

THE BIOTECHNOLOGY  
EDUCATION COMPANY®

Edvo-Kit #  
**S-91**

Edvo-Kit #S-91

## Whose Fingerprints Were Left Behind

### Experiment Objective:

The objective of this experiment is to familiarize students with the use of various fingerprinting dusting powders and to match fingerprints as a classroom detective activity.

See page 3 for storage instructions.

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## Experiment Components

### Contents

|  | Check (✓)                |
|--|--------------------------|
| • Brushes  | <input type="checkbox"/> |
| • 1 Ink pad  | <input type="checkbox"/> |
| • 5 Magnifying lenses  | <input type="checkbox"/> |
| • Fingerprint Report Card™ paper (to be cut and distributed) | <input type="checkbox"/> |
| • Black fingerprinting dusting powder                        | <input type="checkbox"/> |
| • Gray fingerprinting dusting powder                         | <input type="checkbox"/> |
| • Weigh boats  | <input type="checkbox"/> |
| • Fingerprint lift tape                                      | <input type="checkbox"/> |
| • FBI Fingerprint Data Sheet (1 example provided)            | <input type="checkbox"/> |

Experiment #S-91 is designed for 32 students.

**Storage:**  
Experiment is stored at room temperature.

All experiment components are intended for educational research only. They are not to be used for diagnostic or drug purposes, nor administered to or consumed by humans or animals.

## Requirements

- Safety goggles
- Disposable vinyl or latex laboratory gloves
- Scissors
- Paper towels
- Various objects for evidence prints that have a smooth surface and are uniform in color (e.g. glass beakers/flasks or metal/plastic objects)
- Lab tape for labeling fingerprinted objects
- Pens

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## Background Information

### THE ORIGINS OF FINGERPRINTING

Fingerprinting is a type of biometric identification that differentiates between individuals based on the unique impression produced by the ridges present on the tips of the fingers. The practice of fingerprinting dates back to antiquity, where potters used their fingerprints to mark their work. In ancient Babylon and China, officials used fingerprints to sign contracts and other legal documents, although it is not clear whether these fingerprints served as identification or as a ceremonial gesture.

In the 1850's, William Herschel, a British officer stationed in India, introduced the practice of fingerprinting to prevent fraud. Each contract included an imprint from the right hand using a stamp pad as the source of the dye. After several years, he recognized that an individual's fingerprints were unique and did not change over time. However, Herschel never recognized the utility of fingerprinting in forensic science.

It was not until the late 1800s that scientists explored methods to use a person's physical characteristics as a tool for identification. The French police expert Alphonse Bertillon recognized that human bone structure and dimensions were very diverse, and that individuals had a unique combination of measurements. As such, he developed a system of identification based upon measurements of body parts, focusing on the head, face, hands, and feet.

In 1880, the Scottish physician Henry Faulds recognized the potential of using human fingerprints as a method of identification. He published these findings in the prestigious journal *Nature*. Faulds' paper inspired the anthropologist Francis Galton to further study the nature of a person's fingerprints. After ten years of exhaustive research, Galton published the classic reference book *Finger Prints*. This book provided a detailed description of the anatomy of a person's fingers, assigning them separate categories based on the specific arrangement of ridges on the fingertips. The publication of *Finger Prints* is widely considered to be the beginning of fingerprinting as an acceptable form of identification. Galton's work inspired Sir Edward Henry to develop a system for criminal identification based on fingerprint patterning. This system was widely accepted around the world, and elements from the Henry Classification System are still used in fingerprint analysis today.

Fingerprinting was first used in the United States in 1901, when the New York Police Department used the Henry Classification system to identify criminals. Within a few years later, it was used in all major cities of the United States. The FBI established a fingerprint database in 1925, and to this day it has the largest collection of fingerprints in the United States.

Although the admissibility of fingerprint evidence was challenged in 1999, fingerprint evidence remains an important forensic tool to this day. However, traditional fingerprinting complements a wealth of different forensic techniques. For example, chemistry techniques are used to describe the composition of trace evidence found at crime scenes. Toxicology studies are used to determine whether poisons, drugs, and/or alcohol are present in bodily fluids. Furthermore, DNA profiling is a technique that allows forensic scientists to identify potential suspects by detecting genetic differences. It is often called DNA fingerprinting as a nod to traditional forensic science.



## Background Information, continued

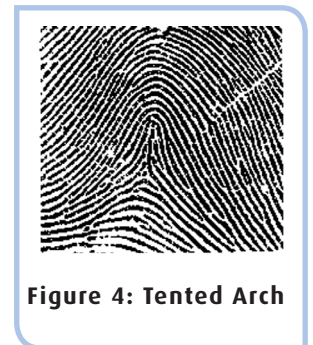
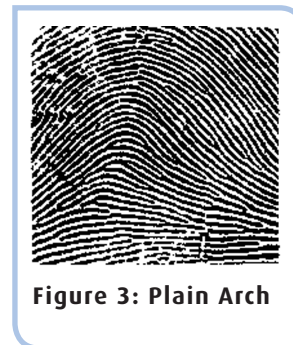
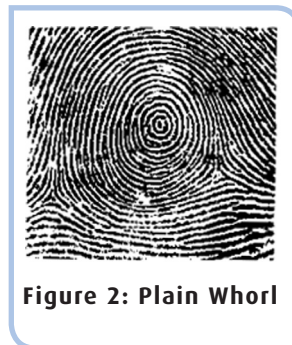
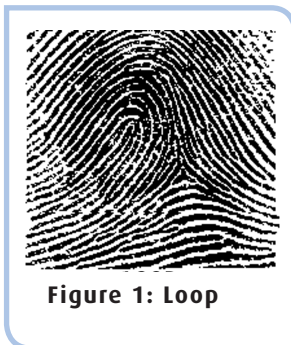
### ANALYZING FINGERPRINTS

While not as definitive as DNA fingerprinting, traditional fingerprinting remains an effective and rapid form of identification. Fingerprints represent a very important form of physical evidence because each one has a unique combination of elements. This makes a fingerprint a distinguishable characteristic of a particular individual. The differences between fingerprints are not based on the general shape or size of the finger but by the number, appearance, and organization of unique ridges present on the fingertips.

Fingerprints are divided into three patterns referred to as loops, whorls, and arches. Loops are the most common of fingerprint patterns, representing about 60% of the population. Around 30% of the population has whorls. Arches are the least common of the three general patterns, representing about 10% of all fingerprints.

A typical loop (Figure 1) displays one or more ridges that enter from one side of the print, curve like a loop, and exit from the same side. The whorl has at least one ridge that makes a complete circle. Many times, the ridges form concentric circles (Figure 2). In general, arches display ridges that enter from one side of the fingertip and exit from the other side. Arches are further subdivided into plain or tented forms. Plain arches are wavelike, gently rising in the center of the arch pattern (Figure 3). In contrast, the tented arch has a sharp cone like pattern at the center of the fingertip (Figure 4).

In this experiment, students will explore the use of fingerprint evidence in forensic science. First, students will collect their entire set of fingerprints using the Fingerprint Report Card™. After creating fingerprint “evidence”, students will use various fingerprinting dusting powders to collect the “crime scene” fingerprints. To identify the “suspect”, students compare the crime scene evidence to the Fingerprint Report Cards™.



## Experiment Overview

### EXPERIMENT OBJECTIVE:

The objective of this experiment is to familiarize students with the use of various fingerprinting dusting powders and to match fingerprints as a classroom detective activity.

### LABORATORY SAFETY

1. Gloves and goggles should be worn routinely as good laboratory practice.
2. Exercise extreme caution when working with equipment that is used in conjunction with the heating and/or melting of reagents.
3. DO NOT MOUTH PIPET REAGENTS - USE PIPET PUMPS.
4. Exercise caution when using any electrical equipment in the laboratory.
5. Always wash hands thoroughly with soap and water after handling reagents or biological materials in the laboratory.



### LABORATORY NOTEBOOKS:

Scientists document everything that happens during an experiment, including experimental conditions, thoughts and observations while conducting the experiment, and, of course, any data collected. Today, you'll be documenting your experiment in a laboratory notebook or on a separate worksheet.

#### Before starting the Experiment:

- Carefully read the introduction and the protocol. Use this information to form a hypothesis for this experiment.
- Predict the results of your experiment.

#### During the Experiment:

- Record your observations.

#### After the Experiment:

- Interpret the results – does your data support or contradict your hypothesis?
- If you repeated this experiment, what would you change? Revise your hypothesis to reflect this change.



## Making Ink Prints

1. Wash hands thoroughly with soap and water. Dry hands completely.
2. Each student should obtain a 1.25" x 2" Fingerprint Report Card™ from their instructor – **handle at the edges and avoid touching the shiny/smooth side of the paper.** Write your name at the very bottom of the shiny/smooth side of the card.
3. Press one of your thumbs lightly on the ink pad and press firmly on the shiny/smooth side of your Fingerprint Report Card™. Use a damp paper towel to wipe excess ink from your thumb. Notice the pattern of the print and record how you would classify the pattern of your fingerprint (i.e. loop, arch, whorl).

**NOTE:**

Be careful not to prematurely touch the shiny/smooth side of the Fingerprint Report Card™ until you are ready to place your fingerprint.

## Making "Evidence" Prints

1. Your instructor will provide a secret code to label items to be fingerprinted as "evidence" from a crime scene. It is important that you keep your code a secret from your classmates.
2. Next, select several objects from the lab, such as glass beakers/flasks or metal/plastic objects that have a smooth surface and are uniform in color.
3. Place a piece of tape on the bottom of the object and write your secret code on the tape.
4. Use a paper towel or tissue to thoroughly clean an area on the object. Place both thumbs firmly on the clean area of the object. Do not slide or move your thumbs (this will smudge the fingerprint) and quickly remove them away from the object.
5. Choose a dusting powder that contrasts in color with the object on which you fingerprinted. Use the designated brush for that powder and do not mix brushes between different color powders. This will yield poorly developed prints due to the mixing of the powders.
6. It is important that you start with a clean dusting brush. Tap the handle of the brush or twirl the brush between your fingers to remove excess powder prior use.
7. Transfer some of the powder to a weigh boat and lightly dip the tips of the brush in the powder. Too much powder will ruin a good, well-defined print.
8. Use a circular sweeping motion to just graze across the surface of the object suspected of containing the print until you can see the print begin to appear. When you have located the print, continue to brush the area lightly, using additional powder if necessary. Once the fingerprint ridges appear, the motion of the brush should follow the direction of the ridge flow. When the print is clearly developed, stop brushing the area – further brushing may destroy the print.
9. Carefully remove excess powder surrounding the print with a clean brush.
10. Compare your ink print with your "dusted" print. How does it compare? Would you conclude that these prints matched?
11. Identify the type or style of your fingerprint.

**HELPFUL NOTE:**

If your finger is dry, rub it along the side of your nose to pick up some oil.



## Optional Activity: Comparison of Fingerprints to Detect Crime Scene Evidence

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1. Move your fingerprinted objects to different areas of the classroom. It is not necessary to hide the items and your instructor may assign specific areas for placement of them.
2. All students should lay their Fingerprint Report Card™ (fingerprint side up) in an orderly manner on a desk or lab bench.
3. Place gloves on hands to avoid making prints on the “evidence” (i.e. the existing prints).
4. Select a Fingerprint Report Card™ (other than your own) and walk to the teacher-designated sites in the classroom comparing the print on the Fingerprint Report Card™ to the printed objects. **NOTE: Use caution when touching the objects so as not to disturb the evidence.**
5. Try to match the Fingerprint Report Card™ to the evidence prints. Record the name of the ink print from the Fingerprint Report Card™ and the code of the print that you think matches.
6. Trade Fingerprint Report Cards™ with another student and look for the evidence print that matches. Write the name of the ink print and the code of the print that you think matches. After several minutes, trade again and look for evidence that matches the prints.
7. After recording several observations, your teacher will reveal the identity of the secret codes so you can check your detective work. Were you able to match any of the Fingerprint Report Cards™ with the evidence prints?

## Study Questions

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1. List the three main fingerprint patterns and draw the characteristic shape. Name a few of the sub-patterns.
2. What percentage of each fingerprint type are found in the population (i.e. – what percentage of people have whorls vs. loops vs. arches)?
3. True or False - The uniqueness of fingerprints is based on the general shape or pattern of an individual's finger.
4. When and how were fingerprints first used in the United States?
5. Describe the difference between classic fingerprinting and DNA fingerprinting.

# Instructor's Guide

## Pre-Lab Preparations:

1. Assemble the following materials and set up 5 stations for students to share:
  - Dusting brushes
  - Dusting powder in weigh boats
  - Various items for fingerprinting (beakers, flasks, drinking glasses, etc.)
  - Lab tape for labeling fingerprint items
  - Magnifying glasses
  - Paper towels for cleaning hands
2. Set up a code sheet to identify students with a secret code. Assign a number to students and ask them to be discreet about their code.
3. Wear gloves and cut the provided 5" x 8" Fingerprint Report Card™ papers into 1.25" x 2" pieces (two 5" x 8" pieces are provided with this experiment). **See Appendix A for cutting Template.** Avoid touching the shiny/smooth side of the Fingerprint Report Card™ paper. (This is where students will place their fingerprint.) Distribute one 1.25" x 2" Fingerprint Report Card™ per student.
4. Display the FBI Fingerprint Data Sheet for students to review.

## Expected Results:

1. Students should be able to match student ink prints with prints made on glassware and other objects. Encourage them to identify the different fingerprint patterns.
2. Tabulate the number of students that have the various fingerprint patterns (i.e. loop, whorl, etc.) and calculate the class averages for the different types

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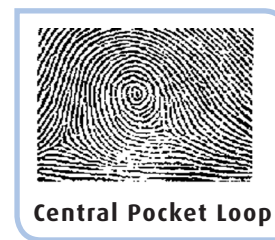
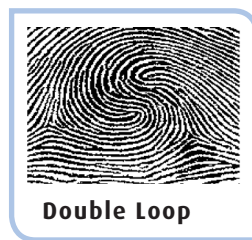
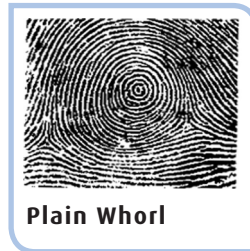
## Questions and Answers to Study Questions

1. List the three main fingerprint patterns and draw the characteristic shape. Name a few of the sub-patterns.

Loops, whorls, and arches

Sub-patterns – plain arch, tented arch, plain whorl, central loop

Below are representations of some common fingerprint patterns



2. What percentage of each fingerprint type are found in the population (i.e. – what percentage of people have whorls vs. loops vs. arches)?

Loops – 60%, Whorls – 30%, Arches – 10%

3. True or False - The uniqueness of fingerprints is based on the general shape or pattern of an individual's finger.

False – Individuality of fingerprints is not based on the general shape or pattern of the finger but by the unique ridge characteristics of a finger. No two fingers have been found to have identical ridges.

4. When and how were fingerprints first used in the United States?

In the United States the first use of fingerprinting was in 1901 by New York City to identify civil service applicants. A few years later it was used in all major cities of the United States.

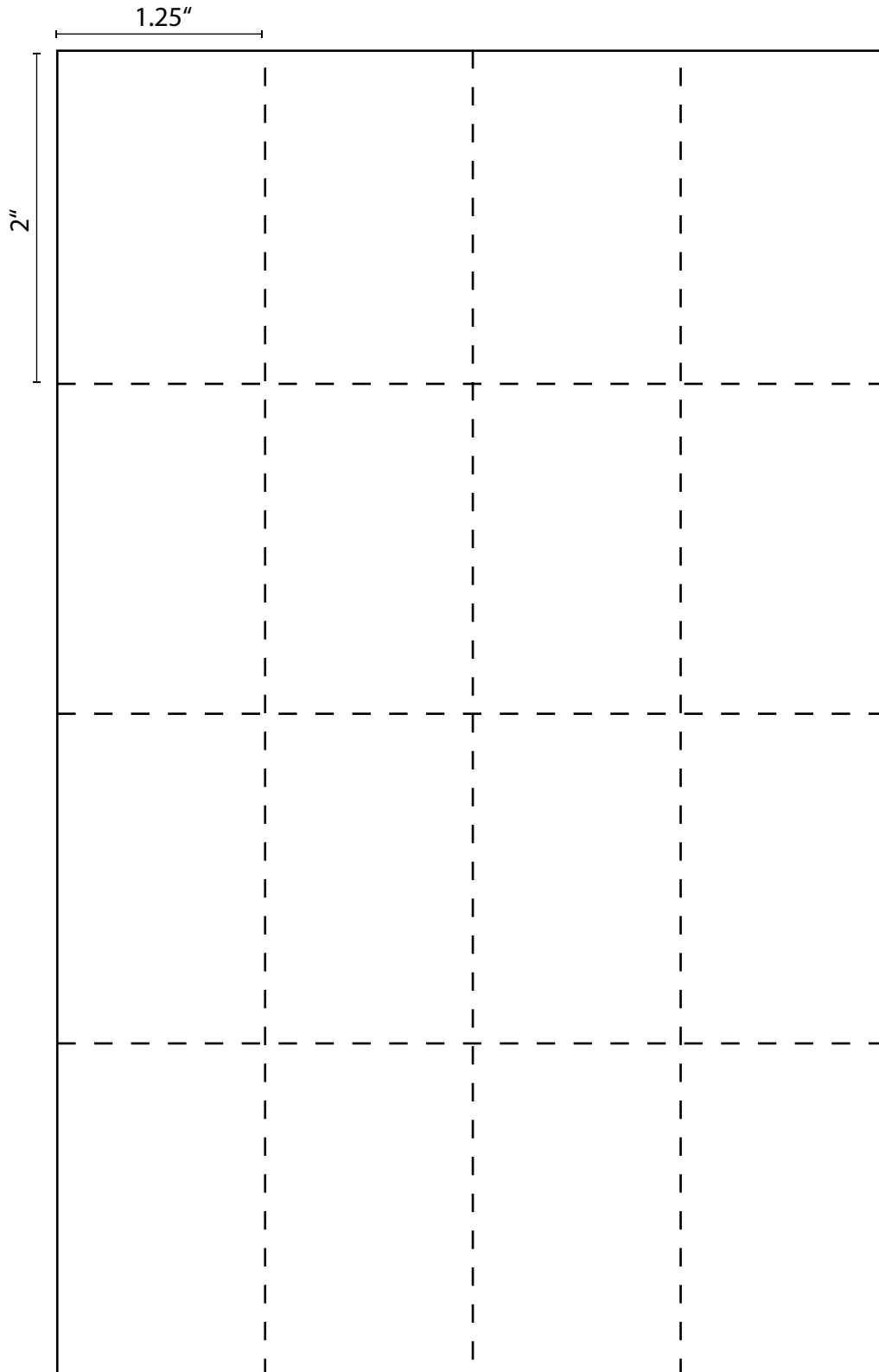
5. Describe the difference between classic fingerprinting and DNA fingerprinting.

Classic fingerprinting involves the printing or lifting of prints left from an individual's unique finger ridge pattern. DNA fingerprinting involves a trace of DNA evidence left at a crime scene as compared to a suspect's unique DNA pattern.

## Appendix A

### Cutting Template for Fingerprint Report Card™

Each 5" x 8" sheet should be cut into 16 squares (approx. 1.25" x 2" each).



*NOTE: Two 5" x 8" sheets are provided with this experiment and should yield enough cards for 32 students.*