SLOs are single-concept, testable objectives for each chapter. Because the SLOs are printed in a Word document, you can tailor these to best fit the needs of your forensic science course. Simply delete the objectives you choose not to cover, or, add additional objectives to the SLO. Students use these as study guides as they read through the chapter. Instructors can assign specific SLOs for the students to answer as they do the reading. This can be especially useful for remote learning. Because the SLOs are sequenced to correspond to the textbook (and lesson plans), teachers and students can easily identify what section of the textbook corresponds to an objective. (Note, these SLOs are different from the short list of broad objectives listed in the front of each chapter)

The introductory SLO file listed with the Student Learning Objectives on the companion sites describes how to use cooperative learning groups and the SLOs for on-going assessments.

5. Additional Teacher Notes (TN) files.

These extended teacher notes are in addition to the many teacher notes found in the margins of the teacher's edition. These notes contain a longer description than the shorter notes found in the TE.

6. List of Forensic Books of Interest Arranged by Topics.:

A list of high-interest, non-fiction forensic books arranged by topic are provided to encourage reading and enhance student learning.

7. Standard Alignments to NGSS (Next Generation Science Standards) and CC (Common Core). State standard alignments are available upon request.

8. **PowerPoints**

Chapter PowerPoints are provided for each chapter. In addition, there are 9 new author PowerPoints to use to facilitate instruction of various activities. For example, the animated PowerPoint for "Activity 7-4 STR Identification of a September 11th Victim," guides students in how to read the STR printout. Use the animated Capstone Project 9, "How to Read Calipers," to show students how to use and read a caliper.

9. Alternative Assessments: This file provides a multitude of ways to access student learning using a variety of assessment formats that can be used to in place a written exam. We provide specific examples of how each format can be applied to specific concepts. This document is particularly useful for teachers

conducting remote learning because it provides many opportunities for students to demonstrate their knowledge by way of projects that can be done at home.

10. Testing by Cognero:
This flexible online system, provides chapter-by-chapter quizzes and enable teachers to:

- Author, edit, and manage test bank content from multiple sources
- Create multiple test versions in an instant.
- Deliver tests from teacher/school-specific learning management system (LMS0 or classrooms)

11. Additional Resources are available on the website.

MINDTAP FOR FORENSIC SCIENCE: FUNDAMENTALS AND INVESTIGATIONS

MindTap features an integrated course for a complete digital experience for the student and teacher. MindTap is highly customizable and combines the enhanced e-book (digital book) along with interactivities, lab activities, auto-graded quizzing and virtual labs to enable students to directly analyze and apply what they are learning and allow teachers to measure skills and outcomes with ease. With MindTap, teachers are able to add comments to students throughout the chapter. We suggest that teachers refer to the end-of-chapter bibliography and side margin teacher notes for suggested websites or book and articles that offer additional tutorials or information and add these throughout the chapter. This customization feature also helps teachers to direct students to a current event by linking to an article or news story that was just published!

AUTHOR WEBSITE AND FREE TEACHER RESOURCES www.BertinoForensics.com

Visit our **author website** www.BertinoForensics.com and click on teacher resources and then click on Books and Magazines. There are **free digital forensic magazines** you can order by clicking on the links on our website. We recommend that you order the back issues of *The Forensic Science Teacher* magazine available in DVD disk format. Check out the many other free materials provided on the teacher resource page.

FOR ADDITIONAL INFORMATION:

- **Read the preface pages in the front of the textbook**
- **Contact a sales representative using Rep finder**: https://www.cengage.com/repfinder/natgeo/?ngl=true/
- **Call Customer Service (888) 915-3276)**
- **Contact the authors: www.BertinoForensics**
  Click on "Contact Us" (Patricia and Anthony Bertino)
- **Any questions, we're happy to help!**
  Patricia Nolan Bertino nolanp@nycap.rr.com
  Anthony Bertino bud@BertinoForensics.com

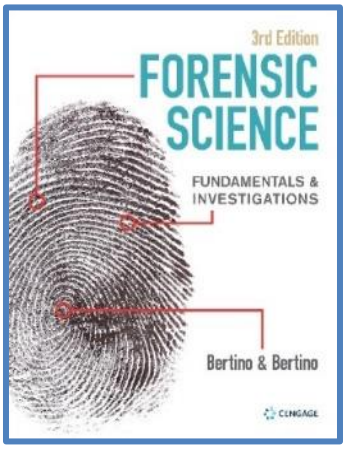
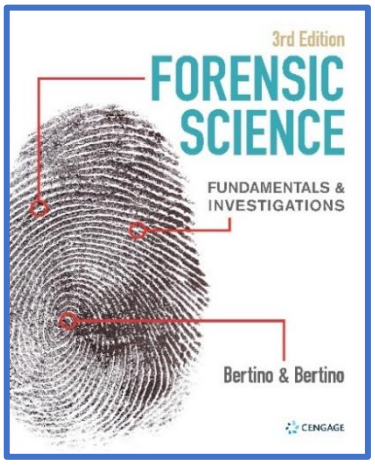


Table of Contents

Forensic Science: Fundamentals and Investigations 3rd ed. 2021

Authors: Anthony J. Bertino and Patricia Nolan Bertino

Publisher: National Geographic Learning and Cengage Learning Company



Introduction: Forensic Science: Fundamentals and Investigations 3rd edition

Authors: Bertino & Bertino rev. 1.24.21
Publisher: National Geographic Learning/Cengage

The Bertino & Bertino high school forensic textbook, ***Forensic Science: Fundamentals and Investigations 3rd edition,*** was written by experienced high school teachers using high school lab equipment and chemicals. Forensic science courses are interdisciplinary and integrate math, biology, chemistry, earth science, physics, math, history, politics, writing and technology. This high interest, real life application forensic science course engages students as they use problem solving and critical thinking skills while collaborating with classmates to analyze a crime scene. Students collect and analyze scientific evidence that supports or refutes claims of innocence or guilt. The content of the textbook avoids descriptions and graphic images of violent crimes or detailed information regarding serial killers. Use of this book is appropriate for advanced middle school, high school and community college students.

One of the greatest benefits of forensic science courses is that students gain confidence in their abilities to do math and science as they apply these skills to solving crimes. A course in forensic science demonstrates to students why they need to learn these skills. Not only are students learning about math and science, but they are also learning about the technology needed to obtain scientific evidence. Forensic science helps students improve their writing and public speaking skills as they prepare both written and oral presentations describing the scientific evidence used to support their claims.

Forensic Science: Fundamentals and Investigations 3rd edition is a **both a textbook and a hands-on activity book**. Each activity is a stand-alone activity containing objectives, safety information, materials, procedures and final analysis with easily understood directions and questions. The activities are arranged from basic information to more complex information. The **End-of-Chapter Activities** focus on the physical evidence described in a particular chapter. The **Capstone Projects** found at the end of the textbook, include several types of physical evidence. The end-of-chapter Activities and Capstone Projects include hands-on activities, kinesthetic learning activities, debate planning and strategies along with pre-writing activities to help students with written reports. All activities have been pre-tested by high school students.

Each chapter contains 3 -8 activities covering a variety of activities that corresponds to the evidence described in that chapter. Most of the activities contain a **Going Further Section** for those students who want to go above and beyond the textbook. There is a **total of 103 activities**: **80 activities in the textbook** and an **additional 23 new activities** that can be downloaded with an access code from the **Cengage Companion Site**. In addition, there are 10 more Capstone Projects. Note that all activities are available on ***MindTap***. Refer to the ***Activities and Capstone Projects*** document for a complete listing of all activities and Capstone Projects or refer to the textbook preface pg*. xiv and the Table of Contents on pages xxi through xxix.*

Activity Worksheets (WKSTs) and additional **Teacher Notes** (TNs) for all end-of-chapter activities and Capstone Projects can be downloaded and printed from the Cengage Website from the Cengage Companion Site using your access code. No need for teachers to spend extra time to create data tables for student answers; they are already completed! Since the activity worksheets are word documents, you can easily tailor the data table to best suit your needs. The teacher notes on the companion site are in addition to the many teacher notes located in the margins of the teacher edition.

Wraparound Teacher's Edition

Today's teachers are especially busy teaching multiple courses and planning on-line learning lessons. We understand that there's not enough time in the day to plan all these lessons, especially for those courses that include hands-on activities. Often, teachers are asked to teach forensic science without any training in forensic science. Teachers understand the math and science, but how do they apply this to a new forensic science class? That's why we provide you with that additional support in planning your lessons and activities with the new third edition **Wraparound Teacher's Edition.**

We guide you through each chapter and activity using the many teaching notes found in the margins of the teacher's edition. Throughout the teacher's edition, you'll find headings in the side margins identified as ***engage, explore, teach, apply, or access*** with suggestions on:

- How to start a lesson that will captivate and engage your students.
- How to teach a lesson.
- How to extend your forensic lessons by providing interesting websites, books, tutorials for your students to explore.
- How to integrate math, history, politics and public speaking into your forensic lesson.
- How to encourage and motivate your students to dig deeper and explore beyond what is described in the textbook.
- When to apply what the students have learned by noting at what point in the lesson to introduce one of the many activities located at the end of each chapter.
- How to provide learning opportunities for accelerated students and for students who need additional support. Look for the ***Differentiated Learning*** headings found in the teacher's edition and the ***Digging Deeper*** and ***Going Further*** sections found in the student edition.

The **Wraparound Teacher's Edition** helps you to prepare and conduct the **activities** by offering suggestions on:

- Inexpensive materials to use instead of purchasing expensive kits.
- What materials need to be prepared in advance.
- How to engage your students to stimulate interest in the activity.
- How to organize your students and lab materials.
- How to set-up, introduce and deliver the activities.

- How to prevent common "pitfalls" of the activity.
- How to present the information to your students to ensure understanding.
- How to make up your own inexpensive forensic kits that can be re-used each year.

Answers to the end-of-chapter questions and the activity questions are also provided in the Wraparound Teacher's Edition.

Ancillary Materials: The **Wraparound Teacher's Edition** and an **access code** to all teacher ancillary resources are provided free of charge with the purchase of a class set of textbooks. Refer to **Cengage's Companion Site** on the Cengage website to obtain the following updated resources and references:

* Lesson Plans for each chapter **(NEW)**
* PowerPoint Presentations **(revised and NEW)**
* Student Learning Objectives (SLOs) for each chapter
* 23 new additional activities (found only on the companion site, not in the printed book)
* Chapter Activities and Capstone Project Worksheets **(revised)**
* Testing Powered by Cognero **(NEW)**
* Extensive list of alternative assessments and projects ideas for remote learning opportunities.
* Additional Resources (including high interest, non-fiction readings arranged by chapter) **(revised and updated)**
* National Standards Correlations for **NGSS** (Next Generation Science Standards), **CC** (Common Core). State Standard Correlations available on request).

MindTap

Mind Tap is a cloud-based, highly personalized, learning environment that combines student learning tools-readings, multimedia, activities, and assessments into a single Learning Path. MindTap is a learning path design that facilitates the learning process, with each chapter building knowledge and skills through different levels of assessments and authentic activities.

MindTap allows teachers to personalize their forensic science course using the learning tools. Teachers can seamlessly introduce their own content by adding information to the digital chapter throughout the chapter. Teachers should refer to the extensive bibliography and Internet site listings at the end of each chapter for suggested tutorials, websites, books or articles. Teachers also have access to powerful class reports and analytics to help save time, measure progress, and improve outcomes.

MindTap is especially useful for teachers conducting On-Line and remote Instruction!

What's New in the 3rd edition? (abbreviated list)

- Chapter re-organization to facilitate learning and enhanced understanding.
- Alignment to National Standards (NGSS) and Common Core (CC).
- Opening chapter scenarios and case studies (in selected chapters).
- Updated content and statistics with more photos and graphics in each chapter.
- Enhanced history, evidence collection and analysis.
- New section on New Technologies for Forensic Analysis.
- Updated bibliography with expanded and new resources including: new articles and books, links to websites for videos, tutorials and Ted Talks.
- 23 new activities. (total 103-chapter activities PLUS 10 Capstone Projects)
- Revised PowerPoints.
- 8 new PowerPoints to supplement instruction in selected activities.
- Lesson plans and outlines to chapters.
- Test bank powered by Cognero featuring different levels of questions w/feedback and rationale.

Refer to a future section below entitled **"Bertino 3rd ed. What's New"** to see a summary and a chapter-by-chapter description of what's new in the 3rd edition.

Format for *Forensic Science: Fundamentals and Investigations 3rd edition*

The forensic textbook can be purchased as a **hard copy or digital format** that is **particularly useful for online learning**.

List of Activities and Capstone Projects 3rd ed.

Forensic Science: Fundamentals and Investigations 3rd edition 1.24.21

Authors: Bertino and Bertino
Published by National Geographic Learning/Cengage

Forensic Science: Fundamentals and Investigations **3rd edition** by Bertino & Bertino was written by experienced high school teachers using high school lab equipment and chemicals. No need to purchase expensive lab kits because most of our activities can be completed using inexpensive materials described in the activities and in the Wraparound Teacher's Edition.

Forensic Science: Fundamentals and Investigations 3rd edition is a **both a textbook and a hands-on activity book**. Each activity is a stand-alone activity containing objectives, safety information, materials, procedures and final analysis with easily understood directions and questions. The **End-of-Chapter Activities** focus on the physical evidence described in a particular chapter (For example: hair, blood spatter or bones) and are arranged from basic to more complex concepts. The **Capstone Projects** found at the end of the textbook, include several types of physical evidence. For example, Capstone Project #10 entitled *Gravesite Excavation* could include hair, fibers, botanical, fingerprint and ballistic evidence. Activities and Capstone Projects include hands-on activities, kinesthetic learning activities, debate planning and strategies along with pre-writing activities to help students with written reports. All activities have been pre-tested by high school students.

Each chapter has between 3-8 activities covering a range of activities that corresponds to the evidence described in that chapter. Most of the activities contain a Going Further Section for those students who want to go above and beyond the textbook. There is a **total of 104 activities**: **80 activities in the textbook** and an **additional 24 activities** that can be downloaded from **the Instructor's Companion Site** using an access code. The 24 additional activities are labeled by the Act # and title of the activity followed by *ACT*. (For example, Act 9-7 ACT Drug Debate.) Note that all activities are available on ***Mind Tap***.

Student Activity Worksheets (WKSTs) are provided for all activities and Capstone Projects. Specific worksheets for each activity or capstone project are listed under the **Materials** section of each activity. Teachers can reprint the worksheets from the Instructor Companion Site located on the Cengage webpage using their access code. Being able to reproduce the worksheets saves both time and paper! Student Worksheets provide:

* Enlarged charts or diagrams represented in the student textbook.
* Enlarged Data Tables or charts for student answers or responses.
* Standardized forms such as site and evidence log, charts, evidence Labels and markers.

Wraparound Teacher's Edition: To help you prepare and conduct the activity, view the many new teaching notes found in the side margins of the teacher's edition that contains teaching tips, related websites and suggestions that guide you through the activity.

End of Chapter Activities: listed in black are the activities located in the textbook, listed in blue are the activities found on the Instructor's Companion Site, all activities are on Mind Tap.

Chapter 1 Observation Skills

- Act 1-1 Learning to See
- Act 1-2 You're an Eyewitness?
- Act 1-3 What Influences Our Environment?

Chapter 2 Crime-Scene Investigation and Evidence Collection

- Act 2-1 Locard's Principle of Exchange
- Act 2-2 Crime-Scene Investigation

Chapter 3 Hair Analysis

- Act 3-1 Trace Evidence: Hair
- Act 3-2 Hair Measurement
- Act 3-3 Hair Testimony Essay

Chapter 4 A Study of Fibers and Textiles

- Act 4-1 Microscopic Fiber Analysis
- Act 4-2 Bed Sheet Thread Count
- Act 4-3 Weave Pattern Analysis
- Act 4-4 Textile Identification
- Act 4-5 Burn Analysis of Fibers

Chapter 5 Forensic Botany

- Act 5-1 Comparing Suspect Pollen to Crime-Scene Pollen
- Act 5-2 Pollen Expert Witness Presentation
- Act 5-3 Botanical Evidence Case Studies Presentation
- Act 5-4 Processing a Crime Scene for Botanical Evidence
- Act 5-5 Pollen Index
- Act 5-6 Isolation of Pollen from Honey

Chapter 6 Fingerprints

- Act 6-1 Study Your Fingerprints
- Act 6-2 Giant Balloon Fingerprint
- Act 6-3 Studying Latent and Plastic Fingerprints
- Act 6-4 How to Print a Ten Card
- Act 6-5 Minutiae Patterns
- Act 6-6 Fingerprint Analysis
- Act 6-7 Using Cyanoacrylate to Recover Latent Fingerprints
- **Act 6-8 ACT Print Variations (NEW)**

Chapter 7 DNA Profiling

- Act 7-1 Simple DNA Extraction
- Act 7-2 The Break-In
- Act 7-3 Anna Anderson or Anastasia? STR Analysis
- Act 7-4 STR Identification of a September 11th Victim
- Act 7-5 Identification of the Romanovs Using STR Profiling
- **Act 7-6 ACT Design and Build a Human DNA Structure: A Kinesthetic Learning Activity (NEW)**

Chapter 8 Blood and Blood Spatter

- Act 8-1 A Presumptive Test for Blood
- Act 8-2 Creating and Modeling Blood-Spatter Patterns
- Act 8-3 Blood-Spatter Analysis: Effect of Height on Blood Drops
- Act 8-4 Area of Convergence
- Act 8-5 Blood Droplet Impact Angle
- Act 8-6 Area of Origin
- Act 8-7 Crime-Scene Investigation
- **Act 8-8 ACT Antigens and Antibodies Kinesthetic Activity**

Chapter 9 Forensic Toxicology

- Act 9-1 Drug Analysis
- Act 9-2 Should Medical Marijuana be Legalized?
- Act 9-3 Drug Spot Test
- **Act 9-4 ACT Urine Prescription Drug Test**
- **Act 9-5 ACT Drug Research and Presentation**
- **Act 9-6 ACT Drug Residue on Money**
- **Act 9-7 ACT Random Drug Testing in Schools Debate**
- **Act 9-8 ACT Toxin Case Study**
- **Act 9-9 ACT Pre-Testing, Evidence Reliability and Validity (NEW)**

Chapter 10 Handwriting Analysis, Forgery and Counterfeiting

- Act 10-1 Handwriting Analysis
- Act 10-2 Analysis of Ransom Note and Report to Jury
- Act 10-3 Examination of U.S. Currency: Is it Authentic or Counterfeit?
- **Act 10-4 ACT Landmark Handwriting Cases**
- **Act 10-5 ACT President's Signature Activity**

Chapter 11 Forensic Entomology

- Act 11-1 How to Raise Blowflies for Forensic Entomology
- Act 11-2 Mini-Projects for Forensic Entomology
- Act 11-3 Observation of Blowflies or Houseflies

Act 11-4 Factors Affecting Postmortem Interval Estimates and Accumulated Degree Hours
Act 11-5 ACT Processing a Crime Scene for Forensic Insect Evidence
Act 11-6 ACT Jigsaw Research
Act 11-7 ACT Calculating Accumulated Degree Hours (ADH)
Act 11-8 ACT Forensic Entomology Case Study (NEW)

Chapter 12 Death: Manner, Mechanism, Cause

Act 12-1 Calculating Postmortem Interval Using Rigor Mortis
Act 12-2 Calculating Postmortem Interval Using Algor Mortis
Act 12-3 Tommy the Tub
Act 12-4 Analysis of Evidence from Death Scenes
Act 12-5 ACT Chicken Decomposition (NEW)
Act 12-6 ACT Student Projects (NEW)

Chapter 13 Soil Examination

Act 13-1 Observation of Sand (NEW)
Act 13-2 Sorting of Sand Using Sieve Plates (NEW)
Act 13-3 Sorting of Sand by Size and Shape (NEW)
Act 13-4 Examination of Sand and Mineral Percentages
Act 13-5 Chemical and Physical Analysis of Sand
Act 13-6 Soil Evidence Examination
Act 13-7 ACT Grain Size and Velocity (NEW)
Act 13-8 ACT Japanese Fire Balloon Podcast (NEW)
Act 13-9 ACT Sand Theft Podcast (NEW)

Chapter 14 Forensic Anthropology

Act 14-1 Determining the Age of a Skull
Act 14-2 Bones: Male or Female?
Act 14-3 Identifying the Romanovs-an Internet Activity
Act 14-4 Estimation of Body Size from Individual Bones
Act 14-5 What Bones Tell Us
Act 14-6 Height and Body Proportions

Chapter 15 Glass Evidence

Act 15-1 Glass Fracture Pattern Analysis **(NEW Part 2 hands-on)**
Act 15-2 Glass Density
Act 15-3 Approximating the Refractive Index of Glass Using a Submersion Test
Act 15-4 Determining the Refractive Index of Liquids Using Snell's Law
Act 15-5 ACT Case Study Using Conchoidal Fractures (NEW)

Chapter 16 Casts and Impressions

Act 16-1 Making a Plaster of Paris Cast
Act 16-2 Shoe Size, Foot Size, and Height
Act 16-3 Tire Impressions and Analysis
Act 16-4 Vehicle Identification
Act 16-5 Dental Impressions

Chapter 17 Tool Marks

Act 17-1 Tool Marks: Screwdrivers and Chisels
Act 17-2 Hammers and Hammer Impressions
Act 17-3 Casting Impressions of Hammer Strikes on Wood in Silicone

Chapter 18 Firearms and Ballistics

Act 18-1 Bullet Trajectory
Act 18-2 Firing Pin Analysis
Act 18-3 Describing Spent Projectiles
Act 18-4 How Good is Your Aim?
Act 18-5 ACT Sectional Density of Rifle Bullets
Act 18-6 ACT Kinetic Energy of a Projectile

Capstone Projects

Capstone Projects located at the end of the book contain activities that deal with more than one type of physical evidence.

Project 1 Physical Evidence Case Studies

Project 2 Personal Evidence Portfolio

Project 3 How Reliable is the Evidence?

Project 4 Landmark Cases in Acceptance of Evidence

Project 5 Analysis of a Forensic Science TV Show Episode

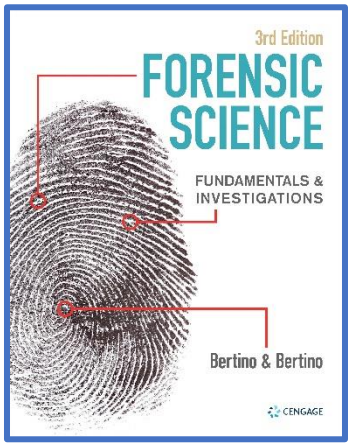
Project 6 Forensic Dumpster Diving- What the Garbage Can Tell Us

Project 7 Forensic Science Career Exploration

Project 8 Crime-Scene Development and Processing

Project 9 How to Read Calipers

Project 10 Gravesite Excavation



Additional Activities on the Companion Site and in MindTap

Forensic Science: Fundamentals & Investigations, 3rd Edition 2021

Bertino & Bertino www.BertinoForensics.com

Chapter 6: Fingerprints

- Act 6-8 ACT Print Variations **Chapter 7: DNA**

Profiling

- Act 7-6 ACT Design and Build a Human DNA Structure (NEW) **Chapter 8:**

Blood and Blood Spatter

- Act 8-8 ACT Antigens and Antibodies Kinesthetic Activity **Chapter 9:**

Forensic Toxicology

- Act 9-4 ACT Urine Prescription Drug Test
- Act 9-5 ACT Drug Research and Presentation
- Act 9-6 ACT Drug Residue on Money
- Act 9-7 ACT Drug Testing Debate
- Act 9-8 ACT Toxin Case Study
- Act 9-9 ACT Pre-Testing, Evidence Reliability and Validity (NEW) **Chapter 10:**

Handwriting Analysis, Forgery, and Counterfeiting

- Act 10-4 ACT Landmark Handwriting Cases
- Act 10-5 ACT President's Signature Activity **Chapter 11:**

Forensic Entomology

- Act 11-5 ACT Processing a Crime Scene for Forensic Insect Evidence
- Act 11-6 ACT Jigsaw Research
- Act 11-7 ACT Calculating Accumulated Degree Hours (ADH)
- Act 11-8 ACT Forensic Entomology Case Study (NEW) **Chapter 12:**

Death: Manner, Mechanism, Cause

- Act 12-5 ACT Chicken Decomposition (NEW)
- Act 12-6 ACT Student Projects (NEW) **Chapter 13: Soil**

Evidence

- Act 13-7 ACT Grain Size and Velocity (NEW)
- Act 13-8 Japanese Fire Balloon Podcast (NEW)
- Act 13-9 Sand Theft Podcast (NEW) **Chapter 15:**

Glass Evidence

- Act 15-5 ACT Case Study Using Conchoidal Fractures (NEW) **Chapter 18:**

Firearms and Ballistics

- Act 18-5 ACT Sectional Density of Rifle Bullets
- Act 18-6 ACT Kinetic Energy of a Projectile

These activities are not in the textbook, but can be located on the Cengage Companion Site or on MindTap.

Bertino Website www.BertinoForensics.com

Anthony (Bud) Bertino and Patricia Nolan Bertino
authors of
Forensic Science: Fundamentals and Investigations 3rd ed. 1.24.21

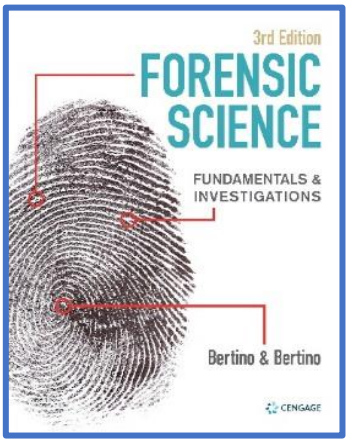
Forensic Resources
If you visit our website **www.BertinoForensics.com** you'll find many resources and list of free forensic magazines.

Click on textbook: Send us your school address and zip code to receive a free student copy of our high school text ***Forensic Science: Fundamentals and Investigations 3rd ed.*** by Bertino & Bertino.

The book was written for high school students using high school equipment.
Hands-on activities are located at the end of each chapter.

Click on Teacher Resources:

- Activities
- Alternative assessments
- Apps
- Book and free Forensic Magazine list: Including The Forensic Teacher and Evidence Technology magazines and books that are high-interest, non-fiction books arranged by topic.
- Demos
- Helpful hints
- Literacy and forensics
- MST
- Podcasts
- Power point presentations
- Publications
- Standards Correlations
- Supplies and equipment



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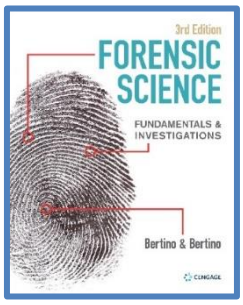
www.BertinoForensics Click on 'contact us'

Visit National Geographic Learning/Cengage website https://ngl.cengage.com
Call Customer Service 888-915-3276
What is Mind Tap? https://ngl.cengage.com/assets/html/mindtap/
Contact a sales representative using Rep finder:
https://www.cengage.com/repfinder/natgeo/?ngl=true/

What's New in 3rd ed. *Forensic Science: Fundamentals and Investigations*

authors: **Bertino & Bertino**

Publisher: **National Geographic Learning/Cengage *1.24.21***



- **Aligned to current National standards NGSS (Next Generation Science Standards).**
- **Chapter reorganization to facilitate learning and improve understanding.**
- **Chapter Objectives revised with correlations to the text, end-of-chapter review questions and activities to provide a clear pathway for learning.**
- **Updated content, statistics, references, weblinks, and technology.**
- **New opening scenarios and case studies in selected chapters.**
- **New section in each chapter focusing on advances in forensic science, including new technologies and techniques related to forensic investigation and analysis.**
- **Enhanced sections in history to provide context.**
- **Additional information on evidence documentation, collection, preservation and analysis to facilitate understanding of the forensic processes.**
- **Emphasis on the collaboration of law enforcement, forensic investigators and forensic experts and scientists in solving crimes.**
- **Focus on evidence reliability and validity reflecting current trends in forensic analysis.**
- **Additional photos and graphics to support and enrich the text and enhance learning.**
- **New resources added to the end of chapter bibliography including tutorial websites, video links, animations, updated articles and books to promote further exploration and learning.**
- **Twenty-three new activities in the textbook and on the instructor's companion site. *Forensic Science: Fundamentals and Investigations* provides you with a total of 103 activities, 80 in the textbook and 23 on the instructor companion site plus an additional 10 Capstone Projects. All activity student worksheets (WKSTs) containing data tables and forms that can be downloaded and reproduced from the Instructor's Companion Site using your access code.**
- **9 New author PowerPoints to be used with activities to enhance understanding.**

- **Combined Glossary and Glosario provides support for English Language Learners (ELL).**
- **New test bank powered by Cognero featuring different levels of questions with feedback and rationale.**
- **Revised chapter PowerPoints.**
- **Mind Tap and electronic versions of the textbook enable you to personalize your lessons for your students. The electronic version of the textbook facilitates online learning!**
- **Wraparound Teacher Edition filled with extensive teaching tips to guide you in your instruction.**

Wraparound Teacher Edition provides support, guidance, references and teaching tips for teaching forensic science that is especially useful for teachers teaching forensic for the first time. The teaching notes are found in the side margins of the teacher edition where the tip can be applied.

1. Look for headings in the text:

a. *Engage, Explore, Enrich, Teach, Apply and Access*

b. *Differentiated Learning, Digging Deeper and Going Further*

Knowing that most high school forensic classes are composed of heterogeneously grouped students, the *Differentiated Learner* sections in the teacher's edition and the *Going Further* features in the activities, provide additional learning opportunities to address the individual needs of your students.

2. The teacher edition provides support for each activity and capstone project including:

- how to pre-plan for each activity.
- how to engage students to promote interest in the activity.
- how to address and prevent student "trouble spots" within the activity.
- how to provide a low budget hands-on activity without using expensive kits

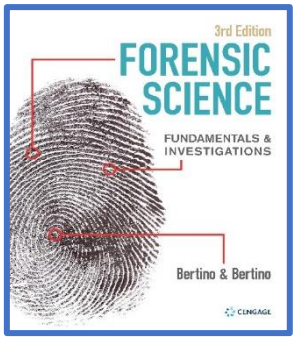
Instructor Companion Site:

The 3rd edition Companion Site provides resources in addition to other valuable references to expand learning beyond the classroom:

- **Lesson Plans** outlining chapter topics and correlating to PowerPoint presentations.
- **PowerPoint Presentations** with/Alt Text aligning to chapter Learning Objectives.
- **Student Learning Objectives** (SLOs) for each chapter.
- **Chapter Activity and Capstone Project Worksheets** w/supporting **Teacher Notes**.
- **Testing Powered by Cognero**.

- **Additional Activities and Resources** including a list of non-fiction books and free forensic magazines.
- **Standard Correlations** for NSGG (Next Generation Science Standards) and Common Core Standards. State Standard Correlation (upon request)

What's New by Chapter



Chapter reorganization: Chapters : 4,5,7,10.11,13,15.17,18

New Opening Scenarios: Chapters : 1,2,4,7,13,16

Enhanced history sections: Chapters: 2,5,9,14,15,17,18

New photos and graphics: Chapters: 3,4,5,6,8,9,11,13,14,15,16.18

New Case Studies: Chapters: 1,2,5,6,7,8,9,12,13,17

Updated resources in references and bibliography: Chapters: 1,2,7,9,10,12,13,16

Phenomenon Based Learning: The use of interesting and historical events that make students wonder to promote further investigation and problem solving.

Chapter 7: Act 7-4 Identification of 9-1-1 Victim using STR Analysis (DNA)
Chapter 9: Case Study: Flint Michigan Water Pollution (Toxicology)
Chapter 13: Act 18-8 ACT Case Study Japanese Fire Balloons of WWII (Sand)
Act 18-9 ACT Sand Theft Podcast, Opening Scenario
Chapter 14: Case Studies: Identification of Romanov Gravesite (Act 14-3), African Burial Grounds Identification using Skeletal Remains.

23 New Activities: Refer to document Activities and Capstone Projects for complete listing of all 103 End-of-Chapter Activities and 10 Capstone Projects.

9 New author PowerPoints for use with the Activities, Capstone Projects and Chapter Discussions

Act 7- 4 Identification of 9-1-1 Victim Using STRs (DNA) - chapter 7
Act 8-6 Area of Origin (Blood Spatter Analysis) - chapter 8
Activities and Chapter 11 Forensic Entomology - chapter 11
Act 12-5 Chicken Decomposition - chapter 12

Act 17-1 Tool Marks: Screwdrivers and Chisels - chapter 17
Act 17-2 Hammers and Hammer Impressions - chapter 17
Act 18-2 Three Suspects and Evidence (Firing Pin Analysis) - chapter 18
Capstone Project 10 How to Use a Caliper 4.19.20 (longer)
Capstone Project Caliper Measurements 4.18.20 (shorter form)

Debate strategies and preplanning End-of-Chapter Activities

Act 9-2 Should Medical Marijuana be Legalized in Every State?
Act 9-7 ACT Random Drug Testing in Schools Debate

Kinesthetic Learning Activities

Act 7-6 ACT: Design and Build a Human DNA Structure **(NEW)**
Act 8-8 ACT: Antigen and Antibodies Kinesthetic Activity **(NEW)**

Phenomenon Based Learning Activities

Act 13-8 ACT Japanese Fire Balloons **(NEW)**
Act 13-9 ACT Sand Theft Podcast **(NEW)**
Act 14-3 Identifying the Romanovs

Pre-writing End-of-Chapter Activities

Act 3-1 Hair Testimony Essay
Act 5-2 Pollen Expert Witness Presentation

Chapter Highlights of Forensic Science: Fundamentals and Investigations 3rd edition

Ch 1 Forensic Science and Observation

- New opening scenario.
- New section on interrogation methods.
- New websites, Ted Talks, videos.
- Claim-Evidence-Reasoning format for student for student research.
- Revised End of Chapter Questions.

Ch 2 Crime-Scene Investigation and Evidence Collection

- Enhanced crime scene processing information.
- New Case Study on Terrorist bombings.
- Updated guidelines for court testimony that protects the rights of the accused by limiting expert witness testimony.
- Many new references added to the bibliography including Ted Talks, tutorials and Observation Evaluations.

Bertino & Bertino, *Forensic Science: Fundamentals and Investigations*, 3rd ed.

Ch 3 Hair Analysis

- New opening scenario using hair analysis isotope ratio mass spectrometry.
- Isotope ratio mass spectrometry used to analyze hair for determination of where someone lived.
- New information on protein hair analysis used for identification.
- New photos.

Ch 4 Fiber Analysis

- Reorganized chapter for improved understanding.
- More comprehensive reference list.

Ch 5 Forensic Botany

- Reorganization of chapter.
- History section expanded.
- New: Role of Customs and Border Protection in pollen investigations involving: drug trafficking, identification of unknown remains using pollen to trace location.
- New Case study of Caledonia Jane: Integrates botany, chemistry, bone analysis and DNA technology.
- Enhanced analysis section on pollen analysis.
- Additional photos.
- Expanded bibliography.

Ch 6 Fingerprints

- New information NGI Next Generation Identification.
- New case study involving police using hand held fingerprint scanning devices.
- New photos and graphics.
- New technologies using fingerprint analysis:
- Touch DNA personal identification and drug analysis from fingerprints.
- Algorithms and machine learning for fingerprint identification to access fingerprint usability to avoid subjective analysis of fingerprints.
- Improved more objective forensic analysis using automated fingerprint analysis.
- Act 6-8 Print ACT Variations **(NEW).**

Ch 7 DNA Analysis

- New DNA technologies discussed.
- New SNP analysis used in forensic genealogy and DNA phenotyping.
- DNA data-mining, algorithms and computer machine learning used in Parabon's® DNA phenotyping along with digital imaging to obtain facial features.
- New opening scenario and case studies solved using the assistance of forensic genealogy, DNA phenotyping and SNP technologies: Buckskin Girl, Ignoto Uno, Billboard Boy.

- Many new teacher notes added to Teacher Edition providing numerous tutorials, websites and TED Talks for differentiated learners to provide additional engagement, enrichments, and further explanations.
- Updated information on: mtDNA, Y STR analysis, familial searching and kinship studies, role of forensic genealogy, DNA phenotyping and SNPs.
- Revised end of chapter questions.
- Bibliography expanded to include more website tutorials and references and updated articles on forensic genealogy.
- New animated and guided PowerPoint to assist instructors and students with Act. 7-4 STR Identification of September 11 Victim. **(NEW)**
- Act. 7-6 ACT Design and Build a Human DNA Structure: kinesthetic learning activity **(NEW).**

Ch 8 Blood and Blood Spatter

- Enhanced Evidence Collection and Documentation.
- More photos.
- New information on hand-held Raman spectroscopy used at crime scene to determine if blood is human or non-human and time since deposition.
- New case study Joe Bryan.
- Revised end of chapter questions.
- New PowerPoint added for Act. 8-6 Area of Origin. **(NEW)**
- New activity Act. 8-8 ACT Antigen and Antibodies Kinesthetic Activity **(NEW).**

Ch 9 Forensic Toxicology

- Chapter reorganized
- Enhanced history, updated statistics
- New photos and graphics
- Drug analysis from fingerprints
- New case studies: Flint Michigan toxic water, Radium Girls (phenomenon-based learning)
- New technologies: TD-DART-MS Rapid Screening Presumptive testing in real time using hand-held mass spectrometry
- Revised End of chapter questions
- Updated bibliography and extensive references to updated tutorials and websites.
- Teacher edition many new teaching notes with new tutorial websites for differentiated learners.
- Act. 11-9 ART: Pre-Testing and Evidence Reliability and Validity **(NEW)**

Ch 10 Handwriting Analysis, Forgery, and Counterfeiting

- New chapter reorganization
- New information on art forgery, on-line fraud, counterfeiting of merchandise
- N-gram tracing for hand writing analysis
- New case studies: counterfeiting money and forgery and fraud involving E Bay sales
- Many new Teacher Notes in Teacher's Edition.

- Updated bibliography, new tutorials

Ch 11 Forensic Entomology

- Reorganized chapter
- Many more graphics, figures and photos in text and in the activities.
- Enhanced crime scene processing, evidence documentation, collection and preservation.
- New technologies using amino acids composition of eggs helps with identification of insects.
- CT scans and X-rays of puparia have improved ability to estimate age of the pupa.
- Many new Teacher notes in Teacher's Edition.
- Activities: Act. 11-8 ACT Forensic Entomology Case Studies **(NEW)**

Ch 12 Death: Manner, Mechanism, Cause

- Reorganized chapter.
- Additional information on autopsy, forensic microbiology and PMI.
- More coverage on crime scene processing death scene.
- Additional photos and tables.
- New case study.
- Updated bibliography and references.
- New Activities: Act 12-5 ACT Simple and Fascinating World of Chicken Decomposition. **(NEW)**
- New PowerPoint Act 12-5 Chicken Decomposition **(NEW)**
- Act 12-6 ACT Student Projects **(NEW).**

Ch 13 Soil Evidence

- Chapter reorganized.
- Many changes and enhancements to this s chapter including new hands-on activities.
- New opening scenario on world-wide sand shortage and sand theft.
- More photos and graphics to enhance learning.
- Expanded bibliography including links to tutorial websites, TED Talks, documentary films and podcasts, curriculum guides, PowerPoints, videos and webinar.
- New Act 13-3 PowerPoint Presentation to provide additional support for the activity.
- New Activities: use of podcast to introduce phenomenon-based learning activities featuring. These activities integrate forensics, history, earth science, meteorology, technology., Many teacher notes supplying additional supporting background. These activities provide many opportunities for extended study and further exploration.
    - ✓ Act 13-8 ACT Japanese Fire Balloons **(NEW).** This fascinating case study examines an interesting historical event during WW II. Through forensic sand analysis, scientists were able to confirm that the source of the fire balloons came from Japan based on the sand used in the ballast of the balloons. This case study is also featured in one of the new case studies.

- ✓ 13-9 ACT Sand Theft Podcast **(NEW).** This event highlights the world-wide environmental problem of sand shortage and the increasing problem of sand theft. This case study integrates forensic, environmental studies, earth science. This case study is also featured in our new opening scenario.

- Other new activities:
  - Act 13-1 Sand Observation **(NEW).**
  - Act 13-2 Sorting of Sand Using Sieve Plates **(NEW).**
  - Act 13-3 Sorting of Sand by Size and Shape **(NEW).**
  - Act 13-7 ACT Grain Size and Velocity Relationship **(NEW).**
- Many additional teacher notes in Teacher Edition suggesting ways to engage learner and suggested links and ideas to extend the learning.

Ch 14 Forensic Anthropology

- Chapter reorganized.
- Enhanced history section.
- More graphics and photos in the text.
- Enhanced sections on distinguishing male and female by skull and pelvis and distinguishing ethnic background.
- Use of isotope ratio analysis to analyze bones to determine where someone lived.
- Phenomenon-based learning case studies integrating forensics, anthropology, DNA, history, technology:
  - ✓ Jamestown Colonial site
  - ✓ African Burial Grounds (NYC)
  - ✓ Romanovs Gravesite Recovery
- Role of DNA bone analysis using mtDNA, YSTRs, SNP analysis and DNA phenotyping, familial and kinship studies and forensic genealogy to aid in identification of unknown remains.

Ch 15 Glass Evidence

- Chapter reorganized.
- Increased coverage of history.
- Additional photos and graphics in text and activities.
- Expanded coverage of collection and documentation of glass evidence.
- New text on conchoidal fractures.
- Many new teacher notes in Teacher Edition.
- Activity 15-1 B: Hands-on Glass Fracture analysis **(NEW).**
- Activity 15-5 ACT Conchoidal Fracture Analysis **(NEW).**

Ch 16 Casts and Impressions

- New opening scenario involving accused murder suspect, football player Aaron Hernandez.
- Chapter reorganized.

- Expanded history coverage.
- Many new photos and graphics.
- Activities: new photos.
- Revised EOC questions
- More Teacher Edition teaching tips.
- Improved end of chapter questions.
- Bibliography new references to tutorials, videos and podcasts.

Ch 17 Tool Mark

- Chapter reorganization.
- Expanded history section.
- Additional information on evidence collection, documentation and preservation.
- New technology, profilometer uses computer-based comparisons of 3-D scanned tool marks to provide more objective analysis.
- New case study.
- Revised end of chapter questions.
- Extended bibliography.
- Two new PowerPoints to use with:
  Act 17-1 Tool Marks: Screwdrivers and Chisels **(NEW)**
  Act. 17-2 Hammers and Hammer Impressions. **(NEW)**

Ch 18 Firearms and Ballistics

- Chapter reorganized.
- Expanded Key Terms.
- Enhanced history section.
- Additional information on laws of motion added to science section.
- More on evidence collection and documentations.
- Expanded text on forensic analysis.
- Many additional photos and graphics to enhance learning.
- Improved end of chapter questions.
- Teacher edition has many new teaching notes.
- New PowerPoint presentation Act 18-2 Three Suspects and Evidence to be used with Act 18-2 Firing Pin Analysis. **(NEW)**

Forensic Science: Fundamentals and Investigations 3rd ed.

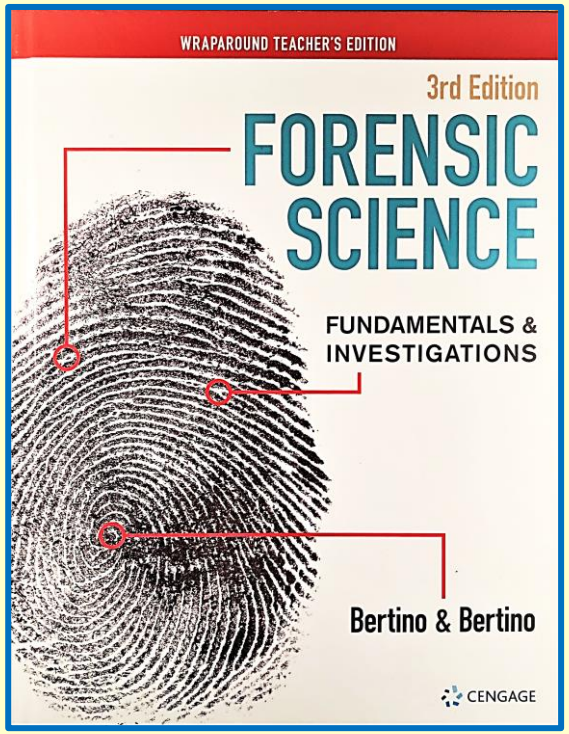
Teacher Edition

Authors

Anthony J. Bertino

Patricia Nolan Bertino

Cengage 2021



3rd ed. Teacher Edition

- Filled with teaching tips to help guide teachers through with chapter and activity.
- Teaching tips found on side margins of the textbook
- Look for headings:
  - Activity
  - Engage
  - Explore
  - Enrich
  - Teach
  - Academic Connections: Math, Biology, Earth science, Chemistry, Physics, Technology
  - Differentiated Learners: Accelerated, English Language Learners, Students in need of additional support
- Activity Pages: Tips on how to introduce the activity, identifies trouble spots and how to avoid them, inexpensive materials to use (not expensive kits), answers to questions.
- Chapter Overview

Sample Screen images from TE pages

Each page is filled with teaching tips

Next slide provides a sample of how the TE can help you to:

- Enrich your presentation with resources, tutorials, ideas
- Enhance student learning.
- Save you time and effort in planning.
- Meet the needs of all students in a heterogeneously-grouped forensics class.
- Help you provide background for activities to enhance student learning.

3rd ed. Teacher edition: Ch 6 Fingerprinting Teaching Tips

ACTIVITY

Consider introducing Activity 6-7: *Using Cyanoacrylate to Recover Latent Fingerprints* at this point in the lesson.

Engage

Help students learn the information in Table 6-2 by enlarging the table and making several copies of it. Then, cut out the squares of information and place each set of pieces into a separate envelope. Working in groups of two, have students recreate the table from the pieces. Make this exercise into a game by assigning a point value for each piece placed in the correct position.

Teach

Tell students that cyanoacrylate is Super Glue®.

Academic Connections

CHEMISTRY

Collecting latent fingerprints requires chemicals that will help investigators see and remove the prints for analysis without damaging them. The method used depends on the surface material. For example, ninhydrin reacts with traces of amino acids left on porous surfaces. Cyanoacrylate fumes adhere to latent prints on nonporous surfaces, such as plastic bags or electrical tape.

Teach

Explain how the prints on a ten card are made. For the upper ten impressions, each digit is individually rolled nail edge to nail edge on the card. This is done to obtain all available ridge detail. The prints at the bottom of the ten card are taken simultaneously without rolling. All of the fingers of each hand—except the thumb, which is printed separately—are set down at a 45-degree angle. These are referred to as plain or flat impressions. The bottom prints are taken in this manner

are logged on the evidence card.

To recover a print from a porous surface that is not smooth and hard requires the use of different chemicals to enhance the image. When the fingerprint residue combines with these chemicals, the fingerprint image becomes visible. Table 6-2 summarizes common chemicals used to recover a latent print.

TABLE 6-2 Other methods used for visualizing latent fingerprints

Chemical	Uses	Application	Safety	Chemical Reaction	Latent Print
Ninhydrin	Paper	Object is dipped or sprayed in ninhydrin; wait for 24 hours	Do not inhale or get on your skin	Reacts with amino acids (from proteins) found in sweat	Purplish-blue print
Cyanoacrylate vapor (super glue)	Household items: plastic, metal, glass; skin	Cyanoacrylate is heated in a vapor tent or fuming wand is used	Do not inhale or get on your skin; irritating to mucous membranes	Reacts with amino acids, proteins, fatty acids	White print
Silver nitrate	Wood; styrofoam	Object is dipped or sprayed in silver nitrate	Wear gloves to avoid contact with skin	Chloride from salt in perspiration on the print combines with silver nitrate to form silver chloride	Black or reddish-brown print under UV light
Iodine fuming	Paper; cardboard; unpainted surfaces	In a vapor tent, heat solid iodine crystals	Toxic to inhale or ingest	Iodine combines with carbohydrates in latent print	Brownish print fades quickly; must be photographed or sprayed with a starch solution

Collecting Patent Prints

Patent or visible prints found in blood or ink are immediately photographed. If the patent print is on a surface, such as a shirt or piece of paper, the item is dried and then bagged in a paper bag. The blood or liquid that was found in the print could be further analyzed in the lab for additional evidence.

Collecting Plastic Prints

Plastic prints that appear as indentations on soft items are first photographed. They usually do not require any enhancement. The item with the plastic print can be collected and may be casted if necessary. Oblique lighting may help enhance images.

Collecting Suspect Prints

Fingerprints of suspects are taken by rolling each of the 10 fingers in ink and then rolling them onto a ten print card that presents the 10 fingerprints in a standard format. In Activity 6-4, you will learn how to take your own ten card fingerprints. In most labs today, however, fingerprints are taken digitally.

200 Chapter 6

Enrich

Ask a fingerprint technician to visit your class and demonstrate the correct procedure in preparing a ten card.

ACTIVITY

Consider introducing Activity 6-4 *How to Print a Ten Card* at this point in the lesson.

Differentiated Learning

Accelerated Learners

Have students research (1) the chemical reactions involved in fingerprint recovery using ninhydrin and cyanoacrylate and (2) how additional hidden data can be identified from fingerprints, including traces of drugs, blood, foods, cosmetics, medicines, explosives, and environmental hazards.

Differentiated Learning

English-Language Learners

To help students understand minutiae terms, explain to students:

- bi = means 2
- tri = means 3
- furcation is similar to a fork
- eye is the same shape as their eyes

Engage

To help students understand that computers don't examine individual minutiae patterns, that an algorithm or pattern does, provide each student with a full-sized enlarged fingerprint. Ask students to circle the distinctive minutiae patterns then connect the minutiae encircled patterns to create an "algorithm" or unique shape. Make a transparency of the "algorithm" to show how its shape can identify the print if the pattern is consistent (aligns) with the minutiae patterns in the fingerprint.

Differentiated Learning

Additional Support for Learners

Students with reduced visual acuity can use a magnifying glass to enlarge the fingerprint, or they can take a digital image of the print and enlarge the photograph for viewing.

Academic Connections

BIOLOGY

The skin has three layers, each with different functions. The surface of the skin is called the *epidermis*. The epidermis is a relatively thin layer where the outermost cells are shed. The newer cells grow from the lowest layer of the epidermis, called the *basal layer*. The epidermis, when undamaged, is mostly waterproof; prevents bacteria and viruses from entering the body; and contains melanin that filters out ultraviolet (UV) rays from the sun. The next layer is called the *dermis*. This layer provides the skin with strength and flexibility and contains nerve endings, sweat glands, oil glands, hair follicles, and blood vessels. The *subcutaneous layer* is the most internal layer of the skin. This layer provides the body with insulation from the cold and heat, offers protective padding, and stores energy.

3rd ed. Teacher Edition Chapter 7 DNA Teaching Tips Samples

Differentiated Learning

Additional Support for Learners

Ask students to stand and stretch out their arms sideways. Their arms represent a gene. Ask them to nod their head. That region of a gene is an exon, the part of the gene that will be expressed. The other sections (their arms) represent introns, the part of the gene that will not be expressed.

Another model: Use a folding measuring stick to represent a gene. Unfold the measuring stick to represent how DNA unfolds, or uncoils. Place 3-foot-long, round styrofoam pipe insulation around three different locations on the measuring stick. The insulation represents exons, and the rest of the wooden stick represents introns of that gene. Note that introns can be found within a gene sequence or in between gene sequences.

Differentiated Learning

Accelerated Learners

Refer to HHMI BioInteractive's website (www.biointeractive.org) for a "CSI Wildlife" activity. In this interactive, students use DNA profiling to solve two cases of elephant poaching. In the process, they will learn about genetic markers, PCRs, gel electrophoresis, allele frequencies, and population genetics.

The Student Supplement (Frequency Primer) scaffolds the "Frequency Primer" section at the end of Case One and provides additional practice with probability calculations. It may be helpful for students who are new to frequency and probability calculations.

Differentiated Learning

Accelerated Learners

Noncoding introns contain sequences that act to regulate when and where the genes are turned on and off. These sites found within the introns provide locations for specialized proteins called *transcription factors* to attach. When some transcription factors are present, it helps "turn on" the gene so the protein is expressed. Other transcription factors will prevent the gene from being expressed and repress the process of making a protein. Mutations in the DNA code in these areas can result in disease. For further information, search the Internet for videos such as those from Learn.Genetics: "Measuring Gene Expression" and "Epigenome at a Glance."

Engage

Google "GTCA So Fast BioRad." Play the engaging video and song written about PCRs and performed by BioRad staff. You can also find this on YouTube by searching for "PCR song YouTube." Ask students to explain the lyrics.

Teach

For a more detailed explanation of DNA fingerprinting or gel electrophoresis, refer to Ch07 TN *Gel Electrophoresis* posted on the Companion Site.

Engage

To help students visualize the process of gel electrophoresis, search the Internet for "Forensics Who Dunnit? A Visual, Active Class Participation Simulation of Gel Electrophoresis" by Patricia Nolan Bertino.

Engage

Show students the following 6 minute tutorial by Paul Andersen before discussing STRs: "DNA Fingerprinting." (Bozeman Science)

Engage

Refer to https://learn.genetics.utah.edu/content/basics/inheritance/ and view "What is Inheritance."

Teacher Edition
3rd ed. Chapter 7 DNA Teaching Tips Samples for Activities

Teach

This activity is an opportunity to team teach with the biology, history, math, and English teachers.

- History: Effect and consequences of September 11
- Math: Calculating probability of someone having the same STR profile at all 13 markers using allele frequencies from population databases
- English: Assist in writing about September 11
- Biology: What is DNA? What are STRs?

If it isn't possible to involve different teachers in this lesson, divide the class into four teams. Each team will be the "teachers" for one discipline. Have student teams develop "lessons" about September 11 and present them to the class.

Teach

If you are unfamiliar with STRs and how to read a STR profile, read Act 7-4 TN *9-11 Victim* found on the Instructor Companion Site. On the same site, refer to Act 7-4_PPT_ *Bertino & Bertino* used to help students understand how to read a STR profile.

Differentiated Learning

Accelerated Learners

Watch the video by Riccardo Sabatini, "How to Read the Genome and Build a Human Being," TED Talk, 2016.

ACTIVITY 7-4

STR Identification of a September 11 Victim *Obj. 7.4, 7.6, 7.10*

Enrich

Invite a member of your local police to address the class and describe how they collect DNA samples from suspects.

Prior to the visit, student shou brainstorm questions to ask th police, such as:

a. How is DNA collected?

b. Is a warrant needed to colle DNA?

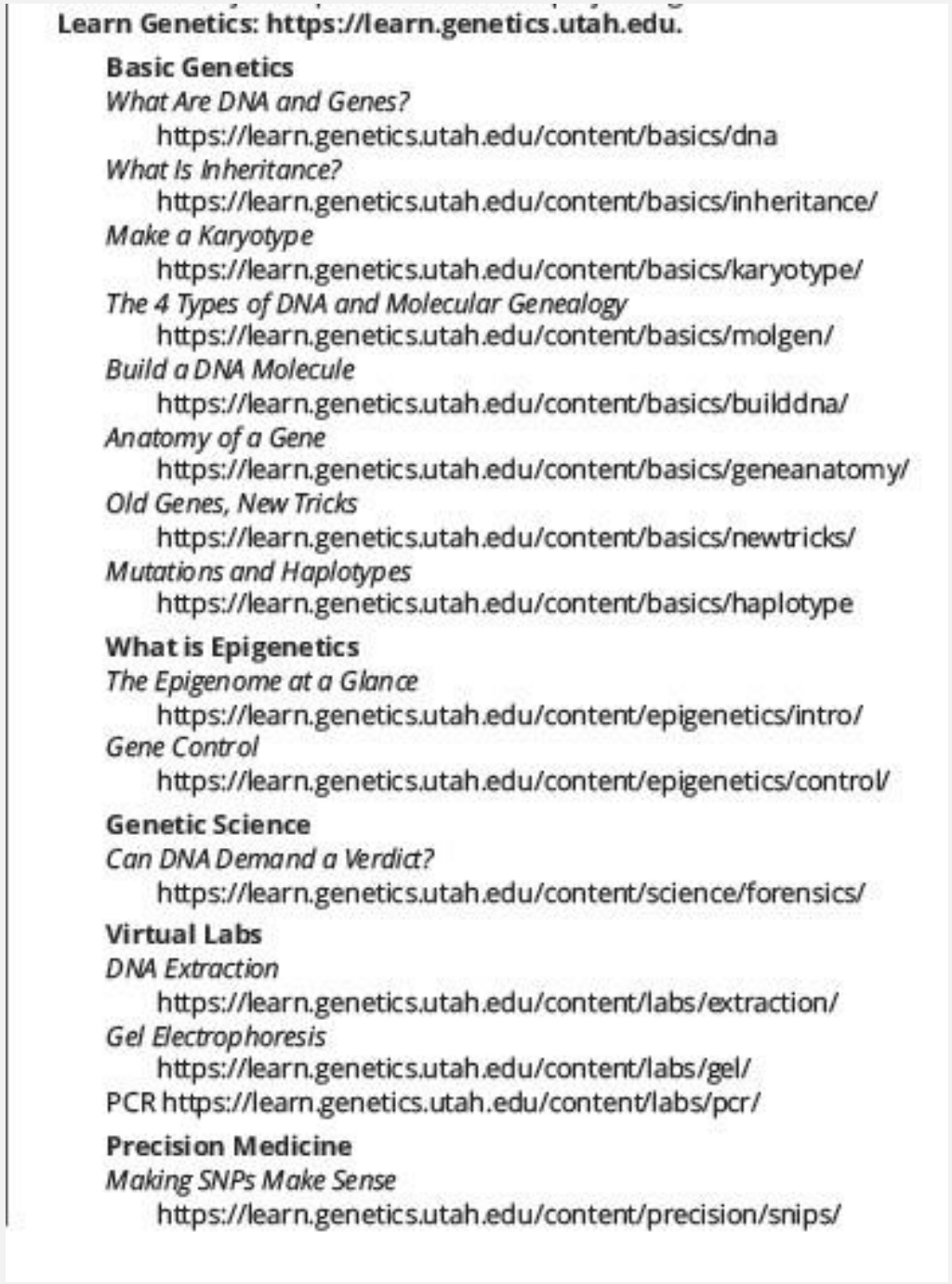
c. Can police collect DNA fror discarded garbage?

PROCEDURE

1. Print and distribute Act 7-4 WKST *STR Profiles* to students. This WKST provides a much larger view of the STR profile found at the end of this activity. It is recommended that in addition to providing each student with their own copy of this STR profile, to also project the STR profile. It is much easier for students to understand how to analyze the profile when viewed from the larger projected image.
2. Refer to the following Teacher Notes: Act 7-4 TN *Carousel Brainstorming Activity* and Act 7-4 TN *9-11 Victim* for additional instructional support in teaching this activity. Also available is Act 7-4 PPT *Bertino & Bertino*, an animated PPT that facilitates how to analyze the STR profile used in this activity.

3rd ed. Teacher Edition Chapter 7 DNA Bibliography: resources, tutorials, Ted Talks and more

Insert links to articles, tutorials, videos, Ted Talks from the bibliography to your digital textbook using MindTap!



Learn Genetics: https://learn.genetics.utah.edu.

Basic Genetics

What Are DNA and Genes?
https://learn.genetics.utah.edu/content/basics/dna

What Is Inheritance?
https://learn.genetics.utah.edu/content/basics/inheritance/

Make a Karyotype
https://learn.genetics.utah.edu/content/basics/karyotype/

The 4 Types of DNA and Molecular Genealogy
https://learn.genetics.utah.edu/content/basics/molgen/

Build a DNA Molecule
https://learn.genetics.utah.edu/content/basics/builddna/

Anatomy of a Gene
https://learn.genetics.utah.edu/content/basics/geneanatomy/

Old Genes, New Tricks
https://learn.genetics.utah.edu/content/basics/newtricks/

Mutations and Haplotypes
https://learn.genetics.utah.edu/content/basics/haplotype

What is Epigenetics

The Epigenome at a Glance
https://learn.genetics.utah.edu/content/epigenetics/intro/

Gene Control
https://learn.genetics.utah.edu/content/epigenetics/control/

Genetic Science

Can DNA Demand a Verdict?
https://learn.genetics.utah.edu/content/science/forensics/

Virtual Labs

DNA Extraction
https://learn.genetics.utah.edu/content/labs/extraction/

Gel Electrophoresis
https://learn.genetics.utah.edu/content/labs/gel/

PCR https://learn.genetics.utah.edu/content/labs/pcr/

Precision Medicine

Making SNPs Make Sense
https://learn.genetics.utah.edu/content/precision/snips/

Teacher 3rd / **Chapter 7 DNA Bibliography**: resources, tutorials, Ted Talks +

Internet Resources

Coble, Michael. "Y Chromosome, mtDNA and the Romanovs." *NIST*, April 18, 2012. https://strbase.nist.gov/training/NY-Apr2012-Y-mtDNA-Romanovs.pdf (Romanov slides and photos are #75-140)

FBI and CODIS https://www.fbi.gov/services/laboratory/biometric-analysis/codis

Genome.gov https://www.genome.gov/About-Genomics/Educational-Resources

HHMI Biointeractive www.biointeractive.org

Chemical Structure of DNA (2:44 minutes) https://www.biointeractive.org/classroom-resources/chemical-structure-dna

DNA Profiling Activity https://www.biointeractive.org/classroom-resources/dna-profiling-activity

Paired DNA Strands (1:20 minutes) https://www.biointeractive.org/classroom-resources/paired-dna-strands

Human Chromosomes (47 seconds) https://www.biointeractive.org/classroom-resources/human-chromosomes

CSI Wildlife https://www.biointeractive.org/classroom-resources/csi-wildlife

Coding Sequence of DNA (1:04 minutes) https://www.biointeractive.org/classroom-resources/coding-sequences-dna

How Stuff Works. "How DNA Profiling Works" https://science.howstuffworks.com/dna-profiling.htm

Innocence Project http://www.innocenceproject.org

Learn Genetics: https://learn.genetics.utah.edu.

Insert links to articles, tutorials, videos, Ted Talks from the bibliography to your digital textbook using MindTap!

MIT Technology Review. "More Than 26 Million People Have Taken an At-Home Ancestry Test." www.technologyreview.com

National Forensic Science Technology Center www.nfstc.org

Forensic DNA Education for Law Enforcement Decision Makers https://projects.nfstc.org/fse/index.html

Principle of Forensic DNA for Officers of the Court https://projects.nfstc.org/otc/

Teaching Resources https://projects.nfstc.org

NIJ Multi Media Resources for NIJ's Forensic DNA Training Courses https://nij.ojp.gov/multimedia-resources-nijs-forensic-dna-training-courses

NIST https://strbase.nist.gov/training.htm

Steffen, Becky, Vallone, Peter, Romsos, Erica, Coble, Michael. "Countdown to 2017: Internal Validation of the New CODIS Loci." ("Meet the New Loci") Oct 15, 2015.

Parabon https://snapshot.parabon-nanolabs.com

"Workflow of Parabon Snapshot Investigation" https://snapshot.parabon-nanolabs.com/workflow (3 minutes)

"Snapshot Genetic Genealogy" https://snapshot.parabon-nanolabs.com/genealogy

"How it Works", https://snapshot.parabon-nanolabs.com/intro

- Genetic geneology
- DNA phenotyping
- Ancestry determination
- Kinship inference
- Forensic art enhancement
- Facial and skull reconstruction

TED Talks

Claes, Peter. "Predicting Faces from DNA." (15:47 minutes)

Sabatini, Riccardo. "How to Read the Genome and Build a Human." (15:29 minutes)

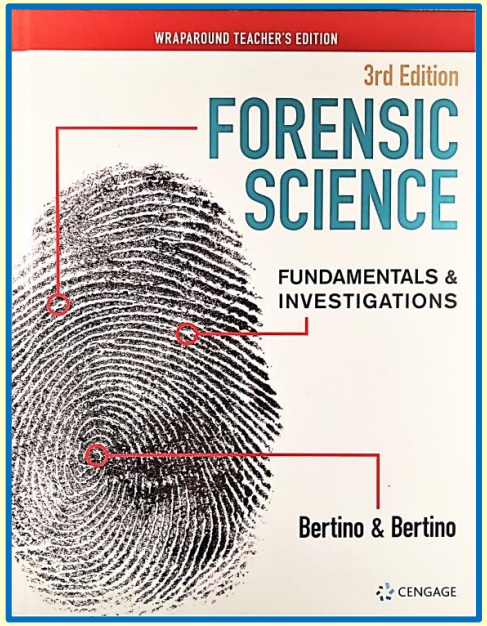
Watson, James. "How We Discovered DNA." (20 minutes)

YouTube

Andersen, Paul. "DNA Fingerprinting", https://www.youtube.com/watch?v=DbR9xMXuK7c (6:10 minutes)

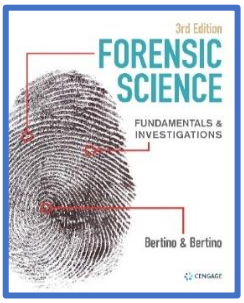
"Introduction to Parabon Snapshot DNA Phenotyping Service." (3 minutes). https://youtu.be/Ln-1-WysCbw

Search YouTube for tutorials on Electropherograms and How to Read SNP Profiles



For more information contact the authors at

www.BertinoForensics.com



Student Learning Objectives (SLOs) Introduction

***Forensic Science: Fundamentals and Investigations,* 3rd edition**

by Bertino and Bertino

National Geographic Learning| Cengage: ngl.cengage.com

Student Learning Objectives: Additional Support for Students

Student Learning Objectives (SLOs) are single concept, testable skills that are expected outcomes of each topic of study. Teachers and students should use SLOs throughout the course. We recommend that teachers ask students to review the objectives related to information already discussed in class for 10 minutes every few days. This allows the teacher to do frequent, brief, on-going assessments and identify misconceptions, allowing the teacher to modify instruction. It also ensures that students understand the basics before advancing to the more complex topics.

Teachers are encouraged to have students work in small collaborative learning groups to review the objectives. The small-group collaboration encourages the more reserved students to comfortably ask questions and orally express their comprehension of the concepts. Additionally, it allows students who are more confident in their comprehension of the topics to assist other students.

Remote Learning and Student Learning Objectives

The SLOs follow the sequence of topics found in the text and the accompanying lesson plans. This can be especially useful for teachers who have students working remotely from home. Teachers can assign specific sections of the chapter and the objectives that correspond them. The objectives help students to focus on the main ideas of the text to improve and enhance their comprehension.

Heterogeneously Grouped Forensic Science Classes

Most high school forensic science classes are composed of heterogeneously grouped students with different ranges of ability. Teachers can easily tailor the extensive list of SLOs to best suit the needs of students. The Word document enables teachers to easily delete objectives or include additional objectives. By changing the verb, teachers can modify the level of the SLO to a higher-level objective.

Student Learning Objectives: Additional Support for Teachers

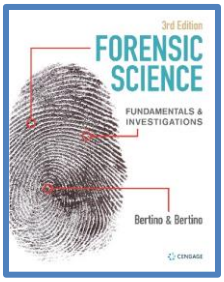
The SLOs, along with the Lesson Plans, provide guidance for teachers by outlining each chapter in a logical sequence and identifying learning outcomes for students. We understand that many first-time forensic teachers do not have formal forensic science training. By reviewing the SLOs and the Lesson Plans, first-time forensic teachers can map out their own forensic science syllabus and lesson plans.

Student Learning Objectives: An Assessment Tool

Use the SLOs as a source for developing higher order thinking questions for testing. Inform students that some of the longer response test questions will be selected from the SLOs. Students are more interested in reviewing the objectives knowing that the review helps them to not only understand the content, but the review will also improve their test grades. Student success in your forensic science class builds their confidence in their abilities to do math and science!

Chapter 6 Fingerprinting

Forensic Science*: Fundamentals and Investigations, 3rd ed.,* Bertino & Bertino, 2021



Student Learning Objectives

At the conclusion of this chapter, the student should be able to:

INTRODUCTION

_____ 1. Describe how technology has impacted fingerprinting analysis.

THE HISTORY OF FINGERPRINTING

_____ 2. Briefly discuss the history of fingerprinting as a means of individual identification. Include in your answer:
   a. early evidence of fingerprinting.
   b. recognition of distinct fingerprint ridges as a means of identification.
   c. Bertillion method of personal identification.
   d. ten card.
   e. increasing use of technology.

_____ 3. Explain and provide examples of new biometric means of identification.

_____ 4. Describe the advances in fingerprint identification using each of the following:
   a. IAFIS (Integrated Automated Fingerprint Identification System)
   b. NGI (Next Generation Identification)

THE SCIENCE OF FINGERPRINTS

_____ 5. Describe dermal or friction ridges found on fingers, palms, toes, feet and state their function.

_____ 6. List the materials secreted by the sweat glands in your fingerprint ridges that result in leaving a fingerprint on a surface.

_____ 7. Label a diagram of human skin. Include in your diagram:
   a. epidermis
   b. dermis
   c. sweat gland
   d. oil gland
   e. hair follicle
   f. pores

_____ 8. Discuss fingerprint ridge development. Include in your answer:
   a. When do fingerprints form?
   b. What layer of the skin forms fingerprint ridges?
   c. What influences the development of fingerprint ridges?

_____ 9. Explain why identical twins may have identical DNA but do not have identical fingerprints.

_____ 10. Describe changes that may occur to fingerprints over time and their significance to forensic fingerprint identification.

CHARACTERISTICS OF FINGERPRINTING

TYPES OF FINGERPRINTS

_____ 11. Define and provide an example of the three types of fingerprints that could be found at a crime scene. Explain how each fingerprint type is formed.
a. Latent
b. Patent
c. Plastic

_____ 12. Distinguish among latent, plastic, and patent fingerprints in terms of:
a. Which forms of fingerprints are visible to the naked eye?
b. Which can be seen if the hands come in contact with blook, paint, grease and then transfers the fingerprint to another surface?
c. Which one has to be made visible using powders or other enhancers?
d. Which can be seen as in an impression in soft materials such as clay, soap, or putty?

BASIC RIDGE PATTERNS

_____ 13. Distinguish among the three basic types of fingerprints ridge patterns: *loops, whorls* and *arches*. Include in your answer:
a. direction of the ridge patterns.
b. general shape of the ridge patterns.

_____ 14. Describe a *delta* ridge pattern within a fingerprint. Include a description of the ridge pattern around the delta.

_____ 15. Compare the number of deltas found in each of the following ridge patterns and describe how this is used to identify fingerprints:
a. arch
b. loop
c. whorl loop

_____ 16. Describe the *core* of a loop or whorl pattern ridge pattern.

_____ 17. Demonstrate how a *ridge count* in a fingerprint is obtained using the core and a delta. Explain the significance of a ridge count in forensic analysis of fingerprints.

Subdivisions of Ridge Patterns

_____ 18. Identify the following fingerprint variations:
   a. plain arch
   b. tented arch
   c. plain whorl
   d. central pocket loop whorl
   e. radial loop
   f. ulnar loop
   g. double loop

_____ 19. Explain how to distinguish among the following fingerprint ridge patterns:
   a. plain whorl pattern and a central pocket loop whorl fingerprint pattern
   b. double loop whorl and an accidental whorl
   c. plain arch and a tented arch

_____ 20. Describe the difference between an ulnar loop and a radial loop.

Minutiae and Fingerprint Identification

_____ 21. Discuss the significance of minutiae patterns in fingerprint analysis.

_____ 22. Given a reference sheet and several fingerprints, be able to identify the following fingerprint minutiae patterns in fingerprints:

a. island	e. ridge ending
b. hook or spur	f. bridge
c. bifurcation	g. delta
d. double bifurcation	h. dot

Collection and Documentation of Fingerprints

_____23. Describe the type of training required to become a fingerprint CSI.

_____ 24. Describe the proper procedures involved in documenting and photographing fingerprint evidence. Include in your answer:
   a. What is the role of lasers or LED devices in locating fingerprints?
   b. Are photos taken with and without powders or enhancers, or are photos taken with just the enhancers or powders?
   c. Why are photos taken both close up and from a distance?
   d. Besides taking the photo, describe how and when each photo is documented.

_____ 25. Describe the technique used to make latent fingerprints visible using powders or stains and a fingerprint brush or magnetic wand.

_____ 26. State the substances that react with the following chemicals in latent fingerprints to enhance the print:
   a. cyanoacrylate vaper (super glue)
   b. iodine fuming
   c. silver nitrate
   d. ninhydrin

_____ 27. Explain how to use tape to lift a fingerprint to preserve the print.

_____ 28. Describe two things that must occur prior to collecting a patent fingerprint.

_____ 29. Explain why it's important to dry plastic prints before collecting the print.

_____ 30. Describe an alternative procedure for collecting a plastic print that does not involve bringing in the entire plastic print.

_____ 31. Analyze an inked fingerprint or ten card using fingerprint characteristics.

_____ 32. Describe a ten card of fingerprints and describe how it is produced.

_____ 33. Distinguish among the various powders used to lift a fingerprint:
   a. Explain when to use a dark-colored powder vs. a light-colored powder.
   b. Compare and contrast the use of magnetic powders vs. non-magnetic powders.

FORENSIC ANALYSIS OF FINGERPRINTING

_____ 34. Analyze fingerprints and ten cards using the characteristics described in this chapter including:
   a. type of ridge pattern
   b. identification of minutiae patterns
   c. presence or absence of deltas or core patterns
   d. unique scar tissues

_____ 35. Discuss why a fingerprint expert analyst is needed at the beginning of the analysis, as well as, at the end of the analysis.

_____ 36. Discuss changes to fingerprint identification and storage in 1999 with the introduction of *IAFIS* (Integrated Automatic Fingerprint Identification Systems). Include in your answer:
   a. how computerized analysis is more objective, reliable, and valid
   b. digital fingerprint searches
   c. electronic storage of fingerprint files containing large databases

_____ 37. Summarize the fingerprint analysis improvements of the 2011 *NGI* (Next Generation Identification). Include in your answer:
   a. latent searches
   b. mobile fingerprint identification
   c. biometric identification
   d. ability to easily and quickly share information locally, nationally, and internationally

_____38. Discuss how computers use algorithms to compare fingerprints rather than to find individual minutiae patterns. Include in your answer:
   a. What is an algorithm as used for fingerprint analysis?
   b. What type of mathematical calculations are made within the algorithm?
   c. How has the use of algorithms improved the speed and reliability of fingerprint identification?
   d. Have computerized algorithms replaced fingerprint experts?

_____ 39. Describe the role of population databases and statistical analysis of fingerprints for improved evidence reliability.

_____ 40. Discuss the role of technology in analyzing fingerprints. Include in your answer:
   a. image enhancers of fingerprints
   b. scanners to identify and mark minutiae
   c. software used for measurements within a fingerprint

_____ 41. List suggestion made by the SWG and OSAC organization to improve fingerprint analysis and expert witness testimony.

_____ 42. Compare and contrast the reliability and validity of fingerprint evidence analysis as performed by fingerprint experts vs. fingerprint analysis performed using mostly technology.

_____ 43. Describe the effect of someone trying to permanently alter their fingerprints.

ADVANCES IN FINGERPRINTING

_____ 44. Explain how technology has improved fingerprint sweat pore analysis.

_____ 45. Discuss how fingerprint analysis is being used to obtain:
   a. trace amounts of DNA
   b. trace amounts of explosives

ACTIVITIES

_____ 46. Analyze fingerprints to:
   a. Determine if the fingerprints are loops, whorls or arches.
   b. Determine if the fingerprint represents a specific subdivision of loops, whorls, or arches.
   c. Identify minutiae patterns found in the fingerprint.
   d. Claim whether or not the suspect can be excluded or included based on your fingerprint analysis and support your answer with evidence from your analysis.

_____ 47. Dust latent fingerprints using magnetic or ink powders or enhancers.

_____ 48. Lift an enhanced latent fingerprint using tape and:
   a. graphite
   b. fingerprint ink
   c. fingerprint powders

_____ 49. Design an experiment to collect plastic fingerprints from a surface and analyze the fingerprint.

_____ 50. Photograph, document, and collect latent, patent, and plastic fingerprints.

_____ 51. Prepare and analyze the fingerprints on a ten card.

_____ 52. Given a partial crime-scene fingerprint and fingerprints of suspects, determine if any suspects' fingerprints are consistent with the crime-scene fingerprint. Support your claim using evidence found in the fingerprints.

_____ 53. Use cyanoacrylate to recover latent fingerprints.

A Note About the Lesson Plans

Forensic Science: Fundamentals and Investigations 3rd ed.

Anthony (Bud) Bertino and Patricia Nolan Bertino www.BertinoForensics.com rev.1.24.21
National Geographic Learning/ Cengage Learning Tel: (888) 915-3276

Due to the variability in which a forensic science course may be taught, time allotments – allocations for the amount of time required for a particular topic or chapter– were not included in the Lesson Plans.

Time dedicated to topics and chapters will vary based on student background, grade level and abilities, as well as length of course and depth of coverage. Forensic science is a course that can be modified to accommodate middle school students to high school AP students. Therefore, it is important to consider the heterogenous nature and the unique needs of your forensic science class when planning out your lessons.

Along with the Lesson Plans, there are many other tools on the Companion Site to assist you with your lesson planning, including:

- PowerPoint® presentations
- Student Learning Objectives
- leveled assessments
- activity worksheets and teacher notes
- additional activities
- standard correlations
- additional resources

Be sure to refer to the Wrap Around Teacher's Edition, which is full of teaching tips located in the side margins. Look for headings such as Engage, Enrich, Explore, Teach, Assess, Activity and Capstone Project. These tips are provided to help you:

- introduce topics
- motivate and capture the interest of your students
- provide you with guidance on how to teach a difficult concept
- locate additional enrichment or online activities to enhance student learning
- identify where in the lesson to introduce the various activities

Additionally, Differentiated Learning tips address the needs of a heterogeneously grouped forensic class consisting of accelerated students, students in need of additional support, and English-language learners.

We encourage you to review these materials and any accompanying instructions prior to implementing them in your course.

Chapter 6: Fingerprints

Preparation:

These lesson plans are designed to help guide you in preparing your lessons for your forensic science course, including classroom and lab time. A correlating PowerPoint presentation is also available to help engage students in the classroom. In addition to these Lesson Plans, we encourage you to refer to the Wraparound Teacher's Edition which contains additional information intended to assist you in teaching the topics introduced in this chapter. It includes background information, ways to engage students and enrich the learning experience, and explains how to differentiate learning for a heterogenous class. Review this additional information, found in the margins of the Wraparound Teacher Edition, when preparing to present your lesson.

Learning Objectives:

Covered in Lesson Plan

6.1 Summarize the history of fingerprinting including the development of new systems used in fingerprint analysis and identification.
6.2 Describe fingerprints and how they are formed.
6.3 Describe different characteristics and types of fingerprint patterns.
6.4 Describe the proper procedures involved in collecting and documenting fingerprint evidence.
6.5 Explain how fingerprints are analyzed and the reliability of fingerprint identification.
6.6 Discuss advances in fingerprinting that have enhanced the analysis and reliability of fingerprints in identifications.

Covered in Activities

6.7 Lift a latent print using different methods to analyze the print's ridge and minutiae patterns. (Activities 6-1, 6-2, and 6-7)
6.8 Distinguish among latent, plastic, and patent fingerprints. (Activity 6-3)
6.9 Prepare a ten card and analyze the ridge patterns of the prints. (Activity 6-4)
6.10 Analyze a fingerprint to determine if it is consistent with a fingerprint on record. (Activities 6-5 and 6-6)

Key Terms Introduced:

- **arch** a fingerprint pattern in which the ridge pattern originates from one side of the print and continues to the other side
- **biometrics** uses measurements and statistical analyses of someone's physical characteristics to aid in their identification
- **core** a center of a loop
- **delta** a triangular ridge pattern created when ridge patterns diverge

- **fingerprint** an impression left on any surface that consists of patterns made by the ridges on a finger
- **Integrated Automated Fingerprint Identification System (IAFIS)** FBI-developed national database of more than 76 million criminal fingerprints and criminal histories
- **latent fingerprint** a concealed fingerprint that is made visible through the use of powders or forensic techniques
- **loop** a fingerprint pattern in which the ridge pattern flows inward and returns in the direction of the origin
- **minutiae** the combination of details in the shapes and positions of ridges in fingerprints that makes each unique; also called ridge characteristics
- **patent fingerprint** a visible fingerprint produced when fingers coated with blood, ink, or some other substance touch a surface and transfer their print to that surface
- **plastic fingerprint** a three-dimensional fingerprint made in soft material such as clay, soap, or putty
- **ridge count** the number of ridges between the center of a delta and the core of a loop
- **ridge pattern** the recognizable pattern of the ridges found in the end pads of fingers that form lines on the surfaces of objects in a fingerprint. They fall into three categories: arches, loops, and whorls. They are also visible on the soles of feet and bottoms of toes
- **ten print card** a form used to record and preserve a person's fingerprints
- **whorl** (plain whorl) a fingerprint pattern that resembles a bull's-eye

References: Refer to chapter bibliography and Internet resources

Suggested readings for students:

Forensic Science: Fundamentals and Investigations. 3rd ed., Bertino & Bertino

Search the Internet for "FBI-Latent Print of the Year 2012" and read how a cold case was solved using IAFIS.

I. Introduction

A. Analyzing fingerprint evidence today involves far more than looking at the fingerprints left at a crime scene.
B. As technology has advanced, so has the world of fingerprint analysis.
C. Today, law-enforcement officers can quickly and easily submit fingerprints to a national database and obtain the identity of a suspect if their prints were entered into the database.
D. Although fingerprints are mostly considered individual evidence, biometrics have improved the ability to establish one's identity.

Reference: *Forensic Science*, p. 192
Slide: 6-2 and 6-3

II. The History of Fingerprinting

Learning Objective 6-1: Summarize the history of fingerprinting including the development of new systems used in fingerprint analysis and identification.

A. Ancient interest in fingerprints
   1. Chinese use fingerprints and palm prints pressed into clay for official seals and legal documents in the third century BC
   2. Fingerprints pressed into clay tablet contracts date to Babylon 1792–1750 BC
   3. In ancient China, inked fingerprints on all official documents were common practice
B. Western Culture
   1. 1684
      a. Earliest record of the study of the patterns on human hands
   2. 1788
      a. Johann Christoph Andreas Mayer described "the arrangement of skin ridges is never duplicated in two persons"
   3. 1800s
      a. 1823: Jan Evangelist Purkinje described nine distinct fingerprint patterns
      b. 1856: Sir William Herschel noted that fingerprint patterns were unique to each person and not altered by age
      c. 1896: New system created with all 10 fingerprints of a person on a card; now called ten print card
   4. 20th century
      a. 1902: Fingerprints replaced the Bertillon measurements for identification
      b. 1980: AFIS used by individual states
      c. 1999: IAFS replaced manual fingerprint searching

5. 21st century
    a. 2011: NGI launched matching algorithmic patterns in its AFIT; launch of RISC
    b. 2013: NGI implemented palm and hand edge prints
    c. 2014: NGI added facial recognition and added Rap Back
    d. 2015: NGI included iris and identification examination in addition to scars, marks, and tattoos
    e. 2018: EBTS implementation; will ultimately contain complete biometric and biographical profiles

Reference: *Forensic Science*, pp. 192-194
Slides: 6-4 and 6-5

III. The Science of Fingerprints

Learning Objective 6-2: Describe fingerprints and how they are formed.

A. Ridges on fingers
    1. Raised portions of skin
    2. Arranged in connected units
        a. Dermal, or friction, ridges
    3. Leave marks when pressed against things
        a. Impression is called a fingerprint
        b. Consist of secretions from skin and dirt
        c. Considered individual evidence
B. Formation of fingerprints
    1. Patterns are formed during the 10th week of gestation
        a. Similar ridges form on palms and sides of hands, soles of feet and toes
    2. Ridge patterns
        a. Found on end pads of fingers
        b. Form lines on the surfaces of objects
        c. Grow in the basal layer
        d. May be altered by scars with damage to the dermal layer

Reference: *Forensic Science*, p. 195
Slides: 6-6 and 6-7

IV. Characteristics of Fingerprints

Learning Objective 6-3: Describe different characteristics and types of fingerprint patterns.

A. Types of fingerprints
    1. Patent fingerprints

a. Visible prints
2. Plastic fingerprints
   a. Actual indentations left in a soft material
3. Latent fingerprints
   a. Not visible to the unaided eye
   b. Can be made visible (developed)
      i. Dusting with powders
      ii. Lifting by using tape or adhesive lifter

B. Basic ridge patterns
1. Named for their general visual appearance
   a. Loops (about 65 percent of population)
   b. Whorls (about 30 percent of the population)
      i. Plain whorl (24 percent)
      ii. Central pocket loop whorl (2 percent)
      iii. Double loop whorl (4 percent)
      iv. Accidental whorl (0.01 percent)
   c. Arches (about 5 percent of the population)
      i. Plain arch (4 percent)
      ii. Tented arch (1 percent)
2. Ridge count is the number of ridges between the core and center of the delta
   a. The core is the center of a loop or whorl
   b. A delta is a triangular ridge pattern

C. Minutiae and fingerprint identification
1. Unique ridge characteristics details
   a. Number and location of minutiae create a unique signature
   b. About 150 individual characteristics are on a full print
2. Minutiae patterns
   a. Ridge ending (including broken ridge)
   b. Fork (or bifurcation)
   c. Island ridge (or short edge)
   d. Bridge
   e. Spur (or hook)
   f. Eye (enclosure or island)
   g. Double bifurcation
   h. Delta
   i. Trifurcation

Reference: *Forensic Science*, pp. 195-198
Activities: Activity 6-1, Activity 6-2, and Activity 6-5
Slides: 6-8 through 6-10

V. Collection and Documentation of Fingerprints

Learning Objective 6-4: Describe the proper procedures involved in collecting and documenting fingerprint evidence.

A. Training for CSIs
   1. Where to look for fingerprint evidence
   2. Identifying different types of fingerprints
   3. Type of lighting, powders, or chemicals should be used to enhance the fingerprint
   4. How to photograph and document each fingerprint

B. Photographing fingerprints
   1. Using alternative light sources
      a. Lasers
      b. LED devices
   2. Photographing *in situ* before lifting

C. Methods of collection
   1. Collecting latent fingerprints
      a. Enhancing the print
         i. Dusting with carbon or magnetic powder
         ii. Using fluorescent dye stains or powders
      b. Lifting the print
         i. Using tape
   2. Collecting patent prints
      a. Patent or visible prints found in blood or ink
      b. Immediately photographed
      c. Source is dried and bagged
   3. Collecting plastic prints
      a. Appear as indentations on soft items
      b. First photographed
      c. Source collected and cast if necessary
   4. Collecting suspect prints
      a. Rolling each of the 10 fingers in ink
      b. Rolling them onto a ten print card

Reference: *Forensic Science*, pp. 199-200
Activities: Activity 6-3, Activity 6-4, and Activity 6-7
Slides: 6-11 through 6-13

VI. Forensic Analysis of Fingerprinting

Learning Objective 6-5: Explain how fingerprints are analyzed and the reliability of fingerprint identification.

A. Initial assessment

1. Made by fingerprint expert
2. Determines if fingerprint has adequate quality and quantity of features

B. Automated fingerprint searches
   1. 1999: IAFIS
      a. Digital fingerprint searches
      b. Latent print searches
      c. Electronic storage of fingerprint photo files
      d. Electronic exchange of fingerprints
      e. Operates 24 hours a day, 365 days a year
   2. 2011: FBI's NGI
      a. Enhanced and will ultimately replace IAFIS
      b. Improved automated fingerprint, latent capabilities, mobile fingerprint identification, and electronic storage
      c. Incorporated biometrics, facial recognition, iris scans, and palm and hand edge prints
   3. 2019: RISC
      a. NGI contained Repository for Individuals of Special Concern with 5 million sets of fingerprints
      b. Over 24,000 law-enforcement agencies submit fingerprints and other identify information to NGI
   4. Today
      a. Most fingerprints are compared using technology first
         i. Image enhancement algorithms
         ii. Scanners used to identify and mark minutiae points
         iii. Software to calculates distances and angles between key minutiae points
      b. Final comparisons are made by an expert
         i. Today, there has been a 90 percent reduction in the number of manual fingerprint reviews

C. Fingerprint reliability and validity
   1. Subjectivity of the examiner
      a. Problem of fingerprint evidence analysis in the past
      b. Led to creation of SWGs
         i. Ensure high standards of evidence evaluation
         ii. Became OSAC in 2014
   2. Recommendations made by SWG and OSAC
      a. Results need to be double-checked
      b. Language for trials needs to be standardized
         ii. Conclusions can be: exclusive, inclusive, or inconclusive

D. Altering or disguising fingerprints
   1. John Dillinger
      a. Put acid on his fingertips to change their appearance
      b. Based on Cuban pineapple field workers
         i. Did not have readily visible fingerprints
         ii. Effects of working with pineapple plants was temporary

2. Fingerprints from Dillinger's body
    a. Had grown back even after putting acid on them
    b. Allowed him to be identified

Reference: *Forensic Science*, pp. 201-203
Activities: Activity 6-6 and Capstone Project 3
Slides: 6-14 through 6-17

VII. Advances in Fingerprinting

Learning Objective 6-6: Discuss advances in fingerprinting that have enhanced the analysis and reliability of fingerprints in identifications.

A. New technology
    1. Significantly improved fingerprint analysis
        a. Speed, accuracy, and reliability
    2. Scanning technology and digital systems of identifying patterns
        a. Algorithm that automates and standardizes the key first step
        b. Assesses a fingerprint's quality and quantity for usability
    3. Analysis of trace amounts of DNA found in fingerprints
        a. Fingerprints contain sweat that can be chemically analyzed
        b. Can determine if explosive or chemicals were handled
    4. Molecular fingerprint
        a. Technology under development
        b. May be able to tell us much more about the lives of the fingerprint donor than just identity

Reference: *Forensic Science*, pp. 203-204
Slide: 6-18

VIII. Summary

- Humans have noticed the patterns on their hands for thousands of years, but it was not until 1684 that these patterns were described in detail. In the mid-1800s, the idea of a fingerprint's uniqueness was studied, and the application of fingerprints to an identification system began. By the late 1800s, two effective systems were being used to identify criminals, and fingerprints were being collected as evidence in crimes. In the past 20 years, improvements in technology have improved fingerprint analysis and reliability.
- The elevated regions in the skin of the finger are called friction ridges formed early in development between two layers of skin. Unique to individuals, their shape does not change during their lifetime.
- Fingerprints left on an object are created by the naturally occurring ridges in the skin of fingertips and secretions from sweat glands that

leave small amounts of oils and salts when the ridges are pressed against an object. The residues leave a reproduction of the ridges found on the finger of the donor.

- Fingerprints found at a crime scene are latent, not easily seen without the addition of powders or chemical; plastic prints are found embedded in soft materials; patent prints are formed when fingers come in contact with a material and are transferred to a surface.
- Fingerprint patterns are classified as loops, whorls, and arches. A core is the center of a loop or whorl. A delta is a triangular region where the ridges diverge. Ridge counts, measured from the center of the delta to the center of a core, provide distinguishing characteristics of fingerprints. The three basic patterns of fingerprints can be further subdivided into more specific subcategories.
- Minutiae patterns are small distinguishing features used to analyze fingerprints.
- Prior to advancements in scanners, fingerprint analysis was a very slow process undertaken by a fingerprint expert that was not always reliable.
- Criminals have sought to alter their fingerprints with chemicals, surgery, and superficial destruction. Some fingerprints can temporarily be altered by long-term contact with rough surfaces. Attempts at permanent fingerprint alteration have been painful, leaving mutilated, deformed, and even more recognizable fingerprints than the original fingerprints.
- Fingerprints must be properly collected and documented to be an acceptable evidence. Both the SWG and OSAC have developed standards and protocols to improve fingerprint evidence reliability and validity.
- Fingerprint collection and documentation may involve dusting with specialized powders or chemicals, casting of plastic prints, and photographing the print.
- Today, much of fingerprint analysis is automated. Fingerprints of suspects can be quickly scanned and compared to a national FBI database of over 149 million fingerprints.
- Mobile handheld scanners obtain fingerprints of suspects, forward them to the national database. Within minutes, the police officer knows if the suspect has an open warrant for arrest, is on a terrorist or sex offender list, or has previously committed crimes.
- New technology continues to improve fingerprint analysis through machine learning to access usability of prints and improved scanning technologies using nanoparticles for pore analysis.
- New uses of fingerprints include DNA analysis and chemical analysis of the sweat found in prints using infrared spectromicroscopy to detect evidence of what donor touched or consumed.

- Fingerprint analysis has become less subjective, faster, and more reliable with advances in technology. AFIT's use of algorithms and NGI's inclusion of palm prints, rapid ID in the field, and biometrics have improved both reliability and validity of fingerprint analysis.

Reference: *Forensic Science*, pp. 204-205
Slides: 6-19 through 6-22

IX. Assignment – Review Chapter 7 and reference accompanying teacher notes in the Wraparound Teacher's Edition of *Forensic Science, 3e*.

Bertino & Bertino, Forensic Science Fundamentals & Investigations, 3e
2020
MindTap Asset Description

Activity	How many?	What is it?	Seat time?	Why it matters?
The Scenario	Every Chapter	These passages are real-life scenarios drawn from the news.	5-10 minutes	The passages provide context for lessons students will be exposed to in each chapter.
Introduction	Every Chapter	This section provides background information to introduce students to the concepts in the chapter, and houses the learning objectives, and Key Terms	10 minutes	This section helps to orient students to the lessons they will be exposed to in the chapter. It also helps to familiarize students with Key Terms, which are critical to comprehension.
Chapter Readings	Every Chapter	This is the chapter content. All content found in the printed text also lives in the chapter. There are also valuable study tools like highlighting, note taking, dictionary, flashcards, ReadSpeaker, and more.	45 – 60 minutes	Readings cover background information essential to successfully completing other assignments, activities and quizzing, providing the students with a complete understanding of the topics.
Overview	Every Chapter	This is a PowerPoint review of the concepts taught in every chapter.	10 minutes	This section provides a summary to help students prepare for the chapter assessment.

Case Studies	Every Chapter	These real-life case studies bring to life the concepts taught in each chapter.	10 minutes	The case studies provide context and a deeper level of understanding to the topics introduced in the chapter.
Careers in Forensics	Every Chapter	These career profiles highlight a professional at work in a field related to the chapter topic.	5-10 minutes	In reading about the daily work life of professionals in various career paths, students are given authentic opportunities to delve deeper into the concepts and potential careers in the field.
Bibliography	Every Chapter	The bibliography includes books, journals, and internet resources referenced to in the text.	Varies by student.	The bibliography provides students with the opportunity to research content areas of interest in order to expand their learning.
Flashcards	Every Chapter	Flashcards are a study tool for students that include key terms with accompanying definitions, and in certain cases, images for visual identification of concepts.	Varies by student.	Flashcards enable students to study at their own pace and learn the terms necessary for effective communication. As applicable, images provide a visual representation of the concept in order to facilitate learning.
Matching (Learning the Lingo)	Every Chapter	This matching activity prompts students to match key terms from the chapter to the correct corresponding definition.	10-15 minutes	These activities provide meaning for critical concepts and strengthen knowledge of industry terms in

				order to be able to communicate effectively. (Default: Practice)
True False Activity (Fact or Fiction?)	Every Chapter	This true false quiz evaluates student knowledge of the key facts presented in the chapter.	10-15 minutes	This quiz enables instructors to monitor and evaluate student knowledge of specific concepts. For the student, it highlights any areas that may require further study. (Default: Practice)
Multiple Choice (What is Missing?)	Every Chapter	This multiple-choice quiz allows students to demonstrate their knowledge of the main concepts presented in the chapter.	10-15 minutes	This activity enables students to review the key concepts in each chapter and to strengthen their understanding of the concepts presented. (Default: Practice)
Final Analysis	Every Chapter	This multiple-choice quiz evaluates student knowledge of the information presented in the chapter. The grade feeds the MindTap gradebook.	10-15 minutes	This chapter end quiz is the guide by which the teacher can evaluate student mastery of the concepts presented in the chapter as compared with the level of engagement in other chapter assignments and activities. (Default: Counts Toward Grade)

Topic/Chapter	MindTap Assignments	Points
Chapter 1: Forensic Science and Observation	• Chapter 1: The Scenario	• NA
	• Chapter 1: Forensic Science and Observation	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 1: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 1: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 2
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 1: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 1-1: Learning to See	• 10
	○ Activity 1-1: WKST Photo 1	• 10
	○ Activity 1-1: WKST Photo 2	• 10
	○ Activity 1-1: WKST Photo 3	• 10
	○ Activity 1-2: You're an Eyewitness!	• 10
	○ Activity 1-2: WKST Jane's Questions	• 10
	○ Activity 1-2: WKST Jane's Restaurant	• 10
	○ Activity 1-3: What Influences Our Environment?	• 10
	○ Activity 1-3: WKST Form A	• 10
	○ Activity 1-3: WKST Form B	• 10
	○ Activity 1-3: WKST Observations	• 10
	○ Chapter 1: Observations Skills Interactive Lab	• NA
	• Chapter 1: Final Analysis	• 20
Chapter 2: Crime-Scene Investigation and Evidence Collection	• Chapter 2: The Scenario	• NA
	• Chapter 2: Crime-Scene Investigation and Evidence Collection	• NA
	○ Introduction	• NA
	○ Reading	• NA

	○ Overview	• NA
	• Chapter 2: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 2: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 4
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 2: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 2-1: Locard's Principle of Exchange	• 10
	○ Activity 2-1: WKST Paper Bindle	• 10
	○ Activity 2-1: WKST Evidence Inventory Label	• 10
	○ Activity 2-1: Evidence Markers	• 10
	○ Activity 2-1: Mini Notebook	• 10
	○ Activity 2-1: Site and Evidence Form	• 10
	○ Activity 2-1: Trace Evidence Data Table	• 10
	○ Activity 2-1: First Responder Checklist	• 10
	○ Activity 2-1: Recorder Checklist	• 10
	○ Activity 2-1: Artist Checklist	• 10
	○ Activity 2-1: Photographer Checklist	• 10
	○ Activity 2-1: Evidence Collector Checklist	• 10
	○ Activity 2-2: Crime-Scene Investigation	• 10
	○ Activity 2-2: WKST Paper Bindle	• 10
	○ Activity 2-2: WKST Evidence Markers	• 10
	○ Activity 2-2: WKST Mini Notebook	• 10
	○ Activity 2-2: WKST Evidence Inventory Label	• 10
	○ Activity 2-2: WKST Evidence and Site Form A	• 10
	○ Activity 2-2: WKST Evidence and Site Form B	• 10
	○ Activity 2-2: WKST First Responder Checklist	• 10
	○ Activity 2-2: WKST Recorder Checklist	• 10
	○ Activity 2-2: WKST Sketch Artist Checklist	• 10
	○ Activity 2-2: WKST Photographer Checklist	• 10

	○ Activity 2-2: WKST Evidence Collector Checklist	• 10
	○ Chapter 2: Crime-Scene Investigation Interactive Lab	• 10
	• Chapter 2: Final Analysis	• 10 • 20
Chapter 3: Hair Analysis	• Chapter 3: The Scenario	• NA
	• Chapter 3: Hair Analysis	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 3: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 3: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 3
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 3: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 3-1: Trace Evidence: Hair	• 10
	○ Activity 3-1: WKST Data Tables 1 and 2	• 10
	○ Activity 3-1: WKST Form A (Scientific Method)	• 10
	○ Activity 3-1: WKST Form B (Claim-Evidence-Reasoning)	• 10
	○ Activity 3-2: Hair Measurement	• 10
	○ Activity 3-2: WKST Hair Measurement	• 10
	○ Activity 3-3: Hair Testimony Essay	• 10
	○ Chapter 3: Study of Hair Interactive Lab	• NA
	Chapter 3: Final Analysis	• 20
Chapter 4: Fiber Analysis	• Chapter 4: The Scenario	• NA
	• Chapter 4: Fiber Analysis	• NA
	○ Introduction	• NA
	○ Reading	• NA

	○ Overview • Chapter 4: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography • Chapter 4: Examining the Facts – What Do You Know? ○ Flashcards ○ Learning the Lingo ○ Fact or Fiction? ○ What is Missing? • Chapter 4: Examining the Evidence – What Do You Observe? ○ Activity 4-1: Microscopic Fiber Analysis ○ Activity 4-1: WKST Data Table ○ Activity 4-2: Bedsheet Thread Count ○ Activity 4-2: WKST Data Table ○ Activity 4-3: Weave Pattern Analysis ○ Activity 4-3: WKST Data Table ○ Activity 4-4: Textile Information ○ Activity 4-4: WKST Data Table ○ Activity 4-4: WKST Evidence Label ○ Activity 4-5: Burn Analysis of Fibers ○ Activity 4-5: WKST Data Table ○ Activity 4-5: WKST Burn Test Dichotomous Key ○ Chapter 4: Study of Fiber Interactive Lab • Chapter 4: Final Analysis	• NA • NA • NA • NA • NA • NA • NA • 4 • 10 • 10 • NA • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • NA • 20
Chapter 5: Forensic Botany	• Chapter 5: The Scenario • Chapter 5: Forensic Botany ○ Introduction ○ Reading ○ Overview • Chapter 5: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography	• NA • NA • NA • NA • NA • NA • NA • NA • NA

	• Chapter 5: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 4
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 5: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 5-1: Comparing Suspect Pollen to Crime Scene	• 10
	○ Activity 5-1: WKST Data Table	• 10
	○ Activity 5-2: WKST Student Designed EX	• 10
	○ Activity 5-1: WKST C-E-R	• 10
	○ Activity 5-2: Pollen Expert Witness Presentation	• 10
	○ Activity 5-2: WKST Writing Assignment	• 10
	○ Activity 5-2: WKST Rubric	• 10
	○ Activity 5-3: Botanical Evidence Case Studies Presentation	• 10
	○ Activity 5-3: WKST Botanical Topics	• 10
	○ Activity 5-3: WKST Botanical Planning	• 10
	○ Activity 5-3: WKST Rubric	• 10
	○ Activity 5-4: Processing a Crime Scene for Botanical Evidence	• 10
	○ Activity 5-4: WKST Botany Habitat Sampling Form	• 10
	○ Activity 5-4: WKST Botanical Evidence and Site Form	• 10
	○ Activity 5-4: WKST Evidence Inventory Label	• 10
	○ Activity 5-4: WKST Evidence Marker	
	○ Activity 5-4: WKST First Responder	• 10
	○ Activity 5-4: WKST Recorder	• 10
	○ Activity 5-4: WKST Artist	• 10
	○ Activity 5-4: WKST Photographer	• 10
	○ Activity 5-4: WKST Evidence Collector	• 10
	Compass	• 10
	○ Activity 5-5: Pollen Index	• 10

	○ Activity 5-5: WKST Data Table ○ Activity 5-6: Isolation of Pollen from Honey ○ Activity 5-6: WKST Data Table ○ Chapter 5: Pollen Examination Interactive Lab Chapter 5: Final Analysis	• 10 • 10 • 10 • NA • 20
Chapter 6: Fingerprints	• Chapter 6: The Scenario • Chapter 6: Fingerprints ○ Introduction ○ Reading ○ Overview • Chapter 6: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography • Chapter 6: Examining the Facts – What Do You Know? ○ Flashcards ○ Learning the Lingo ○ Fact or Fiction? ○ What is Missing? • Chapter 6: Examining the Evidence – What Do You Observe? ○ Activity 6-1: Study Your Fingerprints ○ Activity 6-1: WKST Data Table ○ Activity 6-2: Giant Balloon Fingerprint ○ Activity 6-2: WKST Data Table ○ Activity 6-3: Studying Latent and Plastic Fingerprints ○ Activity 6-3: WKST Latent Print ○ Activity 6-3: WKST Plastic Prints ○ Activity 6-4: How to Print a Ten Card ○ Activity 6-4: WKST Ten Card ○ Activity 6-5: Minutiae Patterns ○ Activity 6-5: WKST Minutiae Patterns ○ Activity 6-6: Fingerprint Analysis ○ Activity 6-6: WKST Include or Exclude?	• NA • NA • NA • NA • NA • NA • NA • NA • NA • NA • 3 • 10 • 10 • NA • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10

	○ Activity 6-6: WKST Comparing Suspects' Prints	• 10
	○ Activity 6-7: Using Cyanoacrylate to Recover Latent Fingerprints	• 10
	○ Activity 6-7: WKST Cyanoacrylate Protocol Redesign	• 10
	○ Activity 6-8: WKST Print Variations	• 10
	○ Chapter 6: Studying Latent Fingerprints Interactive Lab	• NA
	Chapter 6: Final Analysis	• 20
Chapter 7: DNA Profiling	• Chapter 7: The Scenario	• NA
	• Chapter 7: DNA Profiling	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 7: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 7: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 5
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 7: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 7-1: Simple DNA Extraction	• 10
	○ Activity 7-1: WKST Data Table	• 10
	○ Activity 7-1: WKST Student Design	• 10
	○ Activity 7-1: WKST C-E-R	• 10
	○ Activity 7-2: The Break-In	• 10
	○ Activity 7-2: WKST DNA Profiles	• 10
	○ Activity 7-3: Anna Anderson or Anastasia? STR Analysis	• 10
	○ Activity 7-3: WKST STR Results	• 10

	○ Activity 7-4: STR Identification of a September 11 Victim	• 10
	○ Activity 7-4: WKST STR Profiles	• 10
	○ Activity 7-5: Identification of the Romanovs Using STR Profiling	• 10
	○ Activity 7-5: WKST STR Genotypes	• 10
	○ Activity 7-5: WKST STR Profile 2006	• 10
	○ Activity 7-5: WKST Romanov Paternal Lineage	• 10
	○ Activity 7-5: WKST STR Y Analysis	• 10
	○ Activity 7-6: Design and Build a Human DNA Structure	• 10
	○ Chapter 7: DNA Profiling Interactive Lab	• NA
	Chapter 7: Final Analysis	• 20
Chapter 8: Blood and Blood Spatter	• Chapter 8: The Scenario	• NA
	• Chapter 8: Blood and Blood Spatter	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 8: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 8: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 3
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 8: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 8-1: A Presumptive Test for Blood	• 10
	○ Activity 8-1: WKST Data Tables	• 10
	○ Activity 8-2: Creating and Modeling Blood-Spatter Patterns	• 10
	○ Activity 8-2: WKST Blood-Spatter Patterns	• 10
	○ Activity 8-2: WKST Peer Review Guidelines	• 10

	○ Activity 8-3: Blood-Spatter Analysis: Effect of Height on Blood Drops	• 10
	○ Activity 8-3: WKST Data Tables	• 10
	○ Activity 8-4: Area of Convergence	• 10
	○ Activity 8-4: WKST Area of Convergence	• 10
	○ Activity 8-5: Blood-Droplet Impact Angle	• 10
	○ Activity 8-5: WKST Data Tables	• 10
	○ Activity 8-6: Area of Origin	• 10
	○ Activity 8-6: WKST Spatter	• 10
	○ Activity 8-7: Crime-Scene Investigation	• 10
	○ Activity 8-7: WKST Data Table	• 10
	○ Activity 8-7: WKST Crime Scene	• 10
	○ Activity 8-8: Antigens and Antibodies	• 10
	○ Chapter 8: Blood and Blood Spatter Interactive Lab	• NA
	Chapter 8: Final Analysis	• 20
Chapter 9: Forensic Toxicology	• Chapter 9: The Scenario	• NA
	• Chapter 9: Forensic Toxicology	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 9: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 9: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 5
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 9: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 9-1: Drug Analysis	• 10
	○ Activity 9-1: WKST Data Table	• 10
	○ Activity 9-1: WKST Evidence Inventory Labels	• 10

	○ Activity 9-2: Should Medical Marijuana Be Legalized in All States?	• 10
	○ Activity 9-2: WKST Debate Strategy	• 10
	○ Activity 9-2: WKST Debate Planning	• 10
	○ Activity 9-3: Drug Spot Test	• 10
	○ Activity 9-3: WKST Data Tables	• 10
	○ Activity 9-4: Urine Prescription Drug Test	• 10
	○ Activity 9-5: ACT: Drug Research and Presentation	• 10
	○ Activity 9-6: Drug Residue on Money	• 10
	○ Activity 9-6: WKST Evidence Inventory Label	• 10
	○ Activity 9-7: Drug Testing Debate	• 10
	○ Activity 9-8: ACT: Toxin Case Study	• 10
	○ Activity 9-9: Pre-Testing, Evidence Reliability and Validity	• 10
	○ Chapter 9: Drug Identification and Toxicology Interactive Lab	• NA
	Chapter 9: Final Analysis	• 20
Chapter 10: Handwriting Analysis, Forgery, and Counterfeiting	• Chapter 10: The Scenario	• NA
	• Chapter 10: Handwriting Analysis, Forgery, and Counterfeiting	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 10: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 10: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 2
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 10: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 10-1: Handwriting Analysis	• 10

	○ Activity 10-1: WKST Data Tables 1 & 2	• 10
	○ Activity 10-2: Analysis of Ransom Note and Report to Jury	• 10
	○ Activity 10-2: WKST Data Tables 1 & 2	• 10
	○ Activity 10-2: WKST Visual Elimination Form	• 10
	○ Activity 10-3: Examination of U.S. Currency: Is It Authentic or Counterfeit?	• 10
	○ Activity 10-3: WKST Data Tables	• 10
	○ Activity 10-4: Landmark Handwriting Cases	• 10
	○ Activity 10-5: President's Signature	• 10
	○ Chapter 10: Handwriting Analysis, Forgery, and Counterfeiting Interactive Lab	• NA
	Chapter 10: Final Analysis	• 20
Chapter 11: Forensic Entomology	• Chapter 11: The Scenario	• NA
	• Chapter 11: Forensic Entomology	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 11: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 11: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 4
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 11: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 11-1: How to Raise Blowflies for Forensic Entomology	• 10
	○ Activity 11-1: WKST Life Stage Data Table	• 10
	○ Activity 11-1: WKST Daily Data Table	• 10
	○ Activity 11-2: Mini Projects for Forensic Entomology	• 10

	○ Activity 11-3: Observation of Blowflies or Houseflies	• 10
	○ Activity 11-3: WKST Data Table 1	• 10
	○ Activity 11-3: WKST Data Table 2	• 10
	○ Activity 11-4: Factors Affecting Postmortem Interval estimates and ADH	• 10
	○ Activity 11-4: WKST Data Analysis	• 10
	○ Activity 11-5: Processing a Crime Scene for Forensic Insect Evidence	• 10
	○ Activity 11-5: WKST Evidence Collector	• 10
	○ Activity 11-5: WKST Evidence Inventory Label	• 10
	○ Activity 11-5: WKST Evidence Marker	• 10
	○ Activity 11-5: WKST Evidence Scribe	• 10
	○ Activity 11-5: WKST First Responder	• 10
	○ Activity 11-5: WKST Forensic Entomology Data Form	• 10
	○ Activity 11-5: WKST Meteorological Data Form	• 10
	○ Activity 11-5: WKST Mini Notebook	• 10
	○ Activity 11-5: WKST Paper Bindle	• 10
	○ Activity 11-5: WKST Photo Log	• 10
	○ Activity 11-5: WKST Photographer Log	• 10
	○ Activity 11-5: WKST Photographer	• 10
	○ Activity 11-5: WKST Recorder	• 10
	○ Activity 11-6: Jigsaw Research	• 10
	○ Activity 11-6: WKST Insect Study	• 10
	○ Activity 11-6: WKST Timeline	• 10
	○ Activity 11-7: Calculating Accumulated Degree Hours	• 10
	○ Activity 11-8: Forensic Entomology Case Study	• 10
	○ Activity 11-8: WKST Case Study Form	• 10
	○ Activity 11-8: WKST Entomology Questions	• 10
	○ Chapter 11: Body Bugs Interactive Lab	• NA
	Chapter 11: Final Analysis	• 20
Chapter 12: Death: Manner,	• Chapter 12: The Scenario	• NA
	• Chapter 12: Death: Manner, Mechanism, Cause	• NA

Mechanism, Cause	○ Introduction ○ Reading ○ Overview • Chapter 12: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography • Chapter 12: Examining the Facts – What Do You Know? ○ Flashcards ○ Learning the Lingo ○ Fact or Fiction? ○ What is Missing? • Chapter 12: Examining the Evidence – What Do You Observe? ○ Activity 12-1: Calculating PMI Using Rigor Mortis ○ Activity 12-1: WKST Rigor Mortis Reference Tables ○ Activity 12-2: WKST Calculating PMI Using Algor Mortis ○ Activity 12-3: Tommy the Tub ○ Activity 12-3: WKST Data Table ○ Activity 12-4: Analysis of Evidence from Death Scenes ○ Activity 12-4: WKST Rigor Mortis Reference Tables ○ Activity 12-4: WKST Postmortem Interval Reference ○ Activity 12-5: ACT: Chicken Decomposition ○ Activity 12-6: ACT: Student Projects ○ Chapter 12: Calculating Time of Death Interactive Lab Chapter 12: Final Analysis	• NA • NA • NA • NA • NA • NA • NA • NA • NA • 4 • 10 • 10 • NA • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • NA • 20
Chapter 13: Soil Evidence	• Chapter 13: The Scenario • Chapter 13: Soil Evidence ○ Introduction	• NA • NA • NA

	○ Reading	• NA
	○ Overview	• NA
	• Chapter 13: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 13: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 3
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 13: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 13-1: Sand Observation	• 10
	○ Activity 13-1: WKST Data Tables	• 10
	○ Activity 13-2: Sorting of Sand Using Sieve Plates	• 10
	○ Activity 13-2: WKST Data Tables	• 10
	○ Activity 13-2: WKST Reference	• 10
	○ Activity 13-3: Sorting of Sand by Size and Shape	• 10
	○ Activity 13-3: WKST Sand Descriptions	• 10
	○ Activity 13-3: WKST Reference	• 10
	○ Activity 13-4: Examination of Sand and Mineral Percentages	• 10
	○ Activity 13-4: WKST Data Table	• 10
	○ Activity 13-4: WKST Reference	• 10
	○ Activity 13-5: Chemical and Physical Analysis of Sand	• 10
	○ Activity 13-5: WKST Data Table	• 10
	○ Activity 13-5: WKST Data Reference	• 10
	○ Activity 13-6: Soil Evidence Examination	• 10
	○ Activity 13-6: WKST Data Table	• 10
	○ Activity 13-7: ACT: Grain Size and Velocity	• 10
	○ Activity 13-7: WKST Sand Sample Results	• 10

	○ Activity 13-8: ACT: Japanese Fire Balloon Podcast ○ Activity 13-9: ACT: Sand Theft Podcast ○ Chapter 13: Soil Examination Interactive Lab • Chapter 13: Final Analysis	• 10 • 10 • NA • 20
Chapter 14: Forensic Anthropology	• Chapter 14: The Scenario • Chapter 14: Forensic Anthropology ○ Introduction ○ Reading ○ Overview • Chapter 14: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography • Chapter 14: Examining the Facts – What Do You Know? ○ Flashcards ○ Learning the Lingo ○ Fact or Fiction? ○ What is Missing? • Chapter 14: Examining the Evidence – What Do You Observe? ○ Activity 14-1: Determining the Age of a Skull ○ Activity 14-2: Bones: Male or Female? ○ Activity 14-2: WKST Pelvis ○ Activity 14-2: WKST Skull ○ Activity 14-3: Identifying the Romanovs—An Internet Activity ○ Activity 14-3: WKST Data Table ○ Activity 14-4: Estimation of Body Size from Individual Bones ○ Activity 14-5: What Bones Tell Us ○ Activity 14-6: Height and Body Proportions ○ Activity 14-6: WKST Data Tables ○ Chapter 14: Forensic Anthropology Interactive Lab Chapter 14: Final Analysis	• NA • NA • NA • NA • NA • NA • NA • NA • NA • NA • 5 • 10 • 10 • NA • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • NA • 20

Chapter 15: Glass Evidence	• Chapter 15: The Scenario	• NA
	• Chapter 15: Glass Evidence	• NA
	○ Introduction	• NA
	○ Reading	• NA
	○ Overview	• NA
	• Chapter 15: Further Investigation	• NA
	○ Case Studies	• NA
	○ Careers in Forensics	• NA
	○ Bibliography	• NA
	• Chapter 15: Examining the Facts – What Do You Know?	• NA
	○ Flashcards	• NA
	○ Learning the Lingo	• 4
	○ Fact or Fiction?	• 10
	○ What is Missing?	• 10
	• Chapter 15: Examining the Evidence – What Do You Observe?	• NA
	○ Activity 15-1: Glass Fracture Pattern Analysis	• 10
	○ Activity 15-1: WKST Evidence Examination	• 10
	○ Activity 15-2: Glass Density	• 10
	○ Activity 15-2: WKST Evidence Inventory Label	• 10
	○ Activity 15-2: WKST Data Table	• 10
	○ Activity 15-3: Approximating the Refractive Index of Glass Using a Submersion Test	• 10 • 10
	○ Activity 15-3: WKST Evidence Inventory Label	• 10
	○ Activity 15-3: WKST Data Table	• 10
	○ Activity 15-4: Determining the Refractive Index of Liquids Using Snell's Law	• 10
	○ Activity 15-4: WKST Data Table	• 10
	○ Activity 15-4: Polar Graph Paper	• 10
	○ Activity 15-5: Case Study Using Conchoidal Fractures	• 10
	○ Chapter 15: Glass Evidence Interactive Lab	• NA
	• Chapter 15: Final Analysis	• 20
Chapter 16: Casts and Impressions	• Chapter 16: The Scenario	• NA
	• Chapter 16: Casts and Impressions	• NA
	○ Introduction	• NA

	○ Reading ○ Overview • Chapter 16: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography • Chapter 16: Examining the Facts – What Do You Know? ○ Flashcards ○ Learning the Lingo ○ Fact or Fiction? ○ What is Missing? • Chapter 16: Examining the Evidence – What Do You Observe? ○ Activity 16-1: Making a Plaster of Paris Cast ○ Activity 16-1: WKST ○ Activity 16-2: Shoe Size, Foot Size, and Height ○ Activity 16-2: WKST Data Tables ○ Activity 16-3: Tire Impressions and Analysis ○ Activity 16-3: WKST Data Tables ○ Activity 16-4: Vehicle Identification ○ Activity 16-4: WKST Data Table ○ Activity 16-5: Dental Impressions ○ Activity 16-5: WKST Data Tables ○ Chapter 16: Casts and Impressions Interactive Lab Chapter 16: Final Analysis	• NA • NA • NA • NA • NA • NA • NA • NA • 3 • 10 • 10 • NA • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • NA • 20
Chapter 17: Tool Marks	• Chapter 17: The Scenario • Chapter 17: Tool Marks ○ Introduction ○ Reading ○ Overview • Chapter 17: Further Investigation ○ Case Studies ○ Careers in Forensics ○ Bibliography	• NA • NA • NA • NA • NA • NA • NA • NA • NA

	• Chapter 17: Examining the Facts – What Do You Know?
	  ○ Flashcards
	  ○ Learning the Lingo
	  ○ Fact or Fiction?
	  ○ What is Missing?
	• Chapter 17: Examining the Evidence – What Do You Observe?
	  ○ Activity 17-1: Tool Marks: Screwdrivers and Chisels
	  ○ Activity 17-1: WKST Data Table
	  ○ Activity 17-2: Hammers and Hammer Impressions
	  ○ Activity 17-2: WKST Data Table
	  ○ Activity 17-3: Casting Impressions of Hammer Strikes on Wood in Silicone
	  ○ Activity 17-3: WKST Data Table
	  ○ Activity 17-3: WKST Evidence Inventory Label
	  ○ Chapter 17: Tool Marks Interactive Lab
	Chapter 17: Final Analysis
		• NA
		
		• NA
		• 1
		• 10
		• 10
		• NA
		
		• 10
		
		• 10
		• 10
		
		• 10
		• 10
		
		• 10
		• 10
		• NA
		• 20

Chapter 18: Firearms and Ballistics	• Chapter 18: The Scenario
	• Chapter 18: Firearms and Ballistics
	  ○ Introduction
	  ○ Reading
	  ○ Overview
	• Chapter 18: Further Investigation
	  ○ Case Studies
	  ○ Careers in Forensics
	  ○ Bibliography
	• Chapter 18: Examining the Facts – What Do You Know?
	  ○ Flashcards
	  ○ Learning the Lingo
	  ○ Fact or Fiction?
	  ○ What is Missing?
	• Chapter 18: Examining the Evidence – What Do You Observe?
		• NA
		• NA
		• NA
		• NA
		• NA
		• NA
		• NA
		• NA
		• NA
		
		• NA
		• 7
		• 10
		• 10
		• NA

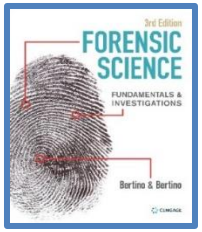
	○ Activity 18-1: Bullet Trajectory ○ Activity 18-1: WKST Scenario Analysis ○ Activity 18-2: Firing Pin Analysis ○ Activity 18-2: WKST Data Table ○ Activity 18-2: WKST Three Suspects and Evidence ○ Activity 18-3: Describing Spent Projectiles ○ Activity 18-8: WKST Data Tables ○ Activity 18-4: How Good Is Your Aim? ○ Activity 18-4: WKST Data Tables ○ Activity 18-5: ACT: Sectional Density of Rifle Bullets ○ Activity 18-6: ACT: Kinetic Energy of a Projectile ○ Chapter 18: Ballistics Interactive Lab Chapter 18: Final Analysis	• 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • 10 • NA • 20
Virtual Lab – The Death of Rose Cedar	• Virtual Lab 1: Evidence Collection ○ Virtual Lab 1: Evidence Collection ○ Virtual Lab 1: Observations ○ Virtual Lab 1: Assessment • Virtual Lab 2: Suspect Identification ○ Virtual Lab 2: Suspect Identification ○ Virtual Lab 2: Observations ○ Virtual Lab 2: Assessment • Virtual Lab 3: Fingerprinting ○ Virtual Lab 3: Fingerprinting ○ Virtual Lab 3: Observations ○ Virtual Lab 3: Assessment • Virtual Lab 4: Hair Analysis ○ Virtual Lab 4: Hair Analysis ○ Virtual Lab 4: Observations ○ Virtual Lab 4: Assessment • Virtual Lab 5: Fiber Analysis ○ Virtual Lab 5: Fiber Analysis ○ Virtual Lab 5: Observations ○ Virtual Lab 5: Assessment • Virtual Lab 6: Handwriting Analysis	• NA • NA • 4 • 65 • NA • NA • 6 • 6 • NA • NA • 3 • 24 • NA • NA • 5 • 5 • NA • NA • 5 • 10 • NA

	○ Virtual Lab 6: Handwriting Analysis 1 ○ Virtual Lab 6: Observations 1 ○ Virtual Lab 6: Handwriting Analysis 2 ○ Virtual Lab 6: Observations 2 ○ Virtual Lab 6: Handwriting Analysis 3 ○ Virtual Lab 6: Observations 3 ○ Virtual Lab 6: Handwriting Analysis 4 ○ Virtual Lab 6: Observations 4 ○ Virtual Lab 6: Handwriting Analysis 5 ○ Virtual Lab 6: Observations 5 ○ Virtual Lab 6: Assessment • Virtual Lab 7: Glass Density ○ Virtual Lab 7: Glass Density ○ Virtual Lab 7: Observations ○ Virtual Lab 7: Assessment • Virtual Lab 8: Soil Analysis ○ Virtual Lab 8: Soil Analysis ○ Virtual Lab 8: Observations ○ Virtual Lab 8: Assessment • Virtual Lab 9: Blood Spatter ○ Virtual Lab 9: Blood Spatter ○ Virtual Lab 9: Observations ○ Virtual Lab 9: Assessment • Virtual Lab 10: Ballistics ○ Virtual Lab 10: Ballistics ○ Virtual Lab 10: Observations ○ Virtual Lab 10: Assessment • Virtual Lab: Final ○ Virtual Lab: Final Observations ○ Virtual Lab: Final Assessment	• NA • 22 • NA • 33 • NA • 33 • NA • 33 • NA • 22 • 5 • NA • NA • 5 • 14 • NA • NA • 6 • 20 • NA • NA • 6 • 15 • NA • NA • 5 • 11 • NA • 18 • 23
Capstone Projects	• Capstone Project 1 ○ Capstone Project 1: Physical Evidence Case Studies ○ CP-1 WKST Physical Evidence Due Dates Form	• NA • 10 • 10

	○ CP-1 WKST Table 1: Individual Case Study Summary Form	• 10
	○ CP-1 WKST Table 2: In-Depth Case Study Notes Form	• 10
	○ CP-1 WKST Table 3: Evidence Collection Notes Form	• 10
	○ CP-1 WKST Table 4: Death Notes Form	• 10
	○ CP-1 WKST Peer Review Notes Form	• 10
	• Capstone Project 2	• NA
	○ Capstone Project 2: Personal Evidence Portfolio	• 10
	○ CP-2 WKST Table 1: Vehicle Identification Form	• 10
	○ CP-2 WKST Table 2: Tire Identification Form	• 10
	○ CP-2 WKST Evidence Inventory Label	• 10
	○ CP-2 WKST Evidence Markers	• 10
	○ CP-2 WKST Evidence Portfolio	• 10
	○ CP-2 WKST Mini Notebook	• 10
	○ CP-2 WKST Paper Bindle	• 10
	• Capstone Project 3	• NA
	○ Capstone Project 3: How Reliable is the Evidence?	• 10
	○ CP-3 WKST Table 1: Debate Strategy Form	• 10
	○ CP-3 WKST Table 2: Performance Evaluation Form	• 10
	• Capstone Project 4	• NA
	○ Capstone Project 4: Landmark Cases in Acceptance of Evidence	• 10
	○ CP-4 WKST Landmark Cases Form	• 10
	○ CP-4 WKST Technology and Evidence Form	• 10
	• Capstone Project 5	
	○ Capstone Project 5: Analysis of a Forensic Science Movie or TV Show Episode	• NA • 10
	○ CP-5 WKST Table 1: TV Episode/Movie Summary Form	• 10
	○ CP-5 WKST Table 2: TV Episode/Movie Evaluation Form	• 10

	• Capstone Project 6	• NA
	○ Capstone Project 6: Forensic Dumpster Diving - What Garbage Can Tell Us	• 10
	○ CP-6 WKST Table 1: Trash Recording Form	• 10
	○ CP-6 WKST Table 2: Household Profile Form	• 10
	○ CP-6 WKST Table 3: Inferences	• 10
	• Capstone Project 7	• NA
	○ Capstone Project 7: Forensic Science Career Exploration	• 10
	○ CP-7 WKST Careers in Forensic Science Sign-Up Form	• 10
	○ CP-7 WKST Career Research Questions	• 10
	• Capstone Project 8	• NA
	○ Capstone Project 8: Crime-Scene Development and Processing	• 10
	○ CP-8 WKST Evidence Collector	• 10
	○ CP-8 WKST First Responder	• 10
	○ CP-8 WKST Photographer	• 10
	○ CP-8 WKST Recorder	• 10
	○ CP-8 WKST Site and Evidence Form	• 10
	○ CP-8 WKST Sketch Artist	• 10
	○ CP-8 WKST Evidence Markers	• 10
	○ CP-8 WKST Evidence Inventory Label	• 10
	• Capstone Project 9	• NA
	○ Capstone Project 9: How to Read Calipers	• 10
	○ CP-9 WKST How to Read Calipers	• 10
	• Capstone Project 10	• NA
	○ Capstone Project 10: Gravesite Excavation	• 10
	○ CP-10 WKST Evidence Markers	• 10
	○ CP-10 WKST Site and Evidence Form	• 10
	○ CP-10 WKST Evidence Inventory Label	• 10
	○ CP-10 WKST Evidence Collector	• 10
	○ CP-10 WKST First Responder	• 10
	○ CP-10 WKST Photographer	• 10
	○ CP-10 WKST Recorder	• 10
	○ CP-10 WKST Sketch Artist	• 10
Appendices	• Appendix A: Table of Sines	• NA

	• Appendix B: Table of Tangents • Appendix C: Celsius-Fahrenheit Conversion Table	• NA • NA
TOTALS	Assignments: 682	Points: 4,230



Integration of Science, Math, Writing and Technology in Forensics© (rev.1.24.21)

Patricia and Anthony Bertino co-authors of *Forensic Science: Fundamentals and Investigations*, *3rd ed.*
www.BertinoForensics.com

Topic	Science	Math	Writing	Technology
Ch 1 Observation	How the brain processes information and stores it as short- or long-term memory? Factors affecting the processing and storage of information	Creation of data tables in experimentation	Using claim-evidence-reasoning or scientific method formats, prepare a scientific description of a student designed experiment involving eye witness accounts.	Use video or telephone cameras to record an incident to be used as a crime scene re-enactment to test observation skills.
Ch 2 Crime Scene	Observational skills Data collection Measurement, use of compass to identify location of evidence and crime scene.	Map a crime scene indicating location of datum, subdatum points along with the evidence location(s). Draw a crime scene sketch to scale.	Preparation of written report of the crime scene including eyewitness interviews. Interview a policeman and ask him what types of reports are required for any investigation	Draw a crime scene using computer software apps. Use GPS to document location of crime scene. Use various Apps to photograph and document crime scene.
Ch 3 Hair	Skin and hair structure and growth Wet mount slide preparation. Learn how to use a compound microscope when analyzing slides of different hair types (human, dog, cat, etc.) Hair analysis involving physical traits, internal structure, chemical analysis, presence or absence of trace evidence.	Measure hair width under microscope Calculate medullary index of hair.	Research and summarize a case study where hair was used to help solve a crime. Provide expert witness testimony based on scientific evidence that supports your claim.	Use digital microscope for measurement of hair. Use a digital camera and film canister to create a digital microscope to photograph & measure hair width.

Ch 4 **Fiber**	Identify sources of fiber based on structure, chemical analysis of fiber, solubility, burn tests, microscopic analysis Sources and use of plant, animal and synthetic fibers Development of specialized fibers and textiles	Measurement of fibers Determine thread count of textiles	Research the Atlanta serial killer Wayne Williams or other case studies and summarize how fiber analysis linked helped to link the suspect to the crime scene.	Use stereomicroscope to analyze weave patterns. Use digital images and enhancement methods to enhance observation of fibers.
Ch 5 **Forensic Botany**	Structure, function, and reproduction of angiosperms, gymnosperms and fungi Formation of and uses of annual rings found in woody stems. Habitat analysis based on ecosystems. Preparing permanent mount slides	Calculate the diameter of various pollen grains under the microscope. Calculate pollen counts. Map and document a crime scene to indicate crime scene and evidence locations.	Write an expert witness testimony on pollen analysis comparing pollen at crime scene with pollen found on suspect.	Use digital microscope to photograph & measure pollen grains. Prepare digital images obtained from your microscope to preparation of power point presentations
Ch 6 **Fingerprinting**	Structure, function and growth of skin that results in ridge patterns. Role of sweat glands in fingerprinting Modification of fingerprinting techniques are based on fingerprint environment and location.	Calculate ridge count. Determine class % of each of the three different ridge patterns.	Research the history of fingerprinting. Prepare a time line indicating when it began and how it has progressed.	Photograph fingerprints using digital photo enhancers to compare the crime scene print with the suspect's print. Use of large data bases, algorithm and machine learning for fingerprint analysis.

Ch 7 **DNA Profiling**	Structure, function of DNA Gel electrophoresis Role of restriction enzymes Principles of electrophoresis STR, SNPs, mtDNA, Y-chromosome analysis DNA phenotyping techniques Forensic genealogy	Graphing skills: comparison of distance traveled to band size; Population data bases, binning, probability calculations of evidence	Prepare a report summarizing the analysis of DNA evidence to determine if two different DNA profiles are consistent or not.	Use gel electrophoresis to analyze DNA PCR, gene sequencing, CODIS data bases DNA phenotyping used for personal ID
Ch 8a **Blood typing and Saliva**	Structure, function of blood cells Antigen-antibody reactions of immune system	Determining the probability of various blood types within populations	Write an essay explaining how a simple blood typing test mimics the reactions of the human immune system.	View tutorials on blood typing from Internet Hand-held devices test blood to determine if human or not.
8b **Blood Spatter**	Chemical testing to identify blood. Antibody testing: human or animal? blood types. Lines of convergence, angle of impact, area of origin. Chemical and physical properties of blood. Forces affecting blood: gravity, adhesion/cohesion, momentum, surface tension. Terminal velocity.	Measurement skills using metric and English system Use of protractor to measure angle of impact Use of sine function to determine angle of impact Use of tangent function to determine height of source of blood	One of the errors made during the investigation of O.J. Simpson and the murder of his wife Nicole Brown involved problems with the collection of the blood spatter evidence. Research this controversy and explain the errors made by the CSI during evidence collection.	Use of calculators to determine sine and tangent values of blood Computer skills using tutorial on CD or Internet Use of digital camera to photograph crime scene Microscopic blood photos 360-degree camera systems to document crime scene
Ch 9 **Toxicology**	Nerve and brain physiology. Role of neurotransmitters, protein receptors, enzymes. Toxin absorption, distribution, metabolism and excretion.	Calculation of blood alcohol levels using body weight and volume of ingested alcohol.	Read and summarize a case study described in The *Poisoner's Handbook* (Deborah Blue)	Create a poster, pamphlet or Power Point of the effects of a drug. Use of rapid, non-

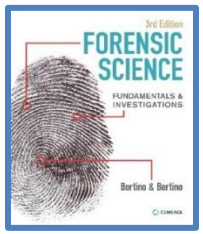
	Toxic effects of drugs, alcohol, lethal gases and heavy metals. Simulated drug testing using indicators, solubility and precipitation tests		Plan and conduct a debate that involves argumentation and counter-argumentation.	invasive hand-held portable drug-testing devices to provide rapid presumptive testing.
Ch10. Handwriting Counterfeiting Fraud	Observational skills Handwriting interaction of muscle and nerves, affected by emotion, illness, injury Chromatography of ink solvents Chemistry of inks	Measurements using calipers: distance between words, difference between capitol and small case letters, angle of slant Calculation of R_f values	Preparation of expert witness testimony to the jury supporting claims based on scientific evidence.	N-gram tracing Gas chromatography and mass spectrometer used in ink, paint identification
Ch 11 Forensic Entomology	Insects: characteristics, structure, development and habitats Drug testing of larvae using DNA and testing of larval crop content for exposure to drugs, toxins Classification of larval stages based on size and spiracle slits. Insect succession on dead bodies used to establish PMI	Calculation of PMI based on insect development and ambient conditions Accumulated Degree Hours (ADH) to determine PMI	Diary entries of a Blowfly on a dead, decomposing body. Insect scrapbook or baby book describing major events in the development of an insect. Mini Poster presentations on Forensic insect research. Expert witness testimony on PMI based on insect evidence.	Stereomicroscope and calipers to view and measure larva Digital photography and video of developing insects. DNA analysis of crop contents. New methods used to analyze amino acids of eggs to ID organisms
Ch 12a Death Rigor Mortis Algor Mortis	Muscle, heart, circulation physiology. Muscle Sliding filament theory.	Calculation of PMI (post mortem intervals) factoring in environmental conditions	Prepare a coroner's report that uses rigor and livor mortis as the basis for PMI (post mortem intervals)	Examine Internet tutorials on muscle contraction.

	Aerobic and anaerobic respiration, ATP, muscle fatigue, role of calcium, environmental effects affecting rigor and algor mortis	along with state of rigor and algor mortis		Facial reconstruction for personal ID using SNP analysis and forensic genealogy. Use probes to determine rate of heat loss
Ch 12b **Death** **Livor Mortis**	Circulatory system, chemical decomposition, gravity. Effects of environmental factors on Livor Mortis.	Calculation of PMI (post mortem intervals)	Write a story from the point of view of a blood cell within the body of a deceased, decomposing body describing livor mortis and other changes taking place.	Prepare a graph comparing onset of livor mortis under different environmental conditions. .
Ch 12c **Death and Decomposition**	Role of bacteria, fungi, animals in decomposition. Anaerobic fermentation Chemistry of saponification Environmental factors affecting decomposition.	Estimations of PMI based on stage of decomposition and environmental factors.	Prepare a chart describing the stages of decomposition and its use in forensics Research and present information pertaining to forensic careers presented in this chapter	Take digital photos of a decomposing animal (grocery store chicken) documenting stages of decomposition using your cell phone.
Ch 13 **Soil**	Soil formation, maturation, classification and profiles. Chemical and physical characteristics of different soil types. Column separation of soil. Density, identification of organic and inorganic matter.	Estimate percentages of soil contents by column separation, % of water and chemical and physical composition of soil, Ph	Investigate a crime scene where the soil contents helped to solve the case. Present the soil evidence as expert witness testimony	Digital comparison photos of suspects' & crime scene soil samples using microscopic and stereoscopic microscopes. Thermal imaging and drones help to identify location of corpse

Ch 14 Forensic Anthropology	Structure, function, growth and ossification, nutrition, disease of bones Identification of skeletal bones. Male versus female bones Ethnic differences in bones Chemical analysis of bones Teeth development	Determine age, sex and ethnic background based on measurements of bones. Use of algebraic equations to estimate height based on bone. Use protractors to measure Sub pubic angle, nasal index Estimate body size based on a single bone	Read William Maples book *Dead Men Do Tell Tales* or Sally Walker's *Written in Bone.* Using a case described in the text, explain how bones helped to identify a person. Research facial construction techniques.	Role of SNPs and forensic genealogy to aid in personal identification of skeletal remains to help identify ethnicity and ancestry. DNA phenotyping applied to skull remains to obtain an image of unidentified person.
Ch 15 Glass	Formation of glass. Chemical additives used in glass making to enhance color or properties. Compress and tension forces affecting glass fracture patterns. Density and refractive index of glass Snell's Law	Calculations and measurements of glass density, width of glass Estimations of glass refractive index using submersion method of Snell's law.	Preparation of glass expert witness testimony using scientific evidence to support your claims regarding an investigation describing: Sequence of bullet firing into glass, type of force used to break glass, relative speed of impact object, direction and angle of impact. Interview a CSI and report on information learned from broken glass	Becke lines estimated using microscope Use of GRIM to calculate refractive index of glass
Ch 16a Dental Impressions	Structure of teeth and gums Growth and development of teeth Characteristics of bite impressions	Using calipers, protractors, determine jaw dimensions and angles to compare bite marks	Research and summarize latest information about dental impression reliability. Research how Ted Bundy's bite pattern led to conviction	Use dental X-rays to compare evidence to suspect's dental impression.

Ch 16b **Foot, tire and tool impressions**	Physics of skid marks that indicate speed and direction. Why are foot impressions and stride patterns unique?	Measurement of wheel base, skid marks speed of vehicle. Use calipers to measure foot and tool impressions	Visit a tire store. Describe the variations found in tires. Explain how these variations can be detected in a tire impression.	Photograph skid marks using a digital camera, measure skid marks using laser to help analyze a crime scene. Use apps to collect data at a crime scene.
Ch 17 **Tool Mark Impressions**	Friction affects wear patterns. Oxidation of iron on tools makes them unique. Role of chemical products to enhance tool impressions and viewing of casting materials.	Measurements of impression evidence	Research and describe case studies involving tool mark impression evidence.	Digital scanning of tool marks impression. Photo enhancing methods to show impression evidence. 3-D imaging showing contours of impression evidence
Ch 18 **Ballistics**	Aerodynamics of bullet design and trajectory patterns. Compare the energy of one bullet of a particular caliber to the energy of another bullet of a different caliber. Discuss the science of ballistics affecting the trajectory path of the projectile, distance traveled and factors affecting accuracy.	Measure the caliber of projectile and cartridge casings. Calculate energy of a projectile given speed and gun velocity. Calculate the trajectory of a bullet	Describe the role of ballistics in the investigations of John F. Kennedy assassination. Describe an actual court case where a particular type of evidence was used to help solve the crime Write a fictitious crime short story using scientific description of possible evidence.	Determine the path of projectiles using the wind speed, distance, time of day and type of weaponry used 3-D ghost guns made of plastic NIBIN and other large databases, algorithms, machine learning used in solving ballistic crimes.

Visit ngl.cengage.com or contact your sales consultant for access to the NGLSync teacher dashboard to access these and other digital resources to support *Forensic Science: Fundamentals and Investigations, 3rd edition* by Bertino and Bertino.



Materials for Teaching

Forensic Science: Fundamentals & Investigations, 3rd Edition 2021

Bertino & Bertino www.BertinoForensics.com rev.**1.24.21**

General Supplies: The materials in this list are unique to forensics and do not include supplies such as 3 × 5 cards, tape (clear and masking), scissors, transparences, plastic rulers, meter sticks, calipers, protractors, compass, marking pens and calculators (with sine and tangent functions).

Large Purchase Items: Some large purchase items are indicated, such as a digital camera (optional) and Sherlock Bones Kit (for Chapter 14). *Check individual activities in the text book for specific ordering information, including quantity or item.*

Items needed are listed only *once* even though some items may be needed for multiple labs. Teachers may choose not to perform every activity as well, reducing the number items.

Chapter:

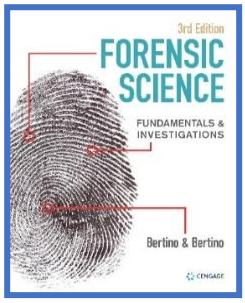
1. Supplies mentioned in first paragraph (above).
2. Hand lenses, socks, forceps, latex or nitrile gloves, resealable bags, penlights, compasses, tape measure, wooden corner markers
3. Microscopes, slides, cover slips, clear nail polish, hair samples
4. Fiber samples, alcohol or Bunsen burners, thread counter or 3 × 5 cards
5. Toothpicks, small beakers, pollen samples, flowers
6. Balloons, fingerprinting pads (inkless are preferred), ten cards, paper towels, cleansing wipes, magnetic powder, brushes
7. Access to computers, unprocessed wheat germ, alcohol, liquid soap, meat tenderizer
8. H_2O_2, ethanol, reduced phenolphthalein, simulated (vampire) blood, meter sticks, string, newspaper, dental floss, cardboard boxes
9. Aleve, Tylenol, aspirin, Motrin, test tubes or vials, well plates, (test solutions can be made *in small amounts* [Marquis solution, sulfuric acid, formaldehyde]), tannic acid 10% solution, ferric chloride 2 g/100ml water, concentrated nitric acid, KOH
10. Paper money or projected images of paper money, hand lenses
11. Small jars, hand sanitizer, liver, blowfly larvae (live or preserved), alcohol, large empty coffee cans, kitchen-sized plastic liners, thermometer, stereomicroscope
12. Thermometer, 66 L tub, cart
13. Sand samples, sieve set, acetic acid, HCl, $AgNO_3$, teaspoon, graduated cylinders, pH paper, paint brushes, cheesecloth, magnets, UV light, watch glasses or glass plates, Petri dishes
14. Sherlock Bones Kit (Wards) at least one, or two to share (~$400/kit), *6 preferred*
15. Window and tempered glass, hemispheric plastic dishes, test tube racks, methanol, isopropyl alcohol, olive oil, castor oil, 10 ml pipettes, balances
16. Cardboard boxes, hair spray, Plaster of Paris, wooden paint paddle coffee cans, petroleum jelly, fingerprint powder or chalk, laser measuring ruler, tires (bicycle or car) Styrofoam plates, transparency film
17. Modeling clay, screwdrivers (borrow), hammers (borrow), small pine boards, florist Styrofoam
18. Dental floss, dowels, cereal boxes, spent cartridge casings, perfect projectiles*

Bottom line for cost: Ask for an open P.O. for about $800 for supplies not on hand. Add 2 Sherlock Bones Kits approximately $800 (6 kits preferred)

Total cost: Approximately $1600 - $2900 to have what you need to complete *all 100+ activities* for 1 to 2 classes of 24 students

***Visit www.bertinoforensics.com, click on 'Teacher Resources', Supplies/Lab Equipment for inexpensive sources of supplies and information on making your own class supplies.**

Forensic Books of Interest



Forensic Science: Fundamentals and Investigations, 3rd edition

by Bertino and Bertino **rev. 1.24.21**

National Geographic Learning| Cengage: ngl.cengage.com

FORENSIC BOOKS OF INTEREST

This is a small sampling of the non-fiction forensic books that are of high interest to students. After reading excerpts of these books in class, many students become motivated to read the rest of the book. Note, some titles are listed under two different headings.

Teachers are encouraged to record the topic and page numbers of books, articles, and blogs in the back of *Forensic Science: Fundamentals and Investigations, 3rd edition*, in order to quickly locate that passage the following year. Teachers may also add sticky notes to certain pages in the book, listing topics or resources for reference. Building a classroom library encourages students to refer to these books to further their interest or understanding in forensic science.

AUTOPSY

Cohle, Stephen D., and Tobin T. Buhk. *Cause of Death: Forensic Files of a Medical Examiner*. Amherst, NY:

Prometheus Books, 2007. *

Timmermans, Stefan. *Postmortem: How Medical Examiners Explain Suspicious Deaths*. Chicago, IL: University of Chicago Press, 2006. *

BLOOD

MacDonell, Herbert Leon. *Bloodstain Patterns*. Elmira Heights, NY: Golos Printing, 2005.

James, Stuart H., Paul Erwin. Kish, T. Paulette. Sutton, and William G. Ecker. *Principles of Bloodstain Pattern Analysis Theory and Practice*. Boca Raton, FL: CRC, 2015. **

Wonder, Anita Y. *Bloodstain Pattern Evidence Objective Approaches and Case Applications*. Cambridge, MA: Elsevier/Academic Press, 2007. **

BONES (FORENSIC ANTHROPOLOGY)

Hansen, Joyce, and Gary McGowan. *Breaking Ground, Breaking Silence: The Story of New York's African Burial*

Ground. New York, NY: Henry Holt, 1998.

Jackson, Donna M., and Charlie Fellenbaum. *The Bone Detectives: How Forensic Anthropologists Solve Crimes and Uncover Mysteries of the Dead*. Boston, MA: Little, Brown and Co., 1996.

Massie, Robert K. *The Romanovs: the Final Chapter*. New York, NY: Random House, 1995.

Maples, William R., and Michael Browning. *Dead Men Do Tell Tales: the Strange and Fascinating Cases of a Forensic Anthropologist*. New York, NY: Doubleday, 1994.

Thomas, Peggy. *Forensic Anthropology: the Growing Science of Talking Bones*. New York, NY: Facts on File, 2003.

Walker, Sally M. *Written in Bone: Buried Lives of Jamestown and Colonial Maryland*. Minneapolis, MN: Carolrhoda Books, 2009. *

Walker, Sally M., and Douglas W. Owsley. *Their Skeletons Speak: Kennewick Man and the Paleoamerican World*. Minneapolis, MN: Carolrhoda Books, 2012. *

Ubelaker, Douglas H., and Henry Scamell. *Bones: a Forensic Detective's Casebook by Douglas H. Ubelaker*. New York, NY: Harper Collins Pub, 1992.

BOTANY

Hall, David Walter, and Jason H. Byrd. *Forensic Botany: a Practical Guide*. Chichester (West Sussex), U.K.: J. Wiley &

Sons, 2012.

Milne, Lynne. *A Grain of Truth: How Pollen Brought a Murderer to Justice*. Sydney, AUS: New Holland, 2005.

Walker, Maryalice. *Entomology and Palynology: Evidence for the Natural World*. Philadelphia, PA: Mason Crest, 2006.

CASE STUDIES

Ashton, Jeff, and Lisa Pulitzer. *Imperfect Justice*. New York, NY: William Morrow, 2011.

Baden, Michael M., and Judith Adler. Hennessee. *Unnatural Death: Confessions of a Medical Examiner*. Toronto, Canada: Ivy Books, 1989.

Baden, Michael M., and Marion Roach. *Dead Reckoning: the New Science of Catching Killers*. New York, NY: Simon & Schuster, 2001.

Craig, Emily A. *Teasing Secrets from the Dead: My Investigations at America's Most Infamous Crime Scenes*. New York, NY: Three Rivers Press, 2004.

Erzinclioglu, Zakaria. *The Illustrated Guide to Forensics: True Crime Scene Investigations*. New York, NY: Barnes & Noble, 2004.

Evans, Colin. *The Casebook of Forensic Detection: How Science Solved 100 of the World's Most Baffling Crimes*. New York, NY: John Wiley & Company, 1996.

Koehler, Steven A., Pete Moore, and David Owen. *Jumped, Fell, or Pushed? How Forensics Solved 50 "Perfect" Murders*. London: Readers Digest Association, 2009.

Mann, Robert W., and Miryam Ehrlich. Williamson. *Forensic Detective: How I Cracked the World's Toughest Cases*. New York, NY: Ballantine Books, 2007.

Schiller, Lawrence. *Perfect Murder Perfect Town*. New York, NY: Harper Collins Publishers, 1998.

CRIME SCENE INVESTIGATIONS

Fletcher, Connie. *What Cops Know: Cops Talk About What They Do, How They Do It, and What It Does to Them*.

New York, NY: Pocket Books, 1990.

Gardner, Ross M. *Practical Crime Scene Processing and Investigation*. Boca Raton, FL: CRC Press, 2012.

Geberth, Vernon J. *Practical Homicide Investigation Checklist and Field Guide*. Boca Raton, FL: CRC Press, 1997.

Hallcox, Jarrett, and Amy Welch. *Bodies We've Buried: inside the National Forensic Academy, the World's Top CSI Training School*. New York, NY: Berkley Books, 2006.

Kollmann, Dana. *Never Suck a Dead Man's Hand: Curious Adventures of a CSI*. New York, NY: Citadel Press Books, 2007. **

Platt, Richard. *Crime Scene: the Ultimate Guide to Forensic Science*. DK Children, 2003.

COUNTERFEITING AND FRAUD

Abagnale, Frank W. *The Art of the Steal: How to Protect Yourself and Your Business from Fraud--America's #1 Crime*.

New York, NY: Random House, 2001.

Abagnale, Frank W., with Stan Redding. *Catch Me If You Can*. New York, NY: Random House, 1980.

Perenyi, Ken. *Caveat Emptor: the Secret Life of an American Art Forger*. New York, NY: Pegasus Books, 2012.

Wittman, Robert K., with John Shiffman. *Priceless: How I Went Undercover to Rescue the World's Stolen Treasures*. New York: Crown, 2011.

DEATH AND TIME OF DEATH

Balko, Radley, Tucker Carrington, with John Grisham. *Cadaver King and the Country Dentist: a True Story of Injustice*

in the American South. New York, NY: PublicAffairs, 2018.

Bass, William M., and Jon Jefferson. *Death's Acre: inside the Legendary Forensic Lab the Body Farm Where the Dead Do Tell Tales*. New York, NY: Berkley, 2003.

Cohle, Stephen D., and Tobin T. Buhk. *Cause of Death: Forensic Files of a Medical Examiner*. Amherst, NY: Prometheus Books, 2007. *

Craig, Emily A. *Teasing Secrets from the Dead: My Investigations at America's Most Infamous Crime Scenes*. New York, NY: Three Rivers Press, 2004.

Hospice, Inc. *When Death Is Near: A Guide for Family, Friends, and Caregivers*. Naples, FL: Quality of Life Publishing, 2019. *

Murray, Elizabeth A. *Death: Corpses, Cadavers, and Other Grave Matters*. Minneapolis, MN: Twenty-First Century Books, 2010.

Roach, Mary. *Stiff: the Curious Lives of Human Cadavers*. New York, NY: W. W. Norton & Company, 2004.

Sachs, Jessica Snyder. *Corpse: Nature, Forensics, and the Struggle to Pinpoint Time of Death*. Cambridge, MA: Perseus Publishing, 2001.

Wecht, Cyril H., Mark Curriden, and Angela Powell. *Tales from the Morgue: Forensic Answers to Nine Famous Cases*. Amherst, NY: Prometheus Books, 2005.

DNA

Butler, John M., and John M. Butler. *Fundamentals of Forensic DNA Typing*. Burlington, MA: Academic

Press/Elsevier, 2010. **

Thompson-Cannino, Jennifer, Ronald Cotton, and Erin Torneo. *Picking Cotton: Our Memoir of Injustice and Redemption*. New York, NY: St. Martin's Press, 2009. *

Massie, Robert K. *The Romanovs: the Final Chapter*. New York, NY: Random House, 1995.

Wambaugh, Joseph. *The Blooding*. New York, NY: Bantam Books, 1989.

DRUGS (SEE TOXICOLOGY)

ENTOMOLOGY

Byrd, Jason H., and James L. Castner, eds. *Forensic Entomology: The Utility of Arthropods in Legal Investigations*.

Boca Raton, FL: CRC Press, 2011. **

Erzinclioglu, Zakaria, Dr. *Maggots, Murder, and Men: Memories and Reflections of a Forensic Entomologist*. New York, NY: Thomas Dunne Books, 2000.

Goff, M. Lee. *A Fly for the Prosecution: How Insect Evidence Helps Solve Crimes*. Cambridge, MA: Harvard University Press, 2000.

EVIDENCE

Lee, Henry C., and Howard A. Harris. *Physical Evidence in Forensic Science*. Tucson, AZ: Lawyers & Judges Pub.

Co., 2000.

EYEWITNESS ACCOUNTS

Loftus, Elizabeth F. *Eyewitness Testimony: with a New Preface by the Author*. Cambridge, MA: Harvard University

Press, 1996.

FACIAL RECONSTRUCTION

George, Robert M. *Facial Geometry: Graphic Facial Analysis for Forensic Artists*. Springfield, IL: Charles C. Thomas,

2007.

Taylor, Karen T. *Forensic Art and Illustration*. Boca Raton, FL: CRC Press, 2001.

FIBERS

Schiller, Lawrence. *Perfect Murder Perfect Town*. New York, NY: Harper Collins Publishers, 1998.

FORENSIC ENVIRONMENT

MacMaster, Greg. *Environmental Forensics*. Kewadin, MI: Greg MacMaster, 2010.

FORENSIC PSYCHOLOGY

Van Zandt, Clint. *Facing down Evil: Life on the Edge as an FBI Hostage Negotiator*. New York, NY: G. P. Putnam Sons,

2006.

GLASS

Fisher, David. *Hard Evidence*. New York, NY: Simon & Schuster, 1995.

Noguchi, Thomas. *Coroner*. New York, NY: Pocket Books, 1985.

HANDWRITING

Rainis, Kenneth G. *Forgery: Crime-Solving Science Experiments*. Berkeley Heights, NJ: Enslow Publishers, 2006.

IMPRESSIONS

Baldwin, David, John Birkett, Owen Facey, and Gilleon Rabey. *The Forensic Examination and Interpretation of Tool*

Marks. Chichester, West Sussex, U.K.: John Wiley and Sons, 2013.

Evans, Colin. *The Casebook of Forensic Detection: How Science Solved 100 of the World's Most Baffling Crimes*. New York, NY: John Wiley & Company, 1996.

McDonald, Peter. *Tire Imprint Evidence*. Boca Raton, FL: CRC Press, 1992.

OBSERVATIONAL SKILLS

Ekman, Paul. *Emotions Revealed: Recognizing Faces and Feelings to Improve Communication and Emotional*

Life. New York, NY: Henry Holt & Company, 2007.

Huston, Philip, Michael Floyd, and Susan Carnicero. *Spy the Lie: Three Former CIA Officers Reveal Their Secrets to Uncloaking Deception*. New York, NY: St. Martin's Press, 2012.

SAND AND SOIL

Coen, Ross Allen. *Fu-Go: the Curious History of Japan's Balloon Bomb Attack on America*. Lincoln, NE:

University of Nebraska Press, 2014.

Erzincliogl u, Zakaria Dr., *The Illustrated Guide to Forensics True Crime Scene Investigations*, New York, NY: Barnes &

Noble, 2004

McPhee, John. *Irons in the Fire*. New York, NY: Farrar, Straus & Giroux, 1997.

Murray, Raymond C. *Evidence from the Earth: Forensic Geology and Criminal Investigation*. Missoula, MT: Mountain Press Pub. Co., 2004.

TOXICOLOGY

Blum, Deborah. *The Poisoner's Handbook: Murder and the Birth of Forensic Medicine in Jazz Age New York*. New

York, NY: Penguin Books, 2010.

Cobb, Cathy, Monty L. Fetterolf, and Jack Goldsmith. *Crime Scene Chemistry for the Armchair Sleuth*. Amherst, NY: Prometheus Books, 2007.

George, David J. *Poisons: An Introduction for Forensic Investigators*. Boca Raton, FL: Auerbach Publishing, 2017.

Moore, Kate. *The Radium Girls: The Dark Story of America's Shining Women*. Naperville, IL: Sourcebooks, 2017.

* Titles are more appropriate for older high-school students.

** Titles are appropriate for advanced students

Webinar: Fingerprinting Activities for Remote Learning

Presented Nov. 19, 2020

Forensic Science: Fundamentals and Investigations 3rd ed.

Authors and presenters: Anthony and Patricia Nolan Bertino rev. 1.24.21

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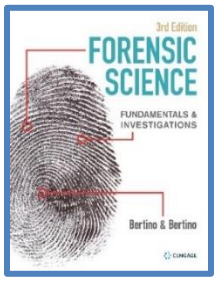


View the Nov. 2020 Webinar "Fingerprinting Activities for Remote Learning" and download the webinar handouts by:

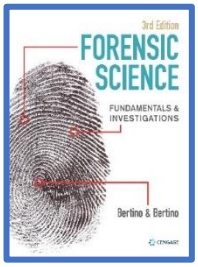
1. going to the author's website www.BertinoForensics.com

2. On the home page is a link for the webinar. Add your information and it takes you to the webinar.

3. On the home page we also provide instructions on how to download all the hand-outs from the webinar including the How to Make Magnetic Wands:
    - from www.BertinoForensics.com
    - Click on Teacher Resources
    - Scroll down to Webinar

For more information, click on the *"Contact Us"* link on the home page.

www.BertinoForensics.com Patricia Nolan Bertino and Anthony (Bud) Bertino



Alternative Assessments

***Forensic Science: Fundamentals and Investigations 3rd ed.* Bertino & Bertino**

Anthony and Patricia Bertino* *rev. 1.24.21

Teachers often use assessments to check for understanding, reinforce learning, and motivate students to succeed. But the results of one written test taken at the end of the chapter do not always demonstrate student mastery of a given concept. Assessments should be frequent, varied, and ongoing to give the instructor time to assess learning and modify instruction to enhance learning. Alternative assessments allow students the opportunity to demonstrate what they've learned through a variety of creative or technology-driven outlets, and motivate them to achieve future successes. The following approach is suggested:

1. PRE-ASSESSMENT: The pre-assessment evaluates previous learning and identifies and address misconceptions.

Example: What do you know? What do you want to know? (surveys)
Example: Carousel brainstorming of the topic prior to any discussions

2. ASSESSMENT DURING LEARNING: Assessing students throughout the learning process allows teachers to monitor how well students are grasping the information. When students demonstrate a lack of understanding, it's important for the instructor to change gears and modify the instruction.

One way to ensure comprehension throughout the chapter is to use the *Student Learning Objectives* (SLOs) found on the *Cengage Companion Site.* These are single concept, testable objectives concerning the most basic to the most complex concepts. The Student Learning Objectives should be distributed to each student at the *beginning* of a topic, so that students can view the "whole picture" of what they should be able to accomplish by the end of the chapter.

Throughout the chapter, students are arranged in small, heterogeneously grouped cooperative learning teams to review the objectives already discussed in class. Numerous, short, 10-minute reviews are recommended instead of one full-period review. Higher-achieving students are encouraged to discuss answers and help others in their group. The small-group collaboration gives all students the opportunity to contribute by either asking or answering questions. Often, an attempt to explain a concept may reveal that a student needs further clarification. Throughout this review, students are actively engaged and the teacher is free to move from group to group, to clarify misconceptions.

3. POST-ASSESSMENT: The post-assessment determines how well students have mastered a topic and identifies the effectiveness of the instruction. In lieu of a full-period written test, alternative assessments *reinforce learning and encourage new learning while promoting student success and interest*.

Students who are unsuccessful in taking a written test may be highly successful using a different format. Because most high school forensic science classes are heterogeneously grouped, a variety of assessment opportunities encourages students to demonstrate their individual skills and aptitudes, giving students a sense of accomplishment that encourages *future* learning.

Examples of alternative assessment ideas used within the Bertino textbook *Forensic Science: Fundamentals and Investigations* 3rd ed. are listed below. References have been made to specific sample labs, activities, or concepts that lend themselves to each of the different forms of assessment. Teachers are encouraged to have students exercise their creativity and develop their own alternative assessments, before providing them with these suggestions.

FORENSICS ALTERNATIVE ASSESSMENT OPTIONS

1. Autobiography (of an insect, for example)
2. Scrapbooking
3. Expert witness testimony presentation
4. Development of three-dimensional models
    - DNA molecule
    - Antibody/Antigen reactions
    - STR inheritance
    - Tire, tool, dental impression evidence
5. Oral presentations with demonstration
6. Video, PowerPoint presentations, photography-*Technology 1*
    - How to analyze blood
    - How to set up a collection site from a crime scene
    - How to analyze glass fractures to determine sequence of bullet entries
    - How to conduct a burn test for fiber analysis using correct protocols
    - How to analyze handwriting
    - How to distinguish bones: male vs female, ethnic background
    - How to estimate age of skeletal remains
    - How to compare and contrast sand samples
    - How to analyze spent cartridge casings and bullets
7. Probes, apps-*Technology 2*
8. Podcasts-*Technology 3*
9. Hands-on learning activity
10. Creativity: Use music, art, dance, writing, photography to convey understanding
11. Forensics book or case study reports
12. Mini poster presentation

13. Debate presentation
14. Mentoring by CSIs, police, or lawyers
15. Engineering and design

    - Redesign lab protocol to improve technique for greater reliability and validity: drug test
    - Design a rearing chamber for insect development

16. Interview: Talk Show host presentation, TV news report, role play witness or suspect interrogation
17. Write a magazine or newspaper report based on an actual or fictitious crime.
18. Case study crime scene analysis

DESCRIPTIONS OF ALTERNATIVE ASSESSMENT OPTIONS

1. AUTOBIOGRAPHY

Students write "autobiographies" that provide descriptions and explanations of scientific phenomenon while allowing imagination and creativity. Information must be scientifically correct. The creative writing component adds an element of fun while at the same time enabling the student to demonstrate knowledge of a topic.

Example: Activity 11-2 "Mini Projects for Forensic Entomology"

Write an autobiography from the viewpoint of the fly as it develops from an egg to an adult. Include in the autobiography:

- Physical description of the insect at different stages of development
- Physical description of the insect's habitat and surroundings
- Description of the insect's food at different stages of development
- Description of the how the insect ingests its food at different stages of development
- Descriptions of the progression through each developmental stage
- Description of any predators and competition
- Description of any movements or migrations during development
- Description of how the insect was collected from a dead body
- Description of how postmortem interval was revealed from the insect
- Digital photos of the life stages of the insect

Example: Chapter 18 Firearms and Ballistics: Write an autobiography from the viewpoint of a *bullet* describing its:

- Anatomy
- Size (caliber)
- Type
- Markings: when, why and how are the marks are formed

- Role of the primer
- Amount and ignition of gunpowder
- The amount of energy yielded as the gunpowder is ignited
- Trajectory of the bullet as the gun is fired and the bullet travels out of the gun barrel through the air toward the target
- Descriptions of the various forces affecting its trajectory
- Distance traveled by the bullet and how that can be calculated
- Discussion of what happens to the bullet upon impact
- Recovery of the fired bullet
- Comparison of a fired bullet recovered from the victim or environment with a bullet fired by the perpetrator's gun

Other autobiographies could be written from the viewpoint of different types of physical evidence found at a crime scene. Students should be given guidance on the type of descriptions that would pertain to different types of physical evidence. **Examples:** pollen, sand, bone, fractured glass, DNA, blood spatter

2. SCRAPBOOKING

Students compile a narrated "scrapbook" of digital photos, art, or other images taken from reliable sources along with descriptions, to provide a visual and written comparison of evidence. The images should be arranged in a logical sequence and progression. Students should be encouraged to use technology in their presentations, a skill that can be applied to their other courses.

Evidence that is collected from a crime scene and linked to a particular suspect should provide:

- A description of how the evidence is recovered, documented, collected, analyzed, and stored
- A section in the scrapbook where the distinctive characteristics of the evidence are described
- Information that demonstrates that the evidence is: relevant, scientific, sufficient, valid, and reliable
- Description of how the evidence was linked to the crime-scene evidence
- Quantitative values assigned to the evidence, if any
- A bibliography to substantiate their descriptions or arguments

Example: Activity 3-1 "Trace Evidence: Hair" and Activity 3-3 "Hair Testimony Essay"

Students determine if one of the hairs taken from the suspects is consistent with the hair evidence at the crime scene. The scrapbook approach includes digital photos taken from the students' microscope of both the suspects' hair and the evidence hair.

Other photos or images include a general description and the various characteristics used to distinguish one hair sample from another. Through the photos and annotated descriptions, students describe the variations in hair color, texture, thickness, medulla, cuticle, cortex, medullary index, and the measurement of the hair's diameter.

After describing the hair characteristics, students use photos and their analyses of the suspects' hair samples to determine if any of the samples are consistent with the evidence hair.

The pre-writing questions in Activity 3-3 "Hair Testimony Essay" help students organize this information in a scrapbook or written report.

Example: Chapters 4, 5, 6, 13, 15, 16, 17, and 18. Scrapbooking can be used when comparing forms of physical evidence, such as fiber, botanical evidence (pollen, seed, flowers), fingerprints, sand, glass, dental or foot impressions, skid marks, and ballistic evidence. Students describe what traits are being analyzed and discuss the distinguishing characteristics of that evidence. Students make a claim based on the scientific evidence of whether or not the crime-scene evidence is consistent with the evidence found on a suspect.

Example: Activity 11-1 "How to Raise Blowflies for Forensic Entomology," (Going Further item 1). A variation of scrapbooking for insect development is the "*baby book*," which shows growth and development of flies through their various stages, with photos and annotations. This activity helps students understand the progression from egg, through three different larval stages, to pupa and adult. Once students understand the basic biology behind insect development, they are better able to apply this information to their analysis of forensic entomology evidence to estimate postmortem intervals.

3. EXPERT WITNESS TESTIMONY

The primary purpose of this assessment is to determine if the student can demonstrate an evidentiary link between a particular suspect and a crime scene. The expert witness states a claim based on scientific evidence and describes their reasoning in making that claim. Part of the testimony includes demonstrating that the evidence is relevant, reliable, sufficient, valid, and scientific. Whenever possible, the expert witness tries to establish a statistical analysis of the evidence that links the suspect to the crime scene. During the expert witness testimony, students argue their case and describe the evidence used to support their claim(s). The expert witness must be prepared to counter argue the claims made by the opposing counsel.

The expert witness testimony provides an example of how forensic science helps to meet the following goals:

Common Core State Standards for Writing

1. Write or verbalize arguments to support claims using valid reasoning and relevant and sufficient evidence.
2. Write or verbalize explanatory texts to convey complex ideas and information clearly and accurately through effective selection, organization, and analysis.

3. Write or verbalize narratives to develop real or imagined experiences or events using well-chosen details and well-structured sequences.

Common Core Writing Standards for Literacy in Science

1. Write arguments focused on discipline-specific content: Introduction of precise, knowledgeable claim(s) that establish the significance of the claim(s) from alternative or opposing claims and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.

2. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audiences' knowledge level, concerns, values, and possible biases.

The initial part of an expert witness testimony presentation requires that the student convince the listeners (jurors) that he or she is an expert in the field by providing scientifically correct background information regarding the evidence examined and by describing how that evidence was collected, documented, handled, analyzed, and stored. Evidence improperly handled and analyzed will not be considered in a trial.

In the second part of an expert witness testimony, it is important to convince the jury that the crime-scene evidence does indeed link a suspect to the crime scene. The expert witness should explain how the evidence was analyzed, including any procedures, lab investigations, and technology used.

The expert witness should be prepared to answer any questions from the jury regarding the evidence. Common questions include:

a. How *relevant* is the evidence?

b. How *reliable* is the evidence and evidence testing?

1. Is the evidence class or individual evidence?
2. What is the statistical likelihood that the evidence could have come from someone other than the suspect?
3. Was the evidence testing reliable? Would another scientist get the same results?
4. Was the evidence tested more than once?
5. Was the evidence tested by more than one person and by more than one laboratory?
6. Is the evidence sufficient to link a suspect to a crime?

c. Is the evidence scientific?

1. Was the testing completed by validated procedures and equipment?
2. Was the technician trained in the proper protocol? Are the conclusions

based on objective or subjective means?

3. Can the results be quantified and measured? Is there a statistical analysis of the evidence?

Finally, the expert witness must be prepared to counter the opposition.

Example: Activity 10-2 "Analysis of Ransom Note and Report to Jury"

In this activity, students are provided with instructions to help them organize and compose their written expert witness report by:

- Providing students with an outline or pre-writing format
- Providing instructions on how to modify their presentation to reach a varied target audience
- Addressing evidence reliability and relevance
- Encouraging students to write a rough draft
- Using small group collaboration: Upon completion of the rough draft, the "expert witness" meets with another student to help with proofreading and editing.

Other examples include:

Example: Activity 3-3 "Hair Testimony Essay" includes pre-writing questions to assist students with the testimony.

Example: Activity 4-4 "Textile Identification" includes pre-writing questions to assist with the testimony.

Example: Activity 5-2 "Pollen Expert Witness Presentation" includes pre-writing questions to assist with testimony.

Example: Activity 10-2 "Analysis of a Ransom Note and Report to the Jury" includes pre-writing questions to assist with the testimony.

4. CONSTRUCTION OF THREE-DIMENSIONAL MODELS

It's important to recognize and utilize the various skills, talents, and interests of your students. If students prefer working with their hands rather than taking a written test, offer them the option of building a model to demonstrate a concept in forensics. Students create models of some aspect of an actual case study that shows how the evidence was used to help solve a case, and then present and describe their models. The presentation provides public speaking opportunities and improves their ability to communicate scientific information.

Example: Activity 7-6 ACT: "Design and Build a Human DNA Structure: A Kinesthetic Learning Activity"

This activity helps students to understand the structure of DNA. Students could make the DNA model using people or with wood, plastic tubing, food, fabric, or other objects.

Example: Activity 17-1, "Tool Marks: Screwdrivers and Chisels"

Students create models of tool marks from screwdrivers and/or chisels using the description in this activity. The models could be constructed in plaster, clay, or in a soft wood, such as pine. In addition to preparing the tool marks from known screwdrivers and chisels, students may use one of the tools to pry open an old door jamb or window sill. The student compares the evidence of the pried-open door jamb with the tool marks made from known assorted screwdrivers and chisels. Students take digital photos of the tool marks and measure each mark as another means of comparison.

An interesting addition to this project is for the student to take two new screwdrivers of the same type, manufacturer, and size and show how individual marks on the screwdrivers result from different uses. These wear-and-tear marks help to distinguish tools.

This alternative assessment provides a venue for students to explain how to examine and compare tool marks. It also provides the instructor with a local database of tool marks for use in future classroom-based crime scenes.

Example: Chapter 18, Firearms and Ballistics

Students research a specific case study; one from your local region, a case in the news, or a historical case such as the assassination of President Kennedy. Students prepare a scaled model of the crime scene (doll house or shadowbox) showing the pathway of the bullet and trajectory. Using the model, students provide evidence as to whether the suspect's description of the events was consistent with the physical evidence. (Refer to Activity 18-1 "Bullet Trajectory") (In the case of the Kennedy assassination, use the Warren Commission's description of the fatal bullet.)

On the *C.S.I Las Vegas* television series, several episodes involved the recreation of crime scenes using dollhouse miniatures. Watching one of these episodes may help students develop their ideas.

Another example of modeling in ballistics is for the student to create a three-dimensional model of the lands and grooves resulting from the bullet traveling down a rifled gun barrel. Students could include an explanation of how guns are test-fired so that spent bullets from a gun can be compared to the spent bullet(s) recovered from the crime scene.

Besides a model of a bullet, many other extensions can be incorporated to demonstrate knowledge of how firearm and ballistics evidence are used to help solve crimes. For example, students could explain how gun barrels are rifled.

Example: Activity 4-2 "Bedsheet Thread Count" and
Activity 4-3 "Weave Pattern Analysis"

When comparing fabric or fibers from the crime scene with fabric or fibers found on a suspect, thread count and weave patterns are compared. If students have difficulty visualizing how different weave patterns are formed, have them make potholders using the small frames and colored loops found in craft stores. Different colors will easily highlight weave patterns.

Example: Chapter 8 Blood Spatter Analysis:

- Activity 8-2 "Creating and Modeling Blood-Spatter Patterns"
- Activity 8-4 "Area of Convergence"
- Activity 8-7 "Crime-Scene Investigation"
- Activity 8-8 ACT "Antigens and Antibodies"

Students create a three-dimensional model or computerized image of the crime scene described in the activity, showing the furniture, bodies, and blood spatter, to scale. Students describe how they were able to recreate the crime through examination and analysis of the evidence.

There are many free online programs and crime scene apps available to students that enable them to create a room with furnishings to represent their crime scene.

5. ORAL PRESENTATIONS WITH DEMONSTRATIONS

a. ***Pamphlet Creation***

Example: Capstone Project 7 "Forensic Science Career Exploration"

After researching information about various careers in forensics, students present the information on a poster or brochure. This information is shared with other class members either through small or large group presentations.

b. ***Diagrams/Tables/ Artwork***

Example: Activity 14-1 "Determining the Age of a Skull"

If actual models of skulls are not available, students can use diagrams or sketches to effectively demonstrate how to determine the age of a skull using suture lines.

Example: Capstone Project 10 "Gravesite Excavation"

Evidence collectors construct a table listing all evidence, description, location, and evidence disposition that is found on the evidence log. Students should discuss the type of information required in an evidence log.

c. ***Evidence display from the crime scene***

Example: Activity 5-3 "Botanical Evidence Case Studies Presentation"

Students gather information on an actual case study and present it to the class via PowerPoint, posters, or other visual means. Students are provided with preliminary questions to assist them in their research. Working in small collaborative groups, students coordinate research and create their presentation, organizing a visual display of evidence collected from the crime scene, such as pollen found on clothing or mud in the tread of a sneaker, and explain how the evidence was used to help solve the crime.

Example: Capstone Activity 10 "Gravesite Excavation"

Students present the various types of evidence recovered from a gravesite excavation. New information learned from each piece of evidence is discussed. All evidence should be evaluated for its relevance, validity, and reliability. Students may feel more comfortable talking about the different types of evidence with the actual evidence in their hand. If this is done as a team presentation, different members of the team could represent the various specialists called upon to analyze evidence.

Example: Capstone Activity 6 "Forensic Dumpster Diving—What Garbage Can Tell Us" This example demonstrates how multiple forms of evidence are recovered and analyzed from someone's trash. Students present the evidence and describe what information can be learned from the evidence. Students evaluate if the evidence is relevant to the case and could be accepted as evidence in a trial. This activity provides a good medium for discussion of whether evidence is relevant and reliable and if the evidence is properly collected.

6. VIDEO, POWERPOINT PRESENTATIONS, PHOTOGRAPHY—TECHNOLOGY 1

Before making any movie or video, students need a basic understanding of the types of physical evidence. The introduction of the video or movie should include an overview of the physical evidence followed by the application of how that type of physical evidence can link someone to a crime scene. With cooperative learning groups arranged by the instructor, a video or short film works well with heterogeneously grouped classes. Teachers should try to arrange each group so at least one student has a background in science and math and at least one student has experience working with technology, cameras, or cell phone cameras.

Video or Short Film

Most students find creating video clips or movies to be a fun activity. If given an option, many students prefer filming a movie to preparing a written lab report. This type of alternative assessment lends itself to small group collaboration. The narration can be recorded during the demonstration, or the explanation can be added after the video is recorded. This format also allows students to make corrections and revisions by re-filming and editing the video before submitting the final finished product.

Videotaped presentations are especially helpful if the student is not accustomed to presenting in front of an audience and needs to gain more confidence in public speaking. Parts of the presentation can be pre-recorded while other parts can be presented live.

By videotaping explanations of complex concepts such as how to interpret blood spatter analysis or how to distinguish skeletal remains by sex, ancestry, age, or height, students are given time to review each concept and then videotape that segment before proceeding to the next step. Breaking the task into workable segments allows students to review their notes prior to filming each segment of the video.

There are various formats for this presentation, including:

a. ***TV news reporter describing a recent crime***

A news reporter's audience is composed of many non-science persons. The report must be presented in a way that will be easily understood by the general public. The reporter must describe the crime scene and its physical evidence without stating any opinions.

Example: Activity 15-1 "Glass Fracture Pattern Analysis"

This scenario involves two bullet glass fractures. The student analyzes the evidence to determine who shot first based on the glass fracture pattern. Additional information such as direction and force of impact can be determined through glass fracture analysis.

b. ***Talk-show host interviewing a witness or expert witness***

Example: Activity 10-2 "Analysis of Ransom Note and Expert Testimony"

Students act as the expert witness and discuss their analysis in the format of a talk show host (another student) interviewing the expert witness. The expert witness explains how handwriting analysis is performed and analyzed. This video can be taped in front of a live audience or pre-recorded and presented to the class at a later date.

c. ***"How-to" Video***

Students demonstrate how to perform a particular procedure in lieu of taking a written exam. Students are assessed on how a procedure is performed and how it is applied to forensics. Their videos can become future tutorials or can be used as an end-of-chapter review. Blood spatter analysis, identification of fingerprints, preparation of plaster casts, distinguishing male and female bones, comparing handwriting, and mapping out a crime scene lend themselves to this mode of presentation.

Example: Capstone Activity 9 "How to Read Calipers"

Example: Activity 7-1 "Simple DNA Extraction"

Example: Activity 8-6 "Area of Origin"

Describe how blood spatter is analyzed. Students use artificial blood or paper cut outs of blood spatter to recreate a crime scene. They then describe how the blood is analyzed to determine:

- Direction of blood when it drops on a surface
- Area of convergence
- Angle of impact

- Area of origin
- Velocity of blood upon impact
- Type of spatter

Example: Activity 10-3 "Examination of U.S. Currency: Is it Authentic or Counterfeit?" Students describe how to analyze currency using a $10, $20, or $50 bill. The student explains where to look for hidden features in the bill that can be detected using a fluorescence light, magnifying lens, or iodine pen.

Example: Activity 15-4 "Determining the Refractive Index of Liquids Using Snell's Law." Students explain how to estimate the refractive index of a liquid and use this information to estimate the refractive index of glass found at a crime scene.

d. ***PowerPoint Presentation***

Example: Act 5-1 "Pollen Examination: Comparing Suspect Pollen to the Crime Scene Pollen." Students photograph microscopic images of pollen and present the images via a PowerPoint presentation. Students make a claim as to whether the suspect should be included or excluded as a suspect, and must support their claim with evidence.

Example: Activity 13-1 "Sand Observation"

Students collect sand from four different areas. Using digital images taken under a stereomicroscope, students present their findings in a PowerPoint presentation. Their presentation must show the jury that one sand sample was either consistent or inconsistent with the sand at the crime scene. Student claims should be supported by the evidence.

e. ***Time Lapse Photography*** Act 12-5 "ACT: Chicken Decomposition"

This activity should be conducted outside in a protected area that will not be disturbed. As such, it may be difficult to do this near your school.

Some of my students are fascinated observing the changes in decomposition and insect succession, but for some other students, this activity may be disturbing. If there are limiting factors to setting up this demonstration near your school, consider having student volunteer(s) conduct this study at home using time lapse photography to depict the many changes observed over the course of decomposition. Still photos with close-up images should also be obtained. If several students are involved in this study, different students could focus on individual aspects, such as: insect succession on the body, life stages of blowfly or beetle development, stages of decomposition, effect of scavengers, insect predation, insect competition, insect behavior, recovering of insect evidence from the crime scene, and more!

7. PROBES, APPS—TECHNOLOGY 2

Because forensic science classes are heterogeneously grouped, technology background and expertise will vary among students. Cooperative learning groups help students to learn more about technology from their peers while preparing a forensic project. Former forensic students have commented that prior to taking the forensic science class, they did not know how to create a PowerPoint, take digital images from their microscopes, use probes to obtain data, or use calculators to assist in calculations and graphing. Various group projects helped students to acquire these new skills and apply them to their other courses.

Probes

Example: Activity 12-3 "Tommy the Tub"

Using temperature probes, computers, and a large plastic tub filled with warm water, students demonstrate how a body loses heat over 24 hours. Students apply this concept to an actual case study where the postmortem interval was used to help solve a crime.

Apps

There are many apps available to assist students in their forensic investigations. Students should research forensic apps and demonstrate to the other students how these apps can facilitate forensic investigations. Apps are particularly useful in mapping out crime scenes.

8. PODCASTS—TECHNOLOGY 3

Most students are very comfortable using technology to gain information and will tend to look for information from these resources. It is important to examine the information and its source to determine if the information is scientifically valid.

Podcasts are especially useful to:

A. Stimulate interest when first introducing a topic ("Excite" phase or your anticipatory set)

B. Use as extensions for extra credit

C. Use as an additional resource for a "flipped classroom"

D. Differentiate learning to meet the needs of heterogeneously grouped classes:

1. Auditory learners
2. Advanced students who want to extend their learning
3. Alternative form of research for students with reading difficulties

E. Use as an alternative type of assessment

1. Students listen to the podcast.
2. Students evaluate the podcast for accuracy.
    a. Scientific accuracy
    b. Evaluate the research, analysis, and conclusions
3. Students conduct further research on the topic from scientific sources.
4. Students research a case study that applies information discussed in the podcast.
5. Students collaborate in small groups to discuss the topics and share information.
6. Students perform a peer evaluation prior to their formal presentations.
7. Students conduct a poster session or oral presentation to present their research.

Many scientific podcasts could be used in addition to those listed on the Bertino Forensic Science Website. Examples of useful podcasts are given below:

Example: Chapter 2 Crime-Scene Investigation and Evidence Collection

- How Crime Scene Investigation Works
- How Crime Scene Photography Works

Example: Chapter 8 Blood and Blood Spatter

- How Bloodstain Pattern Analysis Works

Example: Chapter 10 Handwriting Analysis, Forgery, and Counterfeiting

- How Handwriting Analysis Works

Example: Chapter 12 Death: Manner, Mechanism, Cause

- How Autopsies Work
- How "Body Farms" Work

Example: Chapter 13 Soil Evidence

- Radiolab podcast. "Fu-Go," April 25, 2019 Act 13-8 ACT: Japanese Fire Balloon Podcast.
- NPR podcast # 853 "Peak Sand" (International Shortage of Sand) Act 13-9 ACT: Sand Theft Podcast

9. HANDS-ON LEARNING

Students design and perform a hands-on activity to demonstrate their comprehension of a certain concept. Students should film the hands-on activity and its explanation so it can be used as an example in future classes.

Example: Activity 4-3 Weave Pattern Analysis

Students create weave patterns using crepe paper or colored streamers. Some students hold the warp threads while other students weave the weft threads in a designated weave pattern. If one color thread is used for the warp and a contrasting color is used for the weft, it is easier to see the pattern. If possible, videotape the weaving process and the finished product.

Example: Visualization of Molecular Biology (Chapter 7). Challenge students to create a model that demonstrates:

- Two different STR alleles
- An intron and an exon
- Model of DNA
- Model of DNA Gel Electrophoresis:

After learning about DNA fingerprinting and viewing different animations on the process, ask students to design and participate in a DNA gel electrophoresis simulation using students as the restriction fragments. Avoid giving an explanation. Instead, refer to ***Forensics Who Dunnit? A Visual, Active Class Participation Simulation of Gel Electrophoresis***. To download the article, go to http://www.bertinoforensics.com/teacher_resources.html and click on the link under *demos*.

Example: Chapter 9 Forensic Toxicology: *Chapter Review, Going Further*:

Students work in small collaborative groups to investigate the effect of various drugs on the central nervous system. Each team describes how their particular drug affects nerve transmission and the central nervous system.

After completing the lab activity, students research additional information about how the nervous system transmits messages resulting in behavior modification or other responses. Different teams of students may go further and present student hands-on demonstrations that depict one of the following items in the list below. Not all students are required to do all activities.

a. Changes in a neuron during an impulse

b. Nerve threshold levels

c. Difference between the brain receiving a strong and a weak stimulus

d. Neurotransmitter production and uptake

e. Neurotransmitter inhibitors

f. Effect of specific drugs on the central nervous system

Example: Activity 8-8: "Antigens and Antibodies "

What are antibodies? What occurs when an antibody reacts to a specific antigen? Using balloons and students acting as antibodies, the immune response is visualized.

10. CREATIVITY: **MUSIC, ART, DANCE, WRITING, PHOTOGRAPHY**

Encourage students to integrate forensics with their individual creative abilities. It's important to discover and use the "hidden" talents of your students. Many students may not excel on written exams, but if given an opportunity to combine forensics with a hobby or talent, you might be surprised at their ability to demonstrate mastery of a topic. Students should explain their work and how it pertains to forensics.

Example: Music

Students write a song or rap that helps you access their knowledge. Refer students to Bio-Rad's production of The PCR Song called "GTCA So Fast" to provide them with a model.

http://practicality.wordpress.com/2009/09/11/video-bio-rad-gtca-song/

Example: Artwork

Students who are artistically inclined can draw sketches of bones (Chapter 14) demonstrating the difference between male and female bones, differences among ancestral groups, or age groups. Artwork is used to explain the internal structure of hair that can be distinguished under a microscope, markings on a fired bullet or cartridge shell casing used to determine what firearm was used to fire the projectile, structure of blowfly larva used to estimate PMI, or the various minutiae patterns found in a fingerprint, soil profiles, DNA structure, bloodstains patterns, and glass fracture patterns. Artistic students can be especially helpful in recreating and sketching a crime scene to scale.

An inexpensive "canvas" to create a large model of the artwork can be drawn on solid-colored flat bed sheets using a permanent marker. These works of art and teaching tools are easily stored and can be used year-after-year. Be sure the artists sign their name and date on the artwork!

Example: Dance or drama

Students and their classmates demonstrate a scientific process or concept using dance or theater. Dance is a learning tool for visual learners. Students remember these demonstrations because they were actively involved in their presentation.

Students can demonstrate weave patterns or thread counts (Chapter 4) found in different types of fabric. Assemble the students on a football field or in a gym. Each student has a roll of different colored crepe paper. Using the crepe paper and movement of the students, various weave patterns and thread counts can be easily visualized. The "dance" should be filmed from above in the bleachers and played back to students to show them how various weave patterns or different thread counts are produced. Refer to Activity 4-2 "Bedsheet Thread Count" and to Activity 4-3 "Weave Pattern Analysis".

Students interested in acting may elect to "stage" an interview with suspects or present an expert witness testimony. Students demonstrate proper technique in interviewing a suspect or eye witness. Expert witness testimony is designed to use the scientific evidence associated with a crime to support a claim.

Example: Creative writing: Short stories, poem, song, or rap

Encourage students to incorporate their knowledge of forensics into an original short story, poem, song or rap. Students create their own story or song describing how a crime was resolved. The lyrics of a song or subject of a poem could be a description of a type of evidence or procedure used in forensics.

- Activity 6-3 "Studying Latent and Plastic Fingerprints"

The story centers around a crime solved through the identification of fingerprints. The student can weave a story around the crime including how the fingerprints were "lifted" and later analyzed to reveal that one of the suspects was present at the scene of the crime.

- Activity 13-6 "Soil Evidence Examination"

In this situation, the story revolves around a crime involving soil or sand evidence found in the tread of a sneaker or tire. This form of assessment can encourage students to research why different environments have distinctive sand or soil.

Example: Photography

There are many possibilities for forensic students interested in photography to demonstrate mastery of a topic. Every crime scene depends upon a photographer documenting the crime scene (Chapter 2) and the crime scene evidence *before* anything is touched. Often, court

decisions are made based on the evidence captured in photos. Evidence photos involve evidence found at the crime scene as well as photos of the crime scene evidence taken through the lens of a microscope.

- Chapter 16 “Casts and Impressions”

Photos of impressions: tire, footprints, tool marks, etc., should be taken at the site of the crime scene before anything has been disturbed. Photos of tire marks are especially useful to help the analyst determine the chain of events at a crime scene. Students photograph images of tire marks from an accident, or request those images from the police. Working with an officer from the accident reconstruction team, students prepare a presentation of these images along with explanations as to what could be learned from the impressions from the accident.

- Activity 2-2 "Crime-Scene Investigation"

Ask a student photographer in your class to research the best way to take photographs at a crime scene. Suggest that the student interview the local police photographer. Encourage the student to research what types of cameras are used. What is the best lighting to emphasize details? What is the best angle of lighting to use?

Throughout the year, ask your “class photographer(s)” to photograph your class demonstrations and displays. Have them create a photographic database of items you have chosen from your school and school grounds. Examples include:

- Flowers and pollen from the school grounds Activity 5-1 "Comparing Suspect Pollen to Crime-Scene Pollen”
- Broken glass and fracture patterns Activity 15-1 "Glass Fracture Pattern Analysis"
- Sneaker impressions of students in your class Activity 16-1 "Making a Plaster of Paris Cast"
- Tools and tool marks Activity 17-2 "Hammer and Hammer Impressions"
- Close up images of blowfly larva in various stages of development: Activity 11-3 "Observation of Blowflies or Houseflies"
- Drug testing lab test results: Activity 9-3 "Drug Spot Test"

11. FORENSICS BOOK REPORTS

Students read case studies from scientific books or journals and present and summarize the case study to the class. There are many different formats for presenting. For example, student can utilize PowerPoint slides, interviewer/interviewee, poster, pamphlet, 3-D models, etc. All presentations must include a descriptive oral component. Students should discuss the content and format of their presentation with you in advance.

There are many high-interest forensics books that contain appropriate reading material for most high-school students. Provide an approved reading list for students, such as the Forensic Books of interest list from the Cengage Companion site. This list can also be downloaded from the Bertino website www.BertinoForensics.com. (Click on teacher resources and then *books* and *magazine links*). Forensics topics include murder, violence, rape, death, and decomposition. Be sensitive to the age level of your students. ***Avoid readings describing excessive violence,***

rape, gruesome crime scenes, or serial killers. Develop your own approved reading list based on your student population.

Example: *Unnatural Death: Confessions of a Medical Examiner,* by Michael M. Baden. Interesting description of how different forms of evidence helped to solve crimes.

Example: *Tales from the Morgue* by Cyril Wecht, MD, JD. and Mark Curriden. This book describes nine famous cases and gives Dr. Wecht's detailed assessment of the evidence and his views of the jury's verdict. (Chapters 2 and 12)

Example: *Picking Cotton* by Ronald Cotton and Jennifer Thompson-Cannino. Through the Innocence Project, DNA evidence was used to help exonerate Ronald Cotton, who had served 11 years for a crime he did not commit. The story is told by Ronald Cotton and by Jennifer Thompson-Cannino, the woman who erroneously identified him in a line-up as the man who attacked her. *(The book deals with rape, so it may not be appropriate for younger students.)* (Chapter 7)

Example: *The Romanovs: The Final Chapter* by Robert K. Massie. This book integrates history, archeology, and forensic anthropology. Robert Massie's description of the fates of the Romanovs reads like a detective story. It shows how an international team of scientists identified the skeletal remains of the Romanov family using information from written records and the skeletal and dental remains along with DNA from the remains. (*There are graphic sections of this book.)* (Chapters 7 and 14)

Example: *The Poisoner's Handbook* by Deborah Blum. The author presents fascinating true stories describing early case studies in toxicology that provided the basis of modern toxicology. (Chapter 9)

Example: *A Fly for the Prosecution by M. Lee Goff.* Case studies reveal how insects have helped solve crimes. (Chapter 11)

Example: *Death's Acre* by Dr. Bill Bass and Jon Jefferson. Written by the founder of the Body Farm, this story describes the process of decomposition under varying conditions. Dr. Bass's work was innovative, and for the first time provided a way to estimate time of death based on the rate of decomposition found in different environmental locations. In this book, Bill Bass describes his most intriguing cases. (Chapter 12)

Example: *Cause of Death* by Stephen Cohle, M.D. and Tobin T. Buhk. Using several case studies, the author describe how information about the cause and manner of death is revealed through autopsies. (Chapter 12)

Example: *Corpse: Nature, Forensics, and the Struggle to Pinpoint Time of Death* by Jessica Snyder Sachs. In this book, the author explores how time of death is estimated using nature and technology. As the title states, time of death is not an exact science. The importance of determining the time of death is that is can be used to exonerate an innocent person or to help link a suspect to a crime. (Chapter 12)

Example: *Written in Bone* by Sally Walker. This book, written for students, describes the life of early American colonists based upon examinations of their skeletal remains. (Chapter 14)

Example: *Breaking Ground, Breaking Silence* by Joyce Hansen and Gary McGowan. This book integrates forensic anthropology, archaeology, history, politics and culture. More than 400 skeletal remains were discovered while excavating ground for a building site near Wall Street in New York City. The skeletal remains revealed the history of the lives of enslaved Africans in early colonial New York. (Chapter 14)

12. MINI-POSTER SESSIONS

Mini poster ideas, originally described by Brad and Carol Williamson, (NABT BioBlog April 4, 2012) provide an alternative assessment that:

a. Requires students to present and defend their topic

b. Encourages discussion and student collaboration

c. Encourages students to evaluate evidence and information

d. Incorporates authentic peer review and formative assessment

e. Can include technology though the use of computer-generated graphs and charts and digital images

f. Allows for easy revisions

g. Can be produced in a minimal amount of time and requires little space

h. Can be assigned either as an individual or team project

To construct a mini poster:

1. Take two (or three) colored or plain manila folders stapled together to create a three (or four) page mini poster. (Remove the tabs.)
2. Use sticky notes to post headings.
3. Use a different color sticky note to add text under the headings.
4. Glue graphs or images to the small sticky notes.

To conduct peer review and question-answer poster sessions:

1. Divide the class in half.
2. One half of the class presents and defends their posters; the other half rotates from one poster to another and evaluates the poster and presenter. (Approximately 5 minutes is spent at each poster.)
3. Reverse Step 2 several times so that the poster presenters become the evaluators and the evaluators become the presenters.
4. The instructor and the students should develop a rubric or guide to help to evaluate each poster and presenter.
5. Optional: Prior to the formal poster evaluations, encourage students to have at least one other student peer-review their poster. Minor corrections can be completed prior to the formal poster evaluations.

Activities to be evaluated through mini-poster sessions:

Example: Capstone Project 1 "Physical Evidence Case Studies"

This is an excellent project for the first term of forensics. Divide the class into teams of two. Each team selects a different type of physical evidence used in solving crimes. They become the "specialist" for that type of evidence.

Each team researches actual case studies where a crime was solved using that type of evidence. During the year, when you introduce a new type of evidence, the two student specialists or experts introduce the topic using a case study from their mini poster project. They provide information on the correct procedure for collecting that form of evidence. The team's mini poster remains on display during that chapter. Display all the mini posters at the end of the school year to review all types of evidence discussed in the course.

Example: Capstone Project 4 "Landmark Cases in Acceptance of Evidence."

Students summarize the case and describe why the case was considered to be a landmark case.

Example: Capstone Project 5 "Analysis of a Forensic Science Movie or TV Show Episode" (This could also be evaluation of a forensic novel.) Students present a synopsis of the program or book and evaluate whether the information depicted in the TV program or forensic novel is consistent with real CSI procedures. Any inconsistencies should be described along with an explanation of how the procedure should be done.

Example: Capstone Project 6 "Forensic Dumpster Diving—What Garbage Can Tell Us." Students collect trash and develop a profile of the person or family who discarded the trash. Refer to Figure 2 in the Activity for a list of characteristics that can be discovered as a result of analyzing trash. Students present their analyses in mini-poster sessions.

Example: Act 13-8 "Japanese Fire Balloon Podcast"

Student summarize how sand was used to identify the source of the Japanese Fire Balloons launched at the end of WWII. Students should include photographs, graphics and/or art work that explains why sand was used in the air balloons that dropped bombs on the U.S.

13. DEBATE

Students demonstrate their knowledge by planning and conducting a debate. Students are provided with a Debate Strategy WKST and Debate Planning WKST. Students plan, organize and conduct the debate. Students should be prepared to argue how their claims are supported using scientific evidence and to be able to counterargue the opposing teams' arguments.

Example: Capstone Activity 3 "How Reliable Is the Evidence?"

Students are provided with advice on how to conduct a debate, what information to research along with a debate strategy form found on Companion Site.

Example: Activity 9-2 "Should Medical Marijuana Be Legalized in all States?"

Debate procedure and strategies are provided. An alternative debate on the topic of drugs is whether or not high school athletic teams should be given routine drug tests.

Example: Activity 9-7 “Drug Testing Debate”

14. MENTORING BY CSI, POLICE

If possible, try to locate someone in forensic science or in the police department who would mentor a student. This might entail the student spending a day or more with the person to learn firsthand about what really happens on the job. Information can be displayed or presented in a variety of formats including posters, brochures, PowerPoint presentations, videos, or oral presentations.

Example: Activity 16-4 "Vehicle Identification"

Ask a student to observe how accident reconstruction is performed using skid mark analysis and vehicle identification marks.

Example: Activity 6-3 "Studying Latent and Plastic Fingerprints"

Ask a student to observe how police or CSIs are able to lift a latent print and enter it into the computer-based database.

Example: Capstone Activity 8 “Crime-Scene Development and Processing"

Students work with a crime-scene investigator to help set up mock crime scenes for processing.

Example: Capstone Project 10: “Gravesite Excavation”

Students working with advice of the police or CSIs set up a mock gravesite containing evidence pertaining to the crime, the suspect, and time of year when the crime was committed. Other students in the class are asked to analyze the gravesite and document the evidence.

15. ENGINEERING AND DESIGN

Example: Chapter 1 Observation Skills, Chapter Review.

Design a crime scene that includes multiple forms of evidence.

Example: Chapter 6 Fingerprinting, Chapter Review item 20.

Design a technique to produce plastic fingerprint impressions.

Example: Act 7-6 on Companion Site, "Design and Build a Human DNA Structure"

After providing students with the directions for this activity, challenge them to construct a simulated human DNA molecule.

Example: Activity 9-3 “Drug Spot Test. After conducting the preliminary drug spot test, students are asked to redesign the lab protocols to ensure greater evidence reliability and validity.

Example: Activity 11-2 "Mini-Projects for Forensic Entomology”

Design a rearing chamber for blowflies that will be kept at a constant temperature to obtain control data for accumulated degree hour calculations.

Example: Activity 11-3 "Observation of Blowflies or Houseflies"

Design a technique to view the spiracle slits of blowfly larvae under a stereomicroscope.

SUMMARY

Encourage students to propose, design and create their own forms of alternative assessments. Provide students with time to develop their ideas before providing them with suggestions.

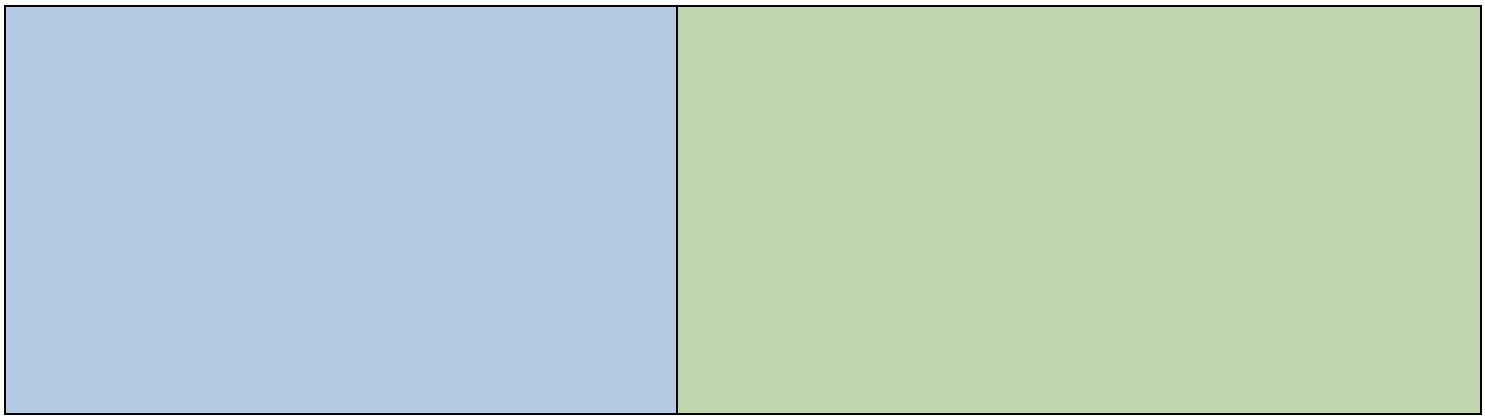
These are only some examples that describe the many ways that student learning can be assessed using the varying formats designed to:

- Improve *student* comprehension and retention
- Provide differential assessments for heterogeneously grouped classes
- Encourage ongoing and frequent assessments so that teaching can be modified to enhance student performance
- Showcase the hidden talents of students
- Motivate and inspire students to do better
- Make learning fun and exciting

The NGSS standards listed in this document have been selected as those most closely aligned with the content in this specific chapter of the third edition of Forensic Science: Fundamentals and Investigations. There may be cases in which portions of a standard are outside the scope of knowledge required for a forensic science course as it is dictated in the standard. Or there may cases in which a concept in the standard is built by scaffolding across chapters. In these cases, the specific portion of the standard is italicized.

Chapter 6 Fingerprints	
Introduction The History of Fingerprinting The Science of Fingerprints Formation of Fingerprints Characteristics of Fingerprints Types of Fingerprints Basic Ridge Patterns Subdivisions of Ridge Patterns Minutiae and Fingerprint Identification Collection and Documentation of Fingerprints Photographing Fingerprints Methods of Collection Collecting Latent Fingerprints Collecting Patent Prints Collecting Plastic Prints Collecting Suspect Prints Forensic Analysis of Fingerprinting How Are Fingerprints Analyzed? Fingerprint Reliability and Validity Can Fingerprints Be Altered or Disguised? Advances in Fingerprinting Chapter Overview Case Studies Careers in Forensics *Peter Paul Biro* Chapter 6 Review Activity 6-1 Study Your Fingerprints Activity 6-2 Giant Balloon Fingerprint Activity 6-3 Studying Latent and Plastic Fingerprints Activity 6-4 How to Print a Ten Card Activity 6-5 Minutiae Patterns Activity 6-6 Fingerprint Analysis Activity 6-7 Using Cyanoacrylate to Recover Latent Fingerprints Activity 6-8 ACT Print Variations	**Disciplinary Core Ideas** **PS1.A: Structure and Properties of Matter** • *The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1), (HS-PS1-2)* **PS1.B: Chemical Reactions** • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2) **PS4.C: Information Technologies and Instrumentation** • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5) **LS1.A: Structure and Function** • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and

	decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)
Science and Engineering Practices	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3) **Obtaining, Evaluating, and Communicating Information** • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5) **Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1) **Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-2), (HS-PS1-3), (HS-PS1-5) **Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2), (HS-LS1-4) ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5) • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)



The Chapter Activities build toward competence in the following Performance Objectives:

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties**.**

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

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Common Core Language and Common Core Math Correlation

Chapter 6 Fingerprints	
Introduction The History of Fingerprinting The Science of Fingerprints Formation of Fingerprints Characteristics of Fingerprints Types of Fingerprints Basic Ridge Patterns Subdivisions of Ridge Patterns Minutiae and Fingerprint Identification Collection and Documentation of Fingerprints Photographing Fingerprints Methods of Collection Collecting Latent Fingerprints Collecting Patent Prints Collecting Plastic Prints Collecting Suspect Prints Forensic Analysis of Fingerprinting How Are Fingerprints Analyzed? Fingerprint Reliability and Validity Can Fingerprints Be Altered or Disguised? Advances in Fingerprinting Chapter Overview Case Studies Careers in Forensics *Peter Paul Biro* Chapter 6 Review Activity 6-1 Study Your Fingerprints Activity 6-2 Giant Balloon Fingerprint Activity 6-3 Studying Latent and Plastic Fingerprints Activity 6-4 How to Print a Ten Card Activity 6-5 Minutiae Patterns Activity 6-6 Fingerprint Analysis Activity 6-7 Using Cyanoacrylate to Recover Latent Fingerprints Activity 6-8 ACT Print Variations	**Common Core (CCSS Science Literacy, Language Arts)** CCSS.ELA-LITERACY.RST.9-10.1 RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.2 RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-LITERACY.RST.9-10.3 RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Craft and Structure: CCSS.ELA-LITERACY.RST.9-10.4 RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*. CCSS.ELA-LITERACY.RST.9-10.5 RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). CCSS.ELA-LITERACY.RST.9-10.6 RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. Integration of Knowledge and Ideas: CCSS.ELA-LITERACY.RST.9-10.7 RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.8 RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CCSS.ELA-LITERACY.RST.9-10.9 RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own

	experiments), noting when the findings support or contradict previous explanations or accounts. Range of Reading and Level of Text Complexity: CCSS.ELA-LITERACY.RST.9-10.10 RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.WHST.9-10.2 WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. CCSS.ELA-LITERACY.WHST.9-10.2.A WHST.9-10.2.A Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. CCSS.ELA-LITERACY.WHST.9-10.2.B WHST.9-10.2.B Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. CCSS.ELA-LITERACY.WHST.9-10.2.C WHST.9-10.2.C Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. CCSS.ELA-LITERACY.WHST.9-10.2.D WHST.9-10.2.D Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. CCSS.ELA-LITERACY.WHST.9-10.2.E WHST.9-10.2.E Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. CCSS.ELA-LITERACY.WHST.9-10.2.F WHST.9-10.2.F Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). CCSS.ELA-LITERACY.WHST.9-10.4 WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

	CCSS.ELA-LITERACY.WHST.9-10.7 WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CCSS.ELA-LITERACY.WHST.9-10.8 WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CCSS.ELA-LITERACY.WHST.9-10.9 WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research. CCSS.ELA-LITERACY.WHST.9-10.4 WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. CCSS.ELA-LITERACY.WHST.9-10.10 WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. CCSS.ELA-LITERACY.RST.11-12.1 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.2 RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. CCSS.ELA-LITERACY.RST.11-12.3 RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. Craft and Structure: CCSS.ELA-LITERACY.RST.11-12.4 RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are

	used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.5 RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. CCSS.ELA-LITERACY.RST.11-12.6 RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. Integration of Knowledge and Ideas: CCSS.ELA-LITERACY.RST.11-12.7 RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CCSS.ELA-LITERACY.RST.11-12.9 RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. Range of Reading and Level of Text Complexity: CCSS.ELA-LITERACY.RST.11-12.10 RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. CCSS.ELA-LITERACY.WHST.11-12.2 WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. CCSS.ELA-LITERACY.WHST.11-12.2.A WHST.11-12.2.A Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. CCSS.ELA-LITERACY.WHST.11-12.2.B WHST.11-12.2.B Develop the topic thoroughly by selecting

	the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. CCSS.ELA-LITERACY.WHST.11-12.2.C WHST.11-12.2.C Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. CCSS.ELA-LITERACY.WHST.11-12.2.D WHST.11-12.2.D Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. CCSS.ELA-LITERACY.WHST.11-12.2.E WHST.11-12.2.E Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). CCSS.ELA-LITERACY.WHST.11-12.4 WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. CCSS.ELA-LITERACY.WHST.11-12.7 WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CCSS.ELA-LITERACY.WHST.11-12.8 WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CCSS.ELA-LITERACY.WHST.11-12.9 WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

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Common Core Language and Common Core Math Correlation

	Common Core (CCSS Mathematics)
	CCSS.Math.Practice.MP2 - Reason abstractly and quantitatively. CCSS.Math.Practice.MP3 - Construct viable arguments and critique the reasoning of others. CCSS.Math.Practice.MP4 - Model with mathematics. CCSS.Math.Practice.MP5 - Use appropriate tools strategically. CCSS.Math.Practice.MP8 - Look for and express regularity in repeated reasoning. CCSS.Math.Content.HSS-IC.B.6 - Evaluate reports based on data.