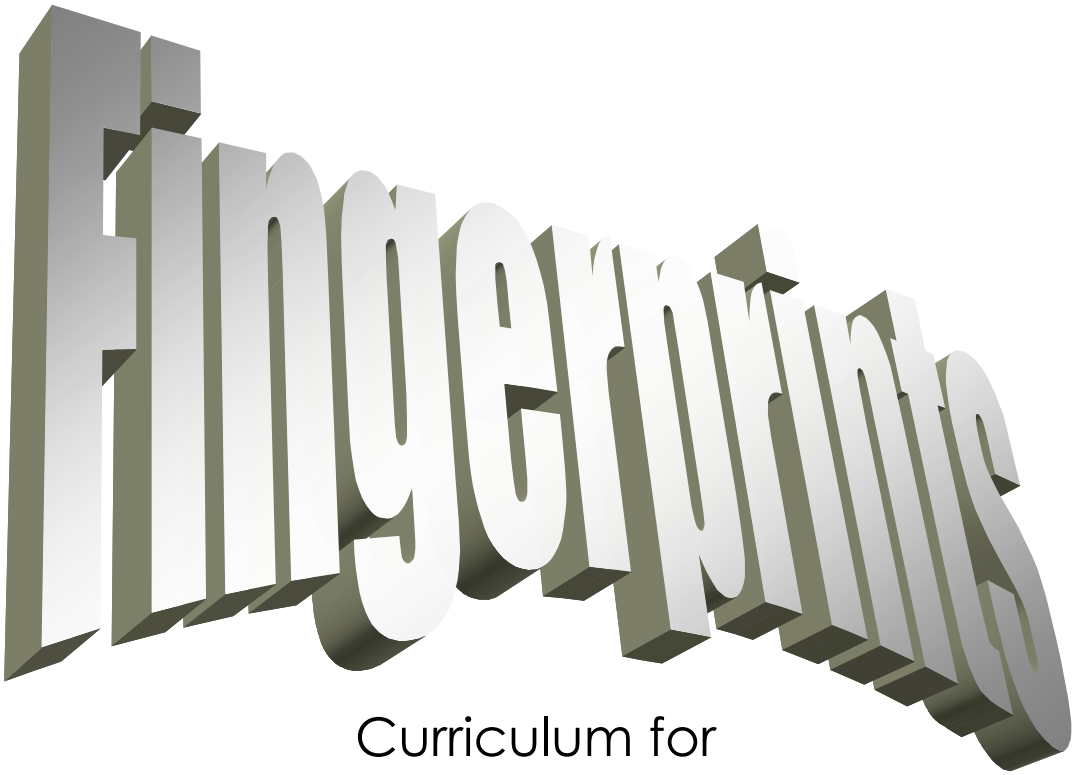
Forensic Science



Curriculum for
Investigative Science

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Dates _____ Class _____

Fingerprinting at a Glance

Day	Students will:	Duration
One	1) discuss how TV crime shows differ from real life crime investigation 2) explore the history of fingerprinting and biology of friction skin 3) investigate collecting inked fingerprints (lab)	1) 15 minutes 2) 15 minutes 3) 45-60 minutes
Two	1) classify fingerprint patterns 2) identify ridge characteristics 3) understand fingerprint terminology	1) 20-30 minutes 2) 20-30 minutes 3) 15-20 minutes
Three	1) explore dusting powders/techniques and lifting techniques (lab)	1) 60-85 minutes
Four	1) learn proper dusting/lifting procedures 2) investigate chemical techniques (lab)	1) 20 minutes 2) 45-60 minutes
Five	1) investigate and solve a hypothetical crime scenario	1) 60 minutes (crime #1) or 85 minutes (crime #2)

_______ ____, 20____

Dear Parent/Guardian,

Beginning ________________ our class will be working on a Forensic Science unit. This unit will last approximately _____ days. We will be studying **fingerprint analysis.** The students will be required to provide their fingerprints. However, these will not be kept or filed. The students will retain them. The students will also participate in a "mock" crime scene in which they will solve a case using fingerprint evidence.

If you have any questions, feel free to contact me at ________________ during my planning period ___________ to ___________. If you have any objection to your child participating in this forensic science unit, please contact me and/or complete the information below. If such is the case, your child will complete an alternative study in the library.

Sincerely,

I would prefer that my child ________________________________ not be involved in this forensics unit. I understand that an alternative unit will be presented in the library.

________________________________ ________________

Signature Date

Forensics Science Unit
Fingerprinting Module Lesson Plans

I. Rationale

Fingerprint evidence is among the most valuable data found at a crime scene. Fingerprints directly indicate an individual's presence at a certain location. Although DNA is usually viewed as a crucial piece of evidence for a crime, fingerprints are easier to obtain, more cost effective, less fallible, and better for identification. Fingerprints are more unique to the individual than DNA. Crime scene investigators use print data more often to identify people.

Within this lesson, students will investigate the fundamental concepts behind fingerprint analysis. Students will identify characteristics in a given set of data, construct qualitative observations, and place information into a classification system. Students will experience using tools and apparatuses to collect evidence and practice safety procedures in all activities. In addition, students will utilize the scientific method to interpret data, recognize variables, derive a hypothesis, and arrive at a conclusion using fingerprint identification.

We have designed these lesson plans to be easily modified as needed by the teacher. It is our goal that teachers can decide to present all the material in one comprehensive package or just pull out specific activities/topics to use as mini-lessons. In all of the activities, additional suggestions and time saving tips are included at the end.

II. Objectives

A. Cognitive objectives:

Upon completion of this module, the student will be able to:

- Understand terminology associated with fingerprints.
- Explain the importance and historical relevance of fingerprint identification in criminal investigation.
- Recognize the fundamental biology of a skin section.
- Distinguish among the basic fingerprint patterns.
- Recognize ridge characteristics (bifurcations, islands, dots, etc.)
- Identify the types of fingerprints that may be found at a crime scene.
- Describe the various methods for developing latent fingerprints.

B. Skills and Performance objectives:

Upon completion of this module, the student will be able to:

- Identify the basic fingerprint patterns given a set of fingerprints.
- Indicate and compare the ridge characteristics of a given fingerprint.
- Demonstrate the correct procedure for collecting inked fingerprints.
- Exhibit the proper techniques (dusting, chemical development, etc.) to collect latent (visible and invisible) prints.
- Report data in an appropriate manner.
- Deduce a criminal suspect based on the identification of latent fingerprints, given a scenario and exclusionary prints.

III. Materials—see lab handouts and crime scenarios for detailed descriptions

IV. Instructional Procedure—based on 85 minute class periods

A. Lesson One

- Opening
  1. Place a piece of glossy photo paper at each lab station, on which you have written "Do Not Touch!"
  2. After taking roll, announcements or bell work, retrieve the glossy paper and use magnetic powder to dust for prints.
  3. Begin discussion of CSI—fact vs. fiction (see lecture materials)
- Middle
  1. Presentation of abbreviated history of fingerprinting. (see lecture materials)
  2. Presentation of biology of friction skin. (lecture materials, transparency 1)
  3. Demonstrate correct procedure for collecting inked prints (ten print cards, transparency 2).
  4. Activity: Collecting inked fingerprints
  5. Looking ahead: Teacher will collect inked thumbprints from each student for analysis of ridge characteristics. Need to make enlarged copy for each student or pairs of students. (lesson two)
- Closing
  1. Observation of fingerprint cards. Challenge lab groups to classify prints.

B. Lesson Two

- Opening
  1. Students present created classification systems.
  2. Summarize similarities in the different systems.
- Middle
  1. Presentation of fingerprint patterns. (transparency 3, handout)
  2. Students will classify own individual prints based on standard patterns system.
  3. Presentation of ridge characteristics. (transparency 4, 5, and 6)
  4. Demonstrate/students model identification of ridge characteristics in unlabeled prints (transparency 7, handout)
  5. Students identify 10 ridge characteristics in an enlarged thumbprint. (individually or pairs)
- Closing
  1. Distribute terminology (handout) and crossword puzzle (handout).

C. Lesson Three

- Opening
  1. Review terminology and characteristics.
- Middle
  1. Activity: Lifting latent prints using powder techniques and various surfaces.
- Closing
  1. Students present, discuss, and defend results from activity.

D. Lesson Four

- Opening
  1. Review dusting results.
  2. Presentation of lifting techniques (powder)

- Middle
    1. Demonstration of chemical techniques (Ninhydrin fuming)
    2. Activity: Chemical Development of Latent Prints
- Closing
    1. Discuss results of activities

E. Lesson Five

- Opening
    1. Review patterns, characteristics, and lifting techniques.

- Middle
    1. Present crime scene scenario(see cumulating experience); *the scenarios were designed for the teacher to select one crime depending on resources and time
- Closing
    1. Discuss, defend, and evaluate results

V. Activities—brief descriptions (see lab handouts for detailed descriptions)

A. Obtaining Inked Fingerprints

- Demonstrate proper procedure to take fingerprints (see lab handout)
- Students will need to practice procedure before committing to the ten-print card.
- In pairs, students will use proper technique to take fingerprints using ten-print cards and a black ink pad.
- Carefully monitor student progress. Have isopropyl (rubbing) alcohol, water & soap, and paper towels on hand.

B. Lifting Prints Using Dusting Techniques

- Provide lab groups (2-4 students) with a variety of surfaces, dusting powders, and enough brushes for each powder (see materials). Also provide lifting tape and fingerprint cards.
- Instruct the students to lay fingerprints on each of the surfaces.
- Have the students experiment with the different surfaces and powders. The students will also need to try to lift the latent prints with the tape and transfer to the fingerprint card.
- Students will need to analyze the results and conclude which powders work best on the different surfaces.

C. Developing Prints Using Chemical Methods

i. Ninhydrin Fuming Demonstration (no lab handout—see enclosed information from "Processing Guide…" to prepare 0.5% solution)

- Materials: ninhydrin solution (0.5%), porous surface (paper, cloth, cardboard, etc.), iron (on steam setting), latex gloves
- Place several fingerprints on the porous surface.
- Spray the porous surface with a 0.5% solution of ninhydrin in a fume hood or well ventilated area until saturated.
- Lay the porous surface on a countertop and without touching, use the steam from the iron to develop the invisible latent prints.
- The prints have a limited life span; you will need to photograph or scan to preserve.
- See included MSDS information for hazardous material concerns

ii. Chemical Development Lab (see lab handout for detailed description)

- Students will use iodine crystals and superglue (cyanoacrylate) to develop invisible latent prints
- You will need to exercise caution when dealing with potentially hazardous materials
- See included MSDS information for hazardous material concerns

VI. Culminating Experience—Crime Scenarios

- **Crime # 1: "Paper" crime—**students will use their skills at fingerprint pattern classification and identification to solve a crime on paper (no processing evidence)
  - Resources (e.g. handouts) are included in the module
  - **Scenario:** Dr. Gadget's silver Porsche 911 was stolen Friday night from the Bricktown parking lot. Dr. Gadget's car was found the next morning wrecked at Lake Thunderbird.
  - **Observations:** The driver's side window had been knocked out. A tire iron was found on the passenger side floor board. The glove box appeared to have been pried open. Approximately twelve feet from the car were two sleeping men with an empty liquor bottle between them.
  - **Evidence:** Officers collected latent fingerprints from the exterior door handle (fingerprints 1 and 2), steering wheel (3 and 4), tire iron (5), dashboard (6), glove box (7), bottle (8 and 9), and interior door handle (10 and 11).
  - **Interview:** The men found at the scene were identified as Bubba Jones and Redd Nekk. They were taken into custody for questioning. Both men vowed that the other had stolen the car and had pulled the lodged criminal from the wrecked car. Afterwards, they celebrated the rescue by drinking the liquor.

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- **Crime #2: "Evidence" crime**—students will use processing techniques and fingerprint pattern classification and identification to solve a crime with physical evidence
  - Some resources (e.g. handouts) included, others will need to be supplied (see evidence list)
  - Have enough materials for each crime team/lab group. *Suggestion: number the evidence according to the crime team/lab groups. Place the evidence in various locations about the room so that the teams must locate their materials.
  - Other materials: gloves, materials for processing evidence (dusting powders, Superglue, iodine, etc.), scanner/digital camera
  - Allow the students to decide how to process the evidence; guide as necessary
  - You will need to supply the TEACHER print (your left thumb print) and the PERPETRATOR print (your right thumb print)
  - To set up the crime scene again, wipe nonporous material with glass cleaner, replace the envelope, and lay your thumb prints (left & right) on the evidence.
  - **Scenario:** The teacher (you) had several after school parent-teacher conferences one afternoon. Some conferences the teacher initiated and the other conferences parents requested. The next morning, the teacher arrives to find a manila envelope that was sitting in a paper tray has been

unsealed. The content of the envelope, a data CD in a CD case, is missing! The CD contained several important chapter tests and the final exam.

- **Observations**: The students will make several observations and indicate them on the crime report.
- **Evidence:** Metal/plastic letter tray, plastic CD case, manila envelope; the students will examine the evidence for prints.
- **Interview:** The teacher produces the list of parent-teacher conferences from the previous afternoon. The teacher states that (s)he left the room in between each conference for breaks, to greet the parents upon arrival, and to escort the parents out upon departure. The teacher indicates that (s)he left the room at 5:30 in the evening in which the door was locked and (s)he did not notice if the envelope was tampered with or missing.
- **AFIS results:** After students have processed the fingerprint evidence, hypothetically run the prints in a fictitious AFIS. Give each crime investigator (student) the results of the AFIS (5 prints). Students will use their obtained skills regarding ridge characteristics to deduce the criminal.

Forensic Science
Fingerprint Lecture Materials

I. Misconceptions: **CSI vs. Real Life**

- Suggestion is to make a table on the board and have the students discuss what they have seen on CSI. The following are some "real world" points to mention. (Note: these points may not apply to all crime labs in the US)
  A. Time—tests and results take days or weeks (sometimes months!) to perform
  B. Money—law enforcement is a public service; no police budget in this country could afford the cost of the tests conducted on every piece of evidence
  C. Evidence
     - DNA is not always conclusive (identical twins have the same DNA…but not the same fingerprints)
     - The National Institute of Justice estimates a back log of 200,000 to 300,000 DNA samples awaiting analysis.
     - Fingerprints can easily be destroyed or damaged, especially on firearms
  D. Equipment—again, no police crime lab would have all possible laboratory equipment needed to conduct all tests (this goes back to time and money!). Most evidence will be sent off to another lab for testing.
  E. Staffing/careers/positions
     - Most crime labs have a smaller number of staff than what is shown on TV (example: Norman, OK police department has a staff of 2 with no blonds in high heels!).
     - Most crime labs do not allow an agent to collect evidence, test evidence, AND interrogate the suspect. Duties are delegated to the proper people.
     - Most agents working in a crime lab do not have a degree in Forensic Science. They typically are police officers that have an interest, possible a background in forensics, that work their way to the position.
     - Forensic Science degree programs are becoming very popular. However, the market is becoming flooded with graduates with not enough positions.
       - In 1999, 4 students graduated with degrees in forensics from West Virginia. In 2005, more than 400 people are enrolled!
       - It's the most popular degree program on the 25,000 student campus.
     - The starting pay for a crime lab technician is not six figures!

II. History—Timeline

- Ancient times—Chinese used fingerprints to sign legal documents
- 1684—Nehemiah Grew—English physician who first called attention to the system of pores and ridges in hands and feet
- 1858—William Herschel—British administrator in India who was the first government official to use prints for identification
- Required them to sign contracts with imprint of their right hand

- 1880—Henry Faulds—Scottish physician in Japan who first developed a method for lifting prints and who concluded that fingerprint patterns remain unchanged throughout one's life
- 1883—Alphonse Bertillon—French police officer who first developed and introduced a systematic attempt at personal identification
    - Bertillon system relied on a detailed description of the subject, combined with full-length and profile photographs and a system of precise body measurements
    - Skeleton sizes were thought to be so extremely diverse that no two individuals could have exactly the same measurements
    - Bertillon system recommended the routine taking of 11 anatomical measurements (e.g. height, reach, width of head, and length of left foot)
    - 1903—system began to fall into disfavor
        - convict Will West arrived at Fort Leavenworth prison to find that William West, already in the prison, could not be distinguished from the other
        - body measurements were practically the same and the two men appeared like twins
        - fingerprints distinguished the two men apart
- 1892—Francis Galton—British anthropologist who presented statistical proof of the uniqueness of fingerprints and outlined principles of fingerprint identification; wrote *Finger Prints*
- 1897—Edward Henry—British police officer in India who developed a method of fingerprint classification that is widely used (called Henry system)
- 1901—New York City Civil Service Commission—adopted the first systematic and official use of fingerprints for personal identification

III. Biology of skin (transparency)

- **Friction skin**—found on fingertips, palms, and soles of feet; designed by nature to provide firmer grasp and resistance to slippage
- Skin is composed of layers of cells
    - Outer portion of skin—**epidermis**
    - Separating boundary—**dermal papillae**
        - Determines the form and pattern of ridges on friction skin
        - Develops during fetal growth at about 12 weeks
        - Damage done to this layer will become permanent; such a wound must penetrate 1 to 2 millimeters beneath the skin's surface; however, impossible to obliterate all ridge characteristics on the hand and presences of scars merely provides new characteristics for identification
    - Inner skin—**dermis**
- Each **skin ridge** is composed of a single row of **pores** that are openings for **ducts** leading from the **sweat glands**
    - Through pores perspiration is discharged and deposited on skin
    - Oils may be picked up by touching hairy portions of the body

- Once a finger/palm/sole touches as surface, perspiration and oils are transferred onto the surface, thereby leaving an impression of the print's ridge pattern

IV. Fundamental Principles of Fingerprints

A. Why fingerprints?
   - Fingerprint evidence is among the most valuable data found at a crime scene.
   - Fingerprints directly indicate an individual's presence at a certain location.
   - Although DNA is usually viewed as a crucial piece of evidence for a crime, fingerprints are easier to obtain, more cost effective, less fallible, and better for identification.
   - Fingerprints are more unique to the individual than DNA.
   - Crime scene investigators use print data more often to identify people.

B. First fundamental principle:
   - A fingerprint is an individual characteristic
   - No two fingers have yet been found to possess identical ridge characteristics

C. Second fundamental principle:
   - A fingerprint will remain unchanged during an individual's lifetime
   - Skin conditions such as wart's, wounds, blisters, or temporary damage (caused by abrasives, sandpaper, or chemicals) have no permanent effect on the pattern; once the condition changes or skin heals, the original patterns return (see info. on dermal papillae)

D. Third fundamental principle:
   - Fingerprints have general ridge patterns that permit them to be systematically classified
   - All fingerprints are divided into three classes on the basis of their general pattern:
     - Loops—65% of population
       - Types: ulnar, radial (transparency/handout)
     - Whorls—30-35% of population
       - Types: plain, central pocket loop, double, accidental (transparency/handout)
     - Arches—5% of population
       - Types: plain, tented (transparency/handout)

E. Ridge Characteristics (transparencies)—also called minutiae—ridge endings, bifurcations, enclosures, and other ridge details, which must match in two fingerprints in order for their common origin to be established
   - Examples:
     - Core—approximate center of the bulb
     - Delta—a triangular area on the bulb
     - Dot—ridge characteristic in which the ridge appears as a single point
     - Islands (Eye, Enclosure)—ridge characteristic in which a ridge divides into two the converges back into one
     - Ridge endings—ridge characteristic in which the ridge blatantly stops
     - Bifurcations (forks)—ridge characteristic in which ridges diverge into two ridges

- In modern forensics, identification of a fingerprint is no longer based on arbitrary point system (e.g. finding 8 or 10 similar points); today, fingerprints are identified and individualized based upon "finding agreement of individual characteristics—with no unexplainable dissimilarities"
- Dactylography—the scientific study of fingerprints as a means of identification
- AFIS (Automated fingerprint identification system)—a computerized system for scanning, mapping, storing, searching, and retrieving fingerprints
  - Uses automatic scanning devices that convert the image of a fingerprint into digital minutiae that contain data showing ridges at their points of termination (ridge endings) and the branching of ridges into two ridges (bifurcations)
  - Set of 10 fingerprints can be searched against a file of 500,000 10-finger prints in about eight-tenths of a second
  - FBI has the largest catalog of fingerprints

F. Types of Prints
- Latent print (common usage) refers to any fingerprint discovered at a crime scene
- Three kinds of crime scene prints:
  - Visible prints (patent prints)—made by fingers touching a surface after the ridges have been in contact with a colored material (e.g. blood, paint, grease, or ink)
  - Plastic prints—ridge impressions left on a soft material (e.g. putty, wax, soap, or dust)
  - Invisible prints—impressions caused by the transfer of body perspiration or oils present on finger ridges to the surface of an object
- Processing surfaces:
  - Hard, nonabsorbent (e.g. glass, mirror, tile, painted wood)—powder or cyanoacrylate techniques
  - Soft, porous (e.g. papers, cardboard, cloth)—chemical techniques

V. **Activities—**Procedure for Collecting Inked Prints (also see lab handout)

1) Always stand at the subject's left, regardless of which hand you are using.
2) Have the subject stand about forearm's length from the work area and slightly behind you. Tell the subject to relax his/her hand and let you do all the work.
3) In rolling the fingers of the right hand, the right thumb should be rolled inward, from right to left, and the other four fingers rolled outward, from left to right. This procedure is reversed for the left hand.
4) Hold the subject's hand in your left hand, with all of the subjects fingers curled except the one you are inking and recording on the card. Grasp the extended finger of the subject with your right thumb and index finger. Roll the subject's fingers on the ink pad, from nail to nail, keeping the finger flat on the pad from the first joint to the tip.

MORE PRINTS ARE RUINED FROM TOO MUCH INK RATHER THAN TOO LITTLE.

5) Roll the inked finger on the ten-print card as previously instructed. Use gentle pressure in rolling the finger, to avoid smearing the ink. At the end of the roll, lift the finger upward to prevent smudging of the edge of the print.
6) Repeat the procedure for all fingers on both hands.
7) When all the impressions have been taken, the subject should wipe his/her fingertips with isopropyl alcohol and then wash with soap and water.
8) Fill in all pertinent information on the ten-print card.

VI. **Activities—**Dusting & Chemical Techniques (also see lab handout)

A. Suggested processing procedure for DUSTING:

- Nonmagnetic powders—brush in the direction of any ridges that begin to appear
- Magnetic powders—drop a pile of dust onto supposed location of print, pick up excess, and apply in a circular motion
- Porous surfaces (i.e. cardboard, paper) usually do not produce latent prints using powder techniques (see chemical techniques)
- Nonporous surfaces—the color of the background on which the print is made determines the color of the powder to use to provide a good contrast (e.g. light-colored powder help prints stand out on a dark background; dark powders are more useful on a light background)
- Glossy paper (semiporous) will work best with magnetic powders.

B. Ninhydrin fuming (chemical reagent used to develop latent fingerprints on porous materials by reacting with amino acids in perspiration) **demonstration procedure (no lab handout—see "Processing Guide…" to prepare 0.5% solution)**

- Materials: ninhydrin solution (0.5%), porous surface (paper, cloth, cardboard, etc.), iron (on steam setting)
- Place several fingerprints on the porous surface.
- Spray the porous surface with a 0.5% solution of ninhydrin in a fume hood or well ventilated area until saturated.
- Lay the porous surface on a countertop and without touching, use the steam from the iron to develop the invisible latent prints.
- The prints have a limited life span; you will need to photograph or scan to preserve.
- See included MSDS information for hazardous material concerns

C. Cyanoacrylate fuming (technique for visualizing latent fingerprints on nonporous surfaces by exposing them to cyanoacrylate vapors) **procedure:**

1) Label the Petri dish with your name, date, and time.
2) Run a finger alongside your nose or run your fingers through your hand to pick up oils. Lay several, non-overlapping fingerprints on the INSIDE of the Petri dish LID.
3) In the base (i.e. bottom) of the Petri dish, place a small dampen piece of paper towel toward the side.
4) Also in the base, place two drops of superglue in the center.
5) Quickly, yet carefully, place the lid on the base with the fingerprints towards the superglue.
6) Place the Petri dish in a sunny window or outside. If neither is available, place directly under a lamp. (Other accelerants: moving air, chemicals—NaOH)

7) Observe the Petri dish for development of latent prints.
8) **Extension:** Either dust & lift the print or photograph/scan.

*See included MSDS information for hazardous material concerns

D. Iodine fuming (technique for visualizing latent fingerprints by exposing them to iodine vapors) **procedure:**

1) Using the scissors, cut approximately ¼ of the bulb off of the plastic pipette (leave ¾ of the bulb attached).
2) Using a portion of the cotton, pack the bottom of the pipette bulb.
3) Place several iodine crystals (< 0.25g) on top of the cotton packing.
4) Using a second portion of the cotton square, pack cotton on top of the iodine crystals.
5) Have your instructor check your mini-iodine fuming chamber.
6) Place several, non-overlapping fingerprints onto the porous surface.
7) IMPORTANT!!! **Carefully** breathe into the end of the pipette bulb. **Do not inhale!** Direct the open end of the pipette toward the porous surface to develop latent fingerprints.
8) Use a camera (or scanner) and ruler to record the developed print.

*See included MSDS information for hazardous material concerns

VII. Crime Scenarios (see lesson plans and handouts for more details)

Crime # 1: "Paper" crime

Scenario: Dr. Gadget's silver Porsche 911 was stolen Friday night from the Bricktown parking lot. Dr. Gadget's car was found the next morning wrecked at Lake Thunderbird.

- **Observations:** The driver's side window had been knocked out. A tire iron was found on the passenger side floor board. The glove box appeared to have been pried open. Approximately twelve feet from the car were two sleeping men with an empty liquor bottle between them.
- **Evidence:** Officers collected latent fingerprints from the exterior door handle (fingerprints 1 and 2), steering wheel (3 and 4), tire iron (5), dashboard (6), glove box (7), bottle (8 and 9), and interior door handle (10 and 11).
- **Interview:** The men found at the scene were identified as Bubba Jones and Redd Nekk. They were taken into custody for questioning. Both men vowed that the other had stolen the car and had pulled the lodged criminal from the wrecked car. Afterwards, they celebrated the rescue by drinking the liquor.

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Crime #2: "Evidence" crime

Scenario: The teacher (you) had several after school parent-teacher conferences one afternoon. Some conferences the teacher initiated and the other conferences parents requested. The next morning, the teacher arrives to find a manila envelope that was sitting in a paper tray has been unsealed. The content of the envelope, a data CD in a CD case, is missing! The CD contained several important chapter tests and the final exam.

- **Observations**: The students will make several observations and indicate them on the crime report.
- **Evidence:** Metal/plastic letter tray, plastic CD case, manila envelope; the students will examine the evidence for prints.

- **Interview:** The teacher produces the list of parent-teacher conferences from the previous afternoon. The teacher states that they left the room in between each conference for breaks, to greet the parents upon arrival, and to escort the parents out upon departure. The teacher indicates that they left the room at 5:30 in the evening in which the door was locked and did not notice if the envelope was tampered with or missing.
- **AFIS results:** After students have processed the fingerprint evidence, hypothetically run the prints in a fictitious AFIS. Give each crime investigator (student) the results of the AFIS (5 prints). Students will use their obtained skills regarding ridge characteristics to deduce the criminal.

Further information:

- ✓ Forensic Science. Stuart H. James and Jon J. Nordby. CRC Press. 2005
- ✓ Criminalistics. Richard Saferstein. Pearson/Prentice Hall. 2004
- ✓ Practical Crime Scene Processing and Investigation. Ross M. Gardner. CRC Press. 2005
- ✓ Criminal Investigation Third Edition. Bruce L. Berg and John J. Horgan. Glenco McGraw-Hill. 1998
- ✓ Processing Guide for Developing Latent Prints. US Department of Justice, Federal Bureau of Investigation, Laboratory Division. 2000
- ✓ www.onin.com Ed German
- ✓ http://www.ccs.neu.edu/home/feneric/cyanoacrylate.html Eric W. Brown
- ✓ "Case of the Solitary Fingerprint" kit. Teachers Discovery demonstration kit.

APPLICANT RECORD CARD

SEE REVERSE SIDE FOR FURTHER INSTRUCTIONS

TYPE OR PRINT ALL INFORMATION IN BLACK

LAST NAME NAM | FIRST NAME | MIDDLE NAME

FBI **LEAVE BLANK**

SIGNATURE OF PERSON FINGERPRINTED

RESIDENCE OF PERSON FINGERPRINTED

PERSON TO BE NOTIFIED IN CASE OF EMERGENCY

NAME _____

ADDRESS _____

FINGERPRINTED BY

FINGERPRINTS SUBMITTED BY

DATE OF BIRTH **DOB** MONTH | DATE | YEAR

DATE FINGERPRINTED	SEX	RACE	HGT.	WGT.	EYES	HAIR	PLACE OF BIRTH **POB**

SOCIAL SECURITY NO.

MISCELLANEOUS NO.

SCARS AND MARKS

LEAVE BLANK

CLASS _____

REF. _____

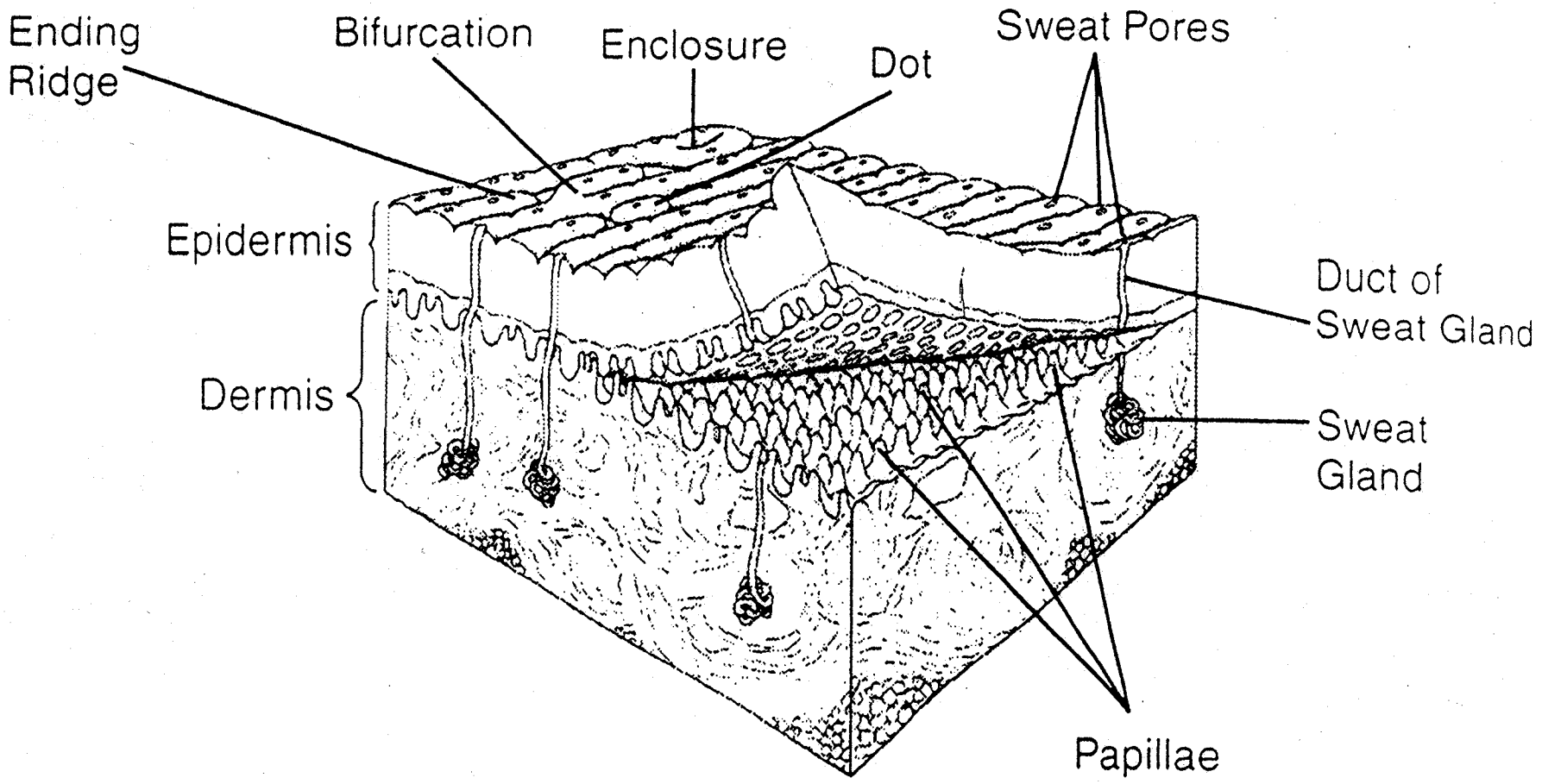
1. R. THUMB	2. R. INDEX	3. R. MIDDLE	4. R. RING	5. R. LITTLE
6. L. THUMB	7. L. INDEX	8. L. MIDDLE	9. L. RING	10. L. LITTLE

LEFT FOUR FINGERS TAKEN SIMULTANEOUSLY

L. THUMB

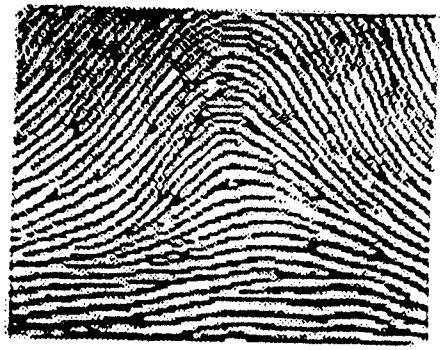
R. THUMB

RIGHT FOUR FINGERS TAKEN SIMULTANEOUSLY



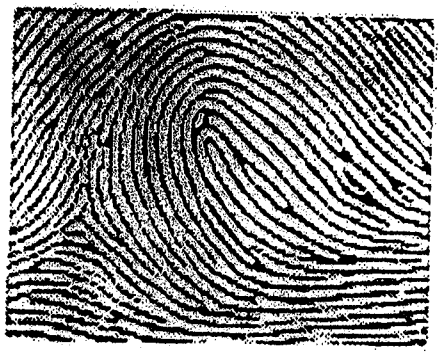
Forensic Science
Stuart H. James & Jon J. Nordby
CRC Press 2005

FINGERPRINT PATTERNS AND CLASSIFICATIONS

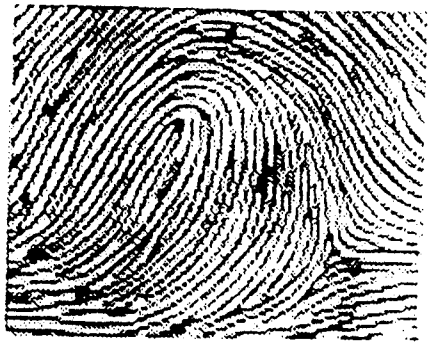


PLAIN ARCHES

TENTED ARCHES

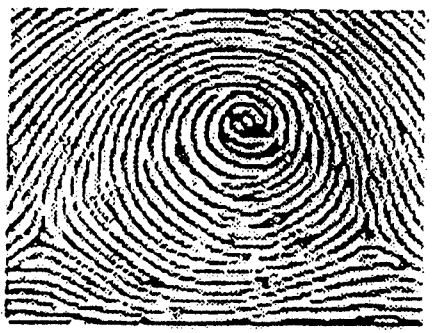


ULNAR LOOPS

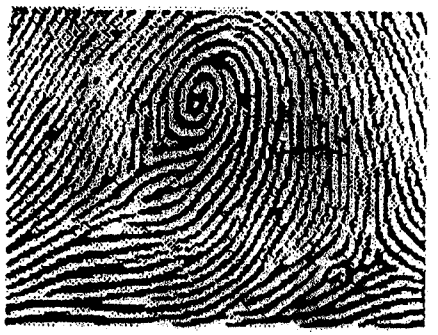


RADIAL LOOPS

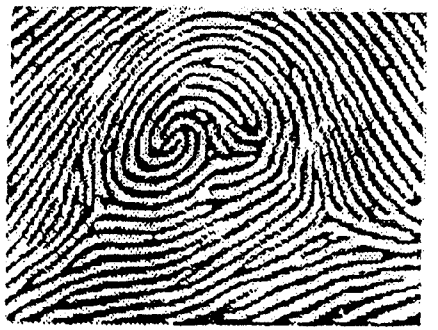
DOUBLE LOOP



PLAIN WHORL



CENTRAL POCKET WHORL



ACCIDENTAL WHORL

adapted from www.onion.com
Ed German

Ten Main Rdige Details:

1 Ending Ridge

2 Fork

3 Short Ridge

4 Dot

5 Bridge

6 Hook

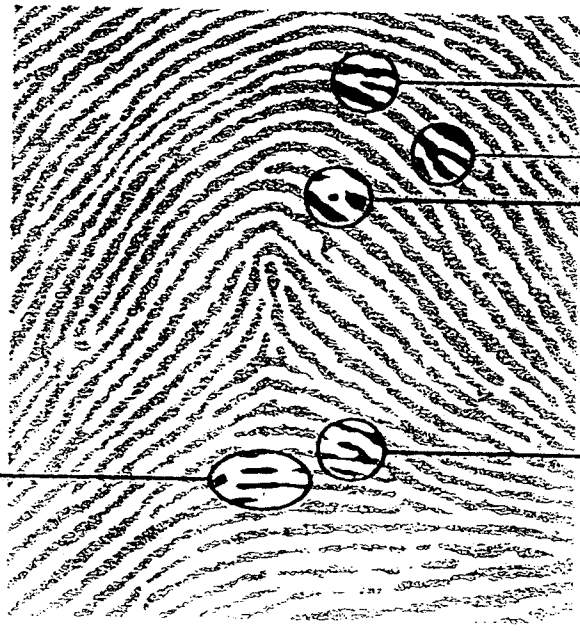
7 Eye

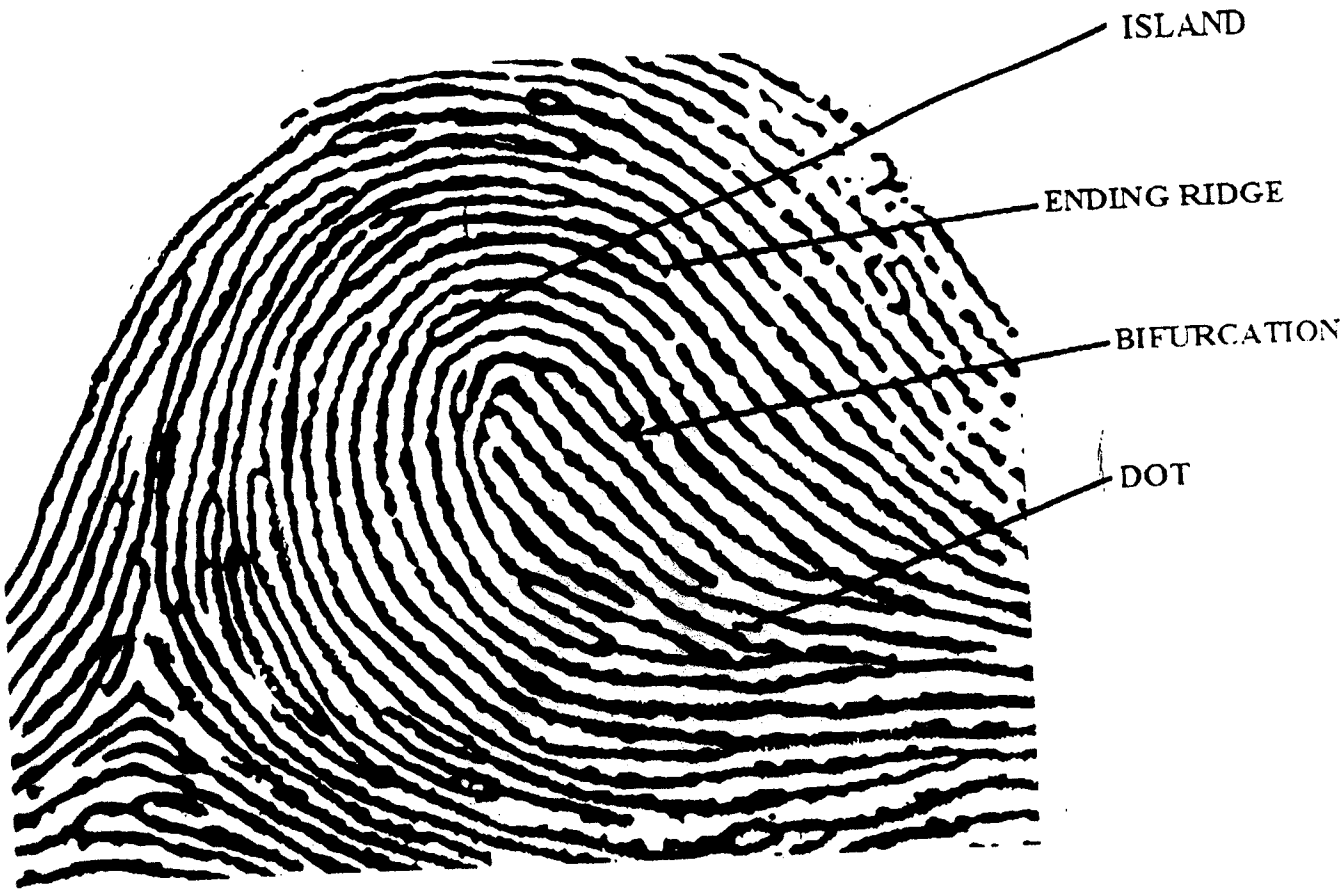
8 Double Fork

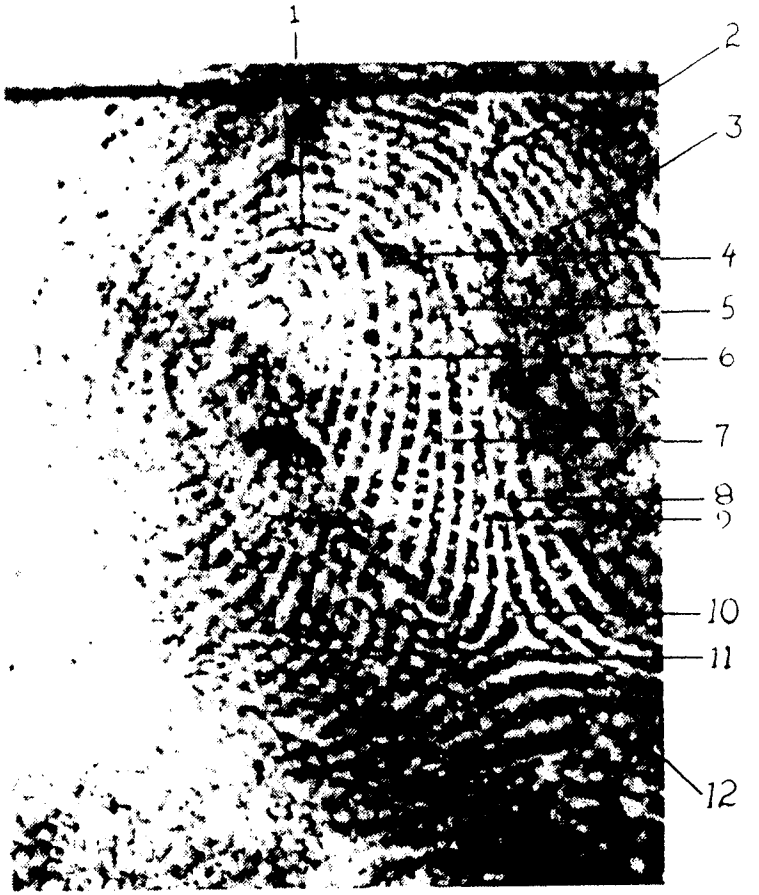
9 Delta

10 Triple Fork

Ridge Detail Example

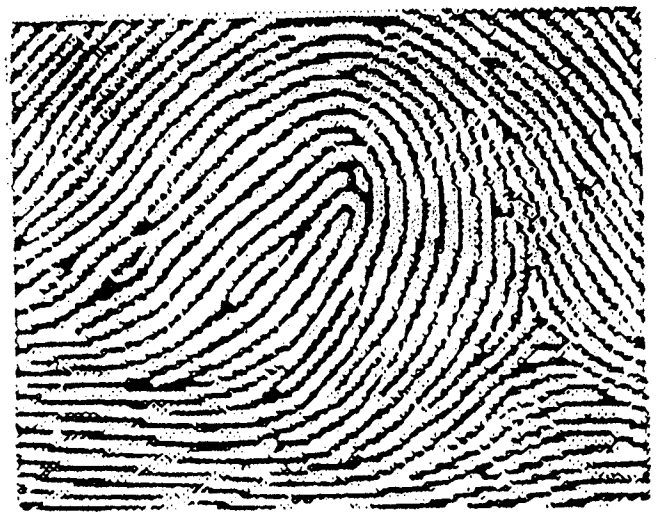


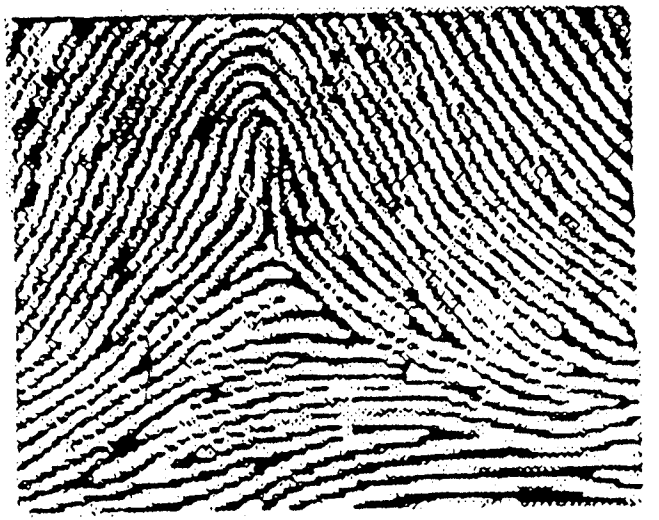

ISLAND
ENDING RIDGE
BIFURCATION
DOT



1. *Bifurcation*
2. *Ridge ending*
3. *Enclosure*
4. *Ridge ending*
5. *Bifurcation*
6. *Bifurcation*
7. *Bifurcation*
8. *Ridge ending*
9. *Ridge ending*
10. *Short ridge*
11. *Bifurcation*
12. *Ridge ending*

Criminalistics
Richard Saferstein
Pearson/Prentice Hall 2005





Name _____ Date _____

Obtaining Inked Fingerprints
Laboratory Activity

Purpose/Objectives: Students will…

- Explore fingerprints patterns.
- Distinguish among the basic fingerprint patterns.
- Organize fingerprint patterns to create a classification system.
- Demonstrate the correct procedure for collecting inked fingerprints.

Hypothesis: Visually inspect your fingerprints. Do you notice any similarities? What are the differences? How many different patterns are present? What would be your basis of establishing a classification system for the different fingerprint patterns? Answer the previous questions for your hypothesis.

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Materials:

- Black ink pads
- Ten-print card or white card stock
- Magnifying glass
- White, unlined paper (for practice)
- Paper towels
- Isopropyl alcohol (rubbing alcohol)

Safety: Goggles and lab aprons are suggested to protect eyes and clothing. Isopropyl alcohol is flammable.

Procedure:

1) The subject should wash and dry hands.
2) Always stand at the subject's left, regardless of which hand you are using.
3) Have the subject stand about forearm's length from the work area and slightly behind you. Tell the subject to relax his/her hand and let you do all the work.
4) In rolling the fingers of the right hand, the right thumb should be rolled inward, from right to left, and the other four fingers rolled outward, from left to right. This procedure is reversed for the left hand.
5) Hold the subject's hand in your left hand, with all of the subjects fingers curled except the one you are inking and recording on the card. Grasp the extended finger of the subject with your right thumb and index finger. Roll the subject's fingers on the ink pad, from nail to nail, keeping the finger flat on the pad from the first joint to the tip.
   MORE PRINTS ARE RUINED FROM TOO MUCH INK RATHER THAN TOO LITTLE.
6) Roll the inked finger on the ten-print card as previously instructed. Use gentle pressure in rolling the finger, to avoid smearing the ink. At the end of the roll, lift the finger upward to prevent smudging of the edge of the print.

7) Repeat the procedure for all fingers on both hands.
8) When all the impressions have been taken, the subject should wipe his/her fingertips with isopropyl alcohol and then wash with soap and water.
9) Fill in all pertinent information on the ten-print card.

Data & Observations:

- Attach your ten-print card.
- Describe the difficulty in taking ink prints.

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- Describe the difficulty in having your prints taken.

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- Describe the appearance (clarity) of the prints.

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Analysis & Conclusion:

1) Is there fingerprint symmetry between your two hands? Explain.

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2) Observe your lab group's prints. What are the similarities? Differences?

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3) In your lab groups, establish a classification system for fingerprints. Explain your reasoning for the system your group creates.

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Name _____ Date _____

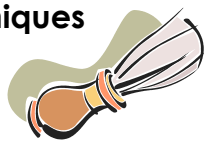
Teacher Suggestions and Expected Results:

Prep time: 5-10 minutes to set-up materials
Lab time: 45-60 minutes

- You will need to have the students practice the rolling technique before they commit to placing ink fingerprints on the cards. (The FBI would reject ten print cards with messy prints or too many mistakes!) This will eliminate waste of the cards. Just use regular unlined white paper for practice.
- Avoid using the "correct" terminology until the students have devised their own classification system. However some groups may require more guidance than others.
- Alternative materials:
  - If you would prefer to not use ink pads, you can use graphite (pencil lead). "Scribble" a dark square of the graphite on a piece of paper and rub the finger on the square.
  - Better prints will result from using "Perfect Print" ink (www.indenticatorinc.com), a flat glass plate, and a roller. If you have the monetary means, you might investigate using a fingerprint station. (www.armorforensics.com)
- Make sure to monitor student progress to avoid mess or horseplay.

Name _____ Date _____

Lifting Prints Using Dusting Techniques
Laboratory Activity



Purpose/Objectives: Students will…

- Explore dusting techniques using a variety of surfaces and dusting powders to formulate a conclusion on which powders are best to use in different places.
- Practice lifting fingerprints using tape and transferring the prints to cards.
- Reinforce previous knowledge of fingerprint patterns and identification.

Hypothesis: Observe the various surfaces and dusting powders. Formulate a hypothesis on which powders will work best on each of the surfaces. Support your hypothesis based on previous knowledge.

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Materials:

Synthetic fiber brushes
Lifting or transparent bookbinding tape
Fingerprint cards or 3x5 index cards
Black dusting powder
White dusting powder
Dual-color dusting powder
Magnetic dusting powder and brush

Various surfaces: lab table counter top, glossy photo paper, white unlined paper, glass slides or beaker, plastic transparency, Formica samples

For extension: student inked fingerprint cards, magnifying glass

Safety: Wear goggles and laboratory apron. Wash hands after completion.

Procedure:

1) Place several fingerprints on each of the surfaces. Try not to overlap fingerprints. If your finger is dry, rub it along side your nose or run your fingers through you hair to pick up some oil.
2) Use each powder on the surfaces at different fingerprints. Do not overlap dusting powders or interchange the brushes, as you will obtain poorly developed latent prints. Label each powder.
3) Record your observations.
4) To lift prints, cut 6-7 cm of tape from the roll. Cover the print with the tape by smoothing the tape over the print with your finger, beginning with one end and working slowly over the print. Do not simply lay the tape over the print! Air bubbles will ruin the fingerprint.
5) Lift the tape with the developed print smoothly and slowly from the surface in one continuous motion. This will prevent distortion. Repeat the laying-down, smoothing operation to eliminate any air bubbles until the print is taped to a card.
6) Record the surface from which the print was taken, your initials, and the powder used to develop the print.

Name _____ Date _____

Data & Observations: Create a qualitative data table (surface, powder, and quality or clarity of transferred print)

Analysis & Conclusion:

1) Based on your experimental results, determine which powder works best for each of the surfaces. Elaborate with explanation.

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2) Did you encounter any problems? What were they? What could (or did) you do to solve these problems?

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3) Why do you suppose that there are different types of dusting powders? Did all surfaces provide a latent print? Why or why not?

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Extension & Application:

(1) For each of the lifted and transferred prints…
   A) Determine the fingerprint pattern (arch, loop, whorl)
   B) Using 8-10 points and the inked fingerprint cards, make an identification of each print.

(2) Research the use of nanoparticles in fingerprint identification.

Name _____ Date _____

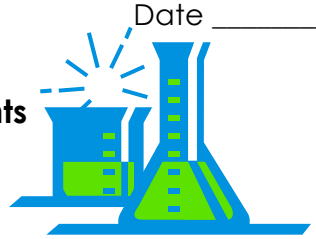
Teacher Suggestions & Expected Results:
Prep time: 10-15 minutes to set up materials
Lab time: 60-85 minutes, depending on extension/application

- Inquiry learning with fingerprint powders will be messy! ☺ Put paper towels underneath the surfaces for *easier* clean up.
- Excess powder should be removed before trying to lift the print.
- www.armorforensics.com has an excellent selection of forensic tools
- Time saving suggestions:
    - Have each lab group investigate only one powder. At the end of the experiment the lab groups would report on their findings, produce a group data table and make a collective conclusion.
    - Limit the variety of powders.
    - Have enough brushes for each student.
- We suggest providing lab groups with a small amount of each powder in a weigh dish or other container. This will help to eliminate *some* mess and waste of powders.
- It is also suggested to have the students wear lab aprons and goggles for clothing and eye protection.
- You should have enough brushes for each powder. It is not advised to interchange brushes and powders because this will cause poorly developed latent prints. Label brushes based on the powder used.
- If you absolutely must use the same brushes, wipe the tips on paper towels until clean.
- To make a pseudo-magnetic brush for the magnetic powder, glue a small magnet to the end of a stick (pencil, skewer, Popsicle stick, etc.) and place inside a thin test tube. Place this test tube into a larger one that has been fitted with a rubber washer at the end. This makes a cheaper alternative to purchasing several magnetic brushes.
- Students will find that not all surfaces will produce a latent print. This will be the bridge to discussion and demonstration of chemical techniques (e.g. ninhydrin, iodine fuming, cyanoacrylate fuming, etc.)
- **Suggested processing procedure**:
    - Nonmagnetic powders—brush in the direction of any ridges that begin to appear
    - Magnetic powders—drop onto surface, remove excess in a circular motion
    - Porous surfaces (i.e. cardboard, paper) usually do not produce latent prints using powder techniques (see chemical techniques)
    - Nonporous surfaces—the color of the background on which the print is made determines the color of the powder to use to provide a good contrast (e.g. light-colored powder help prints stand out on a dark background; dark powders are more useful on a light background).
    - Glossy photo-like paper (semiporous) will work best with magnetic powders.
- **Nanotechnology websites:**
    - "Nanoparticles Clearly Finger the Culprit," 08 Nov 2003, New Scientist www.newscientist.com/article.ns?id=dn4348
    - Nanotechnology in Crime Prevention and Detection, London www.nano.org.uk/crime.htm
    - Fred Rowell, University of Sunderland http://orac.sunderland.ac.uk/~hs0bcl/fjr.htm
    - Nanotechnology, New Scientist www.newscientist.com/hottopics/tech/techindex.jsp?sub=Nanotechnology
    - "Sweat Prints could Nail Criminals," 10 Sept 2001, New Scientist www.newscientist.com/article.ns?id=dn1242
    - "Single cell DNA fingerprinting gathers speed," 31 Oct 2002, New Scientist

Name _____ Date _____

www.newscientist.com/article.ns?id=dn2995

Name _____ Date _____



Chemical Development of Latent Prints
Laboratory Activity

Purpose/Objectives: The student will…

- Explore chemical techniques (cyanoacrylate fuming, iodine fuming) to develop latent prints.
- Utilize technology (e.g. scanner, digital photography) to capture chemically developed latent prints.
- Practice appropriate safety procedures in a chemical laboratory setting.

Hypothesis: Are all fingerprints visible? Can powder dusting techniques be used on any type of surface? Why or why not? What are other methods of developing latent prints?

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(1) Cyanoacrylate Fuming Technique

Materials:

- Superglue (variation of cyanoacrylate)
- Plastic Petri dish
- Deionized water
- Paper towels

Safety: Goggles for eye protection. Use caution with the superglue; it can adhere to skin, cause eye irritation, and produces mildly irritating fumes.

Procedure:

1) Label the Petri dish with your name, date, and time.
2) Run a finger alongside your nose or run your fingers through your hair to pick up oils. Another good place for this is your forehead. Lay several, non-overlapping fingerprints on the INSIDE of the Petri dish LID.
3) In the base (i.e. bottom) of the Petri dish, place a small dampened piece of paper towel toward the side.
4) Also in the base, place two drops of superglue in the center
5) Quickly, yet carefully, place the lid on the base with the fingerprints towards the superglue.
6) Place the Petri dish in a sunny window or outside. If neither is available, place directly under a lamp.
7) Observe the Petri dish for development of latent prints.
8) **Extension:** Either dust & lift the print or photograph/scan.

Name _____ Date _____

Observations: Make a data table for the time lapse and indicate qualitative observations.

(2) Iodine Fuming Technique:

Materials:

- Iodine crystals
- Cotton balls/squares
- Disposable pipette
- Scoopula
- Scissors
- Porous surface
- Camera
- Ruler

Safety: Goggles for eye protection. CAUTION!! Iodine crystals are highly toxic by ingestion and inhalation. **DO NOT INHALE**! Iodine is irritating and corrosive to the skin. Avoid all body contact.

Procedure:

1) Using the scissors, cut approximately ¼ of the bulb off of the plastic pipette (leave ¾ of the bulb attached).
2) Using a portion of the cotton, pack the bottom of the pipette bulb.
3) Place several iodine crystals (< 0.25g) on top of the cotton packing.
4) Using a second portion of the cotton square, pack cotton on top of the iodine crystals.
5) Have your instructor check your mini-iodine fuming chamber.
6) Place several, non-overlapping fingerprints onto the porous surface.
7) IMPORTANT!!! **Carefully** breathe into the end of the pipette bulb. **Do not inhale!** Direct the open end of the pipette toward the porous surface to develop latent fingerprints.
8) Use a camera (or scanner) and ruler to record the developed print.

Observations: Make a sketch of the results. Using the camera or scanner, photograph/scan the results. Record all observations.

Name _____ Date _____

Analysis & Conclusion:

1) Make a generalized statement regarding the development of latent fingerprints on different surfaces using chemical techniques versus dusting techniques.

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2) Compare the prints developed from the two chemical techniques.

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3) Why did you have to take a photograph or scan the prints developed with iodine? Explain.

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4) Propose a hypothesis to explain why you used two different chemical development techniques.

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5) **Extension/Application:** Using the ten-print cards and dusting/lifting techniques, identify a print developed using the cyanoacrylate method. Use 8-10 points to justify identification.

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Name _____ Date _____

Teacher Suggestions & Expected Results:

Prep time: 15-20 minutes
Lab time: 45-60 minutes

- MSDS information included.
- The humidity and sunlight will greatly accelerate the cyanoacrylate fuming technique. The process will occur without the humidity and heat; however it does not produce the same detailed fingerprints and takes a considerable amount of time.
- Do not use a "red" heat source (e.g. hot plate, Bunsen burner, etc.) to accelerate the fuming process. The fumes can ignite and explode!
- Examples of porous surfaces: paper, cardboard, cloth, unfinished wood
- Iodine crystals are toxic by ingestion or inhalation. They react violently with reducers, sulfur, iron, alkali metals, metal powders and phosphorous. They irritate the skin and are corrosive to eyes and respiratory tract. Inhalation of vapors or ingestion of crystals may be fatal! Use extreme caution when conducting this experiment.

Hazards aside, this activity is worth it!

- To dispose of small quantities of iodine: While working in a fume hood or well ventilated room, place the iodine crystals in 50% aqueous solution of sodium thiosulfate (e.g. 50 g $Na_2S_2O_3$ in 100 mL H_2O). Continuously stir. Check with pH paper. Slowly add a small amount of sodium carbonate (1 g or less) and periodically check with pH paper for neutralization. Stir until the iodine is consumed. Do a final check with pH paper for neutralization. Flush down the drain with large quantities of water. (based on the Flinn Chemical & Biological Catalog Reference Manual 2005)
- Dispose of the Petri dish in the waste container.

APPLICANT RECORD CARD

SEE REVERSE SIDE FOR FURTHER INSTRUCTIONS

TYPE OR PRINT ALL INFORMATION IN BLACK

LAST NAME NAM | FIRST NAME | MIDDLE NAME

FBI **LEAVE BLANK**

SIGNATURE OF PERSON FINGERPRINTED

RESIDENCE OF PERSON FINGERPRINTED

PERSON TO BE NOTIFIED IN CASE OF EMERGENCY

NAME _____

ADDRESS _____

FINGERPRINTED BY

FINGERPRINTS SUBMITTED BY

DATE OF BIRTH **DOB** MONTH | DATE | YEAR

DATE FINGERPRINTED	SEX	RACE	HGT.	WGT.	EYES	HAIR	PLACE OF BIRTH **POB**

SOCIAL SECURITY NO.

MISCELLANEOUS NO.

SCARS AND MARKS

LEAVE BLANK

CLASS _____

REF. _____

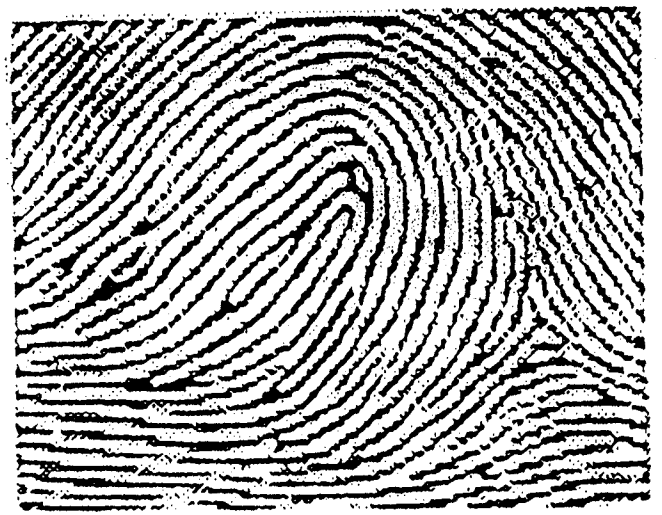
1. R. THUMB	2. R. INDEX	3. R. MIDDLE	4. R. RING	5. R. LITTLE
6. L. THUMB	7. L. INDEX	8. L. MIDDLE	9. L. RING	10. L. LITTLE

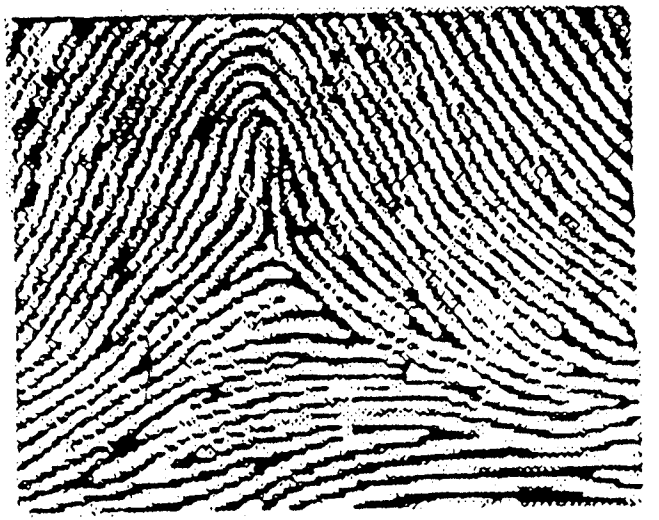
LEFT FOUR FINGERS TAKEN SIMULTANEOUSLY

L. THUMB

R. THUMB

RIGHT FOUR FINGERS TAKEN SIMULTANEOUSLY

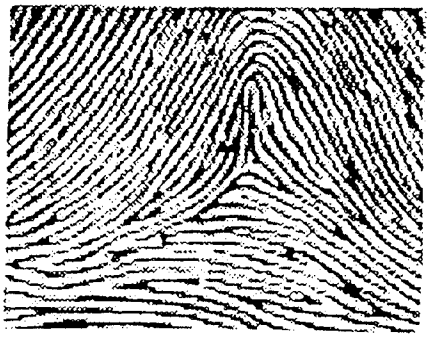




Fingerprint Patterns and Classification

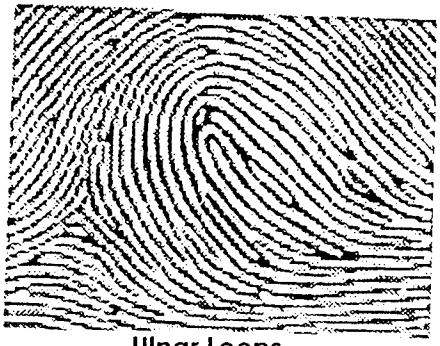
Plain Arches

In plain arches the ridges enter on one side of the print and flow or tend to flow out the other side with a rise or wave in the center.



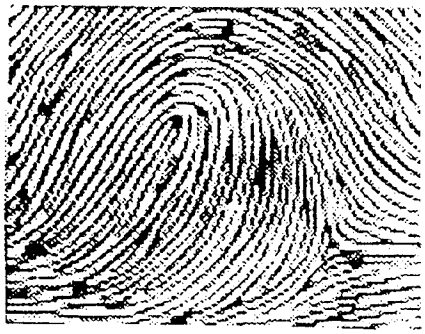
Tented Arches

Tented arches are similar to plain arches with the exception that the ridges in the center form a definite angle or one or more ridges at the center form an upthrust.



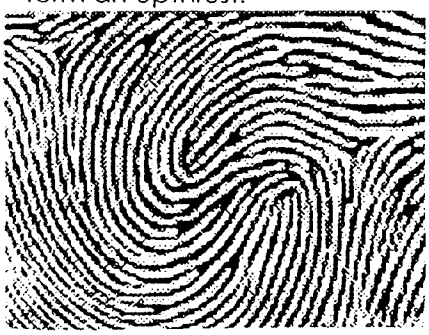
Ulnar Loops

Ulnar loops are those types of patterns in which the loops flow in the direction of the ulna bone (toward the little fingers).



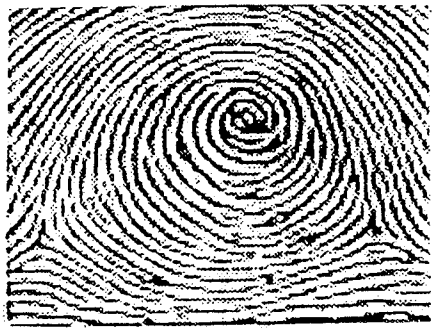
Radial Loops

Radial loops are those types of patterns in which the loops flow toward the radius bone (toward the thumbs).



Double Loop

The double loop consists of two separate loop formations, with two separate and distinct sets of loops and two deltas.



Plain Whorl

A plain whorl has two deltas and at least one ridge making a complete circuit, which may be spiral, oval, or any variation of the circle.

Central Pocket Whorl

The central pocket whorl consists of one or more recurving ridges, or an obstruction at right angles to the inner line of flow with two deltas.

Accidental Whorl

The accidental whorl is a pattern with two or more deltas and a combination of two or more different types of patterns, excluding the plain arch.

The accidental whorl also includes those exceedingly unusual patterns which may not be placed by definition into any other classification.

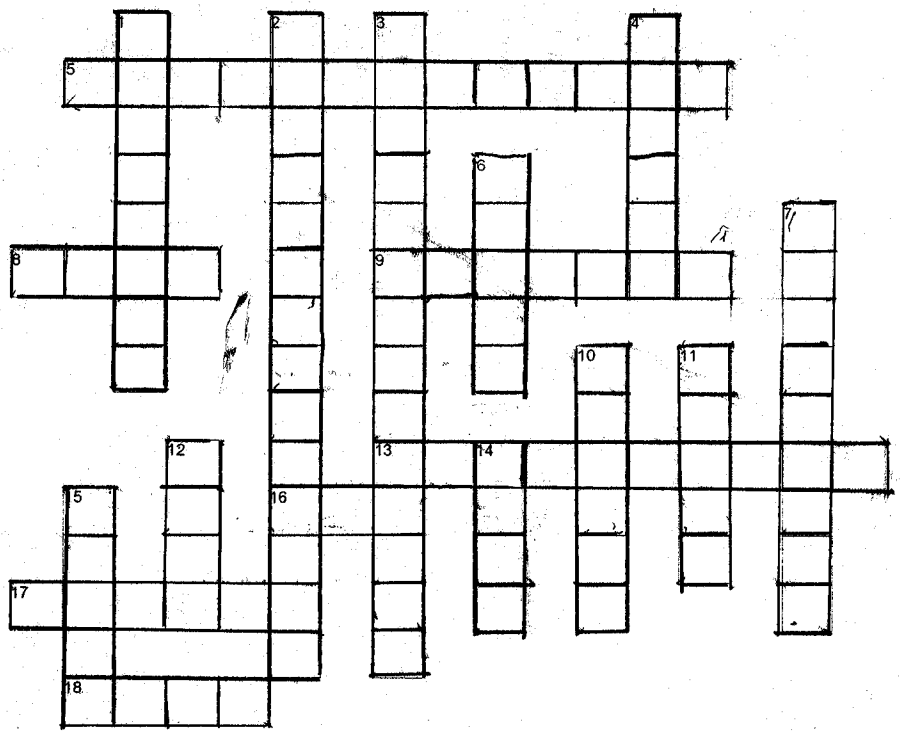
Name _____ Date _____

Fingerprint Terminology

1. **Accidental whorl**—fingerprint pattern that is a combination of two or more types of patterns, except for plain arch
2. **AFIS** (Automated fingerprint identification system)—a computerized system for scanning, mapping, storing, searching, and retrieving fingerprints
3. **Bifurcations** (forks)—ridge characteristic in which ridges diverge into two ridges
4. **Bulb**—rounded area at the end joint of every finger and thumb
5. **Central pocket whorl**—fingerprint pattern in which most of the ridges form a loop, with one or more ridges curving completely around the core to form a pocket
6. **Classification**—method of organizing fingerprints
7. **Core**—approximate center of the bulb
8. **Dactylography**—the scientific study of fingerprints as a means of identification
9. **Delta**—a triangular area on the bulb
10. **Dot**—ridge characteristic in which the ridge appears as a single point
11. **Double loop**—fingerprint pattern consisting of two loop formations, two separate and distinct sets of deltas
12. **Friction ridges**—minute, raised lines on the surface of fingertips, palms, toes, and heels
13. **Fingerprint**—an impression created by the friction ridges, pores, sweat, and oil on a person's hands and feet
14. **Identification**—the determination of an individual's identity through physical evidence, especially fingerprint evidence
15. **Invisible print**—a latent print not visible without some form of developing
16. **Islands** (Eye, Enclosure)—ridge characteristic in which a ridge divides into two the converges back into one
17. **Latent prints**—an impression transferred to a surface by sweat, oil, dirt, blood, or some other substance on the ridges of the fingers; may be visible or invisible
18. **Loop pattern**—fingerprint pattern in which one or more ridges enter from one side, make a turn, and exit on the side from which they entered; has only one delta
19. **Plain arch**—fingerprint pattern in which the ridges enter on one side of the impression and flow, or tend to flow, out the other side with a wave in the center
20. **Plain whorl**—the simplest, most common whorl fingerprint pattern; has two deltas, and at least one ridge that makes a complete circuit about the core
21. **Plastic print**—a form of a visible print that is created in a soft substance, such as wax, soap, butter, putty, grease, or paint
22. **Radial loop**—a loop fingerprint pattern in which the ridges slant toward the thumb, or the radial bone of the forearm
23. **Ridge characteristics** (minutiae)—ridge endings, bifurcations, enclosures, and other ridge details, which must match in two fingerprints in order for their common origin to be established
24. **Ridge endings**—ridge characteristic in which the ridge blatantly stops
25. **Ten-print card**—a card or form on which fingerprints are transferred along with other personal data and then filed for future retrieval

26. **Tented arch**—fingerprint pattern in which the ridges enter on one side and flow out the other, as in the plain arch, however the ridge or ridges at the center have a distinct upward thrust
27. **Ulnar loop**—a loop fingerprint pattern in which the ridges slant toward the little finger, or the ulna bone of the forearm
28. **Visible print**—a latent print that is immediately visible to the naked eye
29. **Whorl pattern**—fingerprint pattern in which at least one ridge must pass completely around the core of the finger; typically spiral, circular, oval, or an variation of a circle; has at least two deltas

Fingerprints Vocab



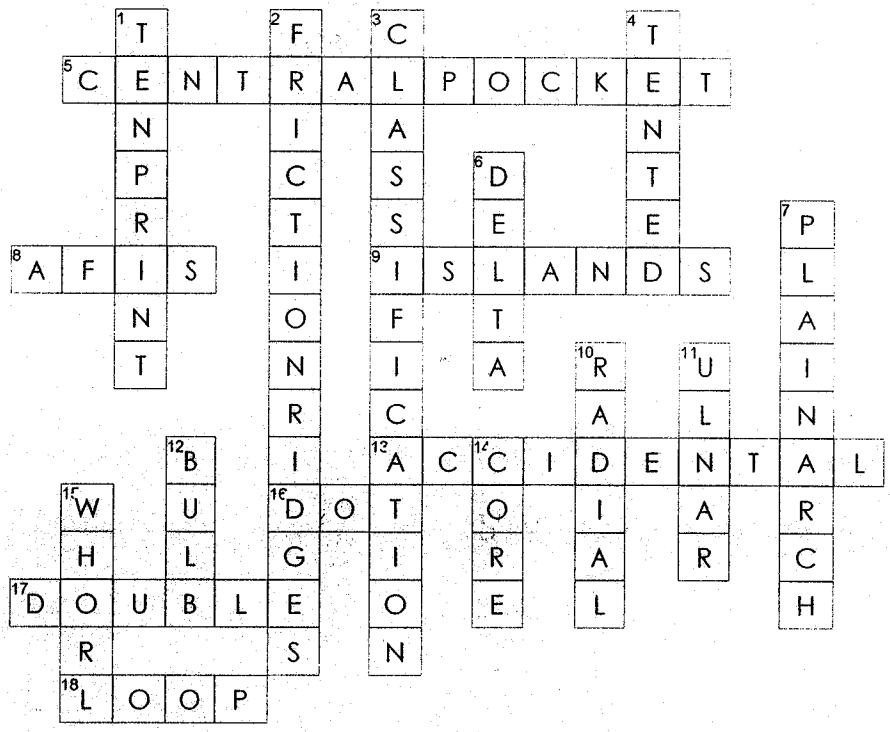
ACROSS

5. a loop formed by one or more ridges going all the way around
8. law enforcement computer network for fingerprint data and matching
9. ridge that separates and rejoins
13. two or more patterns on the same whorl print
16. ridge that is a single point
17. two loop formations on one fingerprint
18. one or more ridges make a turn and return to same side

DOWN

1. cards with inked prints
2. fingerprint lines
3. fingerprint styles and characteristics used for identification
4. ridges come in one side, make a peak, and exit the other side
6. triangle shape on fingerprints
7. ridges come in one side, make a wave, and exit the other side
10. ridges slant towards the thumb
11. ridges slant toward little finger
12. tips of fingers
14. center of fingerprint
15. at least one ridge must make a circle at the center

Fingerprints Vocab



ACROSS	DOWN
5. a loop formed by one or more ridges going all the way around	1. cards with inked prints
8. law enforcement computer network for fingerprint data and matching	2. fingerprint lines
9. ridge that separates and rejoins	3. fingerprint styles and characteristics used for identification
13. two or more patterns on the same whorl print	4. ridges come in one side, make a peak, and exit the other side
16. ridge that is a single point	6. triangle shape on fingerprints
17. two loop formations on one fingerprint	7. ridges come in one side, make a wave, and exit the other side
18. one or more ridges make a turn and return to same side	10. ridges slant towards the thumb
	11. ridges slant toward little finger
	12. tips of fingers
	14. center of fingerprint
	15. at least one ridge must make a circle at the center

Name _____ Date _____

Crime Scenario #1

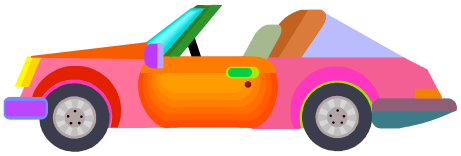
Dr. Gadget's silver Porsche 911 was stolen Friday night from the Bricktown parking lot. Dr. Gadget's car was found the next morning wrecked at Lake Thunderbird.

- **Observations:** The driver's side window had been knocked out. A tire iron was found on the passenger side floor board. The glove box appeared to have been pried open. Approximately twelve feet from the car were two sleeping men with an empty liquor bottle between them.

- **Evidence:** Officers collected latent fingerprints from the exterior door handle (fingerprints 1 and 2), steering wheel (3 and 4), tire iron (5), dashboard (6), glove box (7), bottle (8 and 9), and interior door handle (10 and 11).

- **Interview:** The men found at the scene were identified as Bubba Jones and Redd Nekk. They were taken into custody for questioning. Both men vowed that the other had stolen the car and had pulled the lodged criminal from the wrecked car. Afterwards, they celebrated the rescue by drinking the liquor.

- **Materials:**
  ten print cards, 3
  latent print cards, 11
  magnifying glass (optional)



- **Directions:** Use the materials and information provided to answer the following questions:

1) Which fingerprints belong to Dr. Gadget?
   - How many?
   - What evidence supports your decision?
2) Which fingerprints belong to Bubba Jones?
   - How many?
   - What evidence supports your decision?
3) Which fingerprints belong to Redd Nekk?
   - How many?
   - What evidence supports your decision?
4) Who stole the Porsche? Explain by citing the evidence.
5) Was the bottle already in the car when it was stolen? Explain by citing the evidence.

Name _____ Date _____

Teacher Suggestions

Crime # 1: "Paper" crime

- Students will use their skills at fingerprint pattern classification and identification to solve a crime on paper
- No processing evidence
- Resources (e.g. handouts) are included in the module

Instructions:

- Pass out the crime scenario to each student and other materials to each crime team/lab group.
- Instruct the students to work cooperatively to solve the case and support their answers by utilizing the evidence.

Expected Results

- Fingerprints
    - Dr. Gadget—1, 4, 6, 7, 10
    - Bubba Jones—2, 9
    - Redd Nekk—3, 5, 8, 11
- The car belongs to Dr. Gadget. His prints were all over the car. He enters and exits using both handles. He opened the glove box by pushing the button.
- Redd is the thief. He never opened the car door from the outside. He broke the window with the tire iron and reached inside. He then used the iron to pry open the glove box. He drove the car and shared the liquor.
- Bubba's prints were on the exterior handle only. He opened the door from the outside to rescue Redd. He also shared the bottle of liquor.
- The bottle was not in the car when it was stolen. Dr. Gadget's prints were not on it.

Date 6-21 | Crime SV | Case No. 631-05

Victim: WD GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake Thunderbird-clear Bay Porshe-Ext Door Handle

Prints Lifted by: T.C. Mullins | ID No. 1

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6-21 | Crime SV | Case No. 631-05

Victim: WD GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake Thunderbird-Clear Bay Porshe Steering wheel

Prints Lifted by: T.C. Mullins | ID No. 4

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim: WD GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake thunderbird Clear BAY — Ext. Door Handle

Prints Lifted by: TC Mullins | ID No. 2

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim: WD GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake Thunderbird Clear bay. STEERING WHEEL

Prints Lifted by: D. Dewrite | ID No. 3

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim W.D. Gadget

Address of Incident Bricktown P.L. Lot #2

Location of Latent Prints Lifted Lake Thunderbird - Clear Bay Area

Bottle

Prints Lifted by: D. Deewrite | ID No. 8

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim W.D. GADGET

Address of Incident Bricktown P.L #2

Location of Latent Prints Lifted

Tire Iron

Prints Lifted by: D. Deewrite | ID No. 5

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim W.D. GADGET

Address of Incident Bricktown P.L #2

Location of Latent Prints Lifted

Lake Thunderbird - Clear Bay

Porshe

Dashboard

Prints Lifted by: I.C. Mullins | ID No. 6

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date 6/21 | Crime SV | Case No. 631-05

Victim W.D. GADGET

Address of Incident Bricktown P.L. #2

Location of Latent Prints Lifted Lake Thunderbird - clear

Bay — Glovebox

button

Prints Lifted by: I.C. Mullins | ID No. 7

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date: 6/21 | Crime: SV | Case No.: 631-05

Victim: W D GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake Thunderbird clear bay area - liquor bottle

Prints Lifted by: D. Dewrite | ID No.: 9

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date: 6/21 | Crime: SV | Case No.: 631-05

Victim: W. D. GADGET

Address of Incident: Brick Town P. Lot #2

Location of Latent Prints Lifted: Lake Thunderbird Clear bay

Inter Door Handles

Prints Lifted by: D. Dewrite | ID No.: 10

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

Date: 6/21 | Crime: SV | Case No.: 631-05

Victim: W.D. GADGET

Address of Incident: Bricktown P.Lot #2

Location of Latent Prints Lifted: Lake Thunderbird clear bay

Interior Door handle

Prints Lifted by: D. Dewrite | ID No.: 11

Lightning Powder Company 1-800-852-0300

— Sketch and/or Remarks —

10 LITTLE	9 RING	8 MIDDLE	7 INDEX	THUMB

TYPE OR PRINT ALL INFORMATION IN BLACK

LAST NAME NAM: GADGET | FIRST NAME: William | MIDDLE NAME: D

FBI — LEAVE BLANK

SIGNATURE OF PERSON FINGERPRINTED: William D Gadget

ALIASES AKA: Dr Wow

ORI: SV-631-05

RESIDENCE OF PERSON FINGERPRINTED: 1901 Highbrow Lane Nichols Hills Oklahoma

DATE OF BIRTH DOB: Month 9 Day 22 Year 46

CITIZENSHIP CTZ	SEX	RACE	HGT	WGT	EYES	HAIR	PLACE OF BIRTH POB
USA	M	NA	5'11"	190	BR	Br	Indianapolis IN

DATE: 6/21 | SIGNATURE OF OFFICIAL TAKING FINGERPRINTS: Sgt D. Dewnte

YOUR NO. OCA:

LEAVE BLANK

EMPLOYER AND ADDRESS: Self Employed Same

FBI NO. FBI: NA

CLASS

ARMED FORCES NO. MNU: NA

REF.

SON FINGERPRINTED: Ower of Stolen Porshe 911

SOCIAL SECURITY NO. SOC: 123 44 5566

MISCELLANEOUS NO. MNU

1 R THUMB	2 R INDEX	3. R MIDDLE	4. R. RING	5 R LITTLE

A

10 L LITTLE | 9 L RING | 8 L MIDDLE | 7 L INDEX | THUMB

TYPE OR PRINT ALL INFORMATION IN BLACK

LAST NAME NAM: Jones | FIRST NAME: Bubba | MIDDLE NAME: Jay

FBI LEAVE BLANK

SIGNATURE OF PERSON FINGERPRINTED: Bubba J. Jones

ALIASES AKA: Robert Jay Big Un

ORI: SV-631-05

RESIDENCE OF PERSON FINGERPRINTED: 4321 Rattlesnake Hill Road Pink Oklahoma

DATE OF BIRTH DOB (Month Day Year): Apr 20 71

CITIZENSHIP CTZ: USA

SEX	RACE	HGT	WGT	EYES	HAIR
m	Can	6'6"	270	Gr	Bla

PLACE OF BIRTH POB: Dale Ok

DATE: 6/21

SIGNATURE OF OFFICIAL TAKING FINGERPRINTS: Sgt D Dewitt

EMPLOYER AND ADDRESS: Lindys Lounge 32256 Hwy #9 Norman Ok

RESSON FINGERPRINTED

YOUR NO. OCA

FBI NO. EBI 621-B

ARMED FORCES NO. MNU: AirForce

SOCIAL SECURITY NO. SOC: 748 52 2019

MISCELLANEOUS NO. MNU: —

LEAVE BLANK

CLASS

REF.

1 R THUMB | 2 R INDEX | 3 R MIDDLE | 4 R RING | 5 R LITTLE

10 L LITTLE	9 L RING	8 L MIDDLE	7 L INDEX	THUMB

TYPE OR PRINT ALL INFORMATION IN BLACK

FBI LEAVE BLANK

LAST NAME NAM: NEKK

FIRST NAME: REDD

MIDDLE NAME: LEE

SIGNATURE OF PERSON FINGERPRINTED: Redd Nekk

ALIASES AKA: Fast Eddy, Thom Gotcha

ORI: SV-631-05

RESIDENCE OF PERSON FINGERPRINTED: ~~Box~~ 42-B, Findenme Oklahoma

DATE OF BIRTH DOB: Month Nov, Day 20, Year 61

SEX	RACE	HGT	WGT	EYES	HAIR	PLACE OF BIRTH POB
M	Cau	6' 2"	250	Blu	Blo	Findenme Ok

DATE: 6/21

SIGNATURE OF OFFICIAL TAKING FINGERPRINTS: Sgt D Desuite

CITIZENSHIP CTZ: USA

YOUR NO. OCA:

EMPLOYER AND ADDRESS: Whatever I can get Inc, 23 Five Finger Rd, Findenme Ok

FBI NO. FBI: 5321

ARMED FORCES NO. MNU: No

SOCIAL SECURITY NO SOC: 777-20-9876

MISCELLANEOUS NO. MNU:

LEAVE BLANK

CLASS

REF

SON FINGERPRINTED: Suspect – Gadget/911

1 R THUMB | 2 R INDEX | 3 R MIDDLE | 4 R RING | 5 R LITTLE

Name _____ Date _____

Crime Scenario #2

The teacher had several after school parent-teacher conferences one afternoon. Some conferences the teacher initiated and the other conferences parents requested. The next morning, the teacher arrives to find a manila envelope sitting in a paper tray that has been unsealed. The content of the envelope, a data CD in a CD case, is missing! The CD contained several important chapter tests and the final exam.

- **Observations**: Use the crime scene form to record your observations.
- **Evidence:** Use the crime scene form to record information about the evidence.
- **Interview:** The teacher supplies the list of parent-teacher conferences from the previous afternoon.

Parent(s) Name	Reason for Conference	Time
Wanna & Gunna Bee	Son/step son—Hank Crank—has not been turning in homework; teacher requested conference	3:45—did not show
Susie Purrfect	Daughter was caught cheating on an exam; teacher requested conference	4:00-4:11
Nate Naval	Son is failing class, must pass to graduate; parent requested conference	4:20-4:37
Marsha Mellow	Daughter is having behavioral issues in class (i.e. anger management); teacher requested conference	4:45-5:02
Principal Ian Charge	Several parents have called to complain about exams being "too difficult", has requested copies of exams; principal requested conference	5:25-5:30

The teacher states that they left the room in between each conference for breaks, to greet the parents upon arrival, and to escort the parents out upon departure. The teacher indicates that they left for the evening at approximately 5:30, in which the door was locked and they did not notice if the envelope was tampered with or missing.

Name _____ Date _____

Tecumseh Police Department
Crime Scene Investigation

Date of Report _____ Crime Team _____ Agent Reporting _____

Description of Incident _____

Address of Incident _____

VICTIM

Name			
Address			
Phone			
Race	Gender	Age	Date of Birth
Place of Employment			Work Phone
Work Address			

EVIDENCE COLLECTED

Item #	Description, Location	Processing Technique	Processing by
Item #	Description, Location	Processing Technique	Processed by
Item #	Description, Location	Processing Technique	Processed by
Item #	Description, Location	Processing Technique	Processed by
Item #	Description, Location	Processing Technique	Processed by

Name _____ Date _____

Observations of Scene _____

_____

_____

_____

Sketch of Scene

Details—Actions—Remarks

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Name _____ Date _____

AFIS results: After running the prints your crime team lifted in the Automated Fingerprint Identification System, the computer produced these results:

Name/Description	Reason in AFIS	Print
Principal Ian Charge 55, Male, Caucasian	Educator	
Nate Naval 43, Male, Caucasian	Military	
Officer Dudly Duwright 32, Male, African American	Law enforcement	
Teacher 29, Female, Native American	Educator	
Hank Crank 16, Male, Caucasian	Offender (drugs)	

Name _____ Date _____

Analysis and Results

Use complete sentences to answer the following. Attach additional paper as necessary.

1) Where did you look for prints? Why?
2) Where were prints found?
3) How many different prints were found? Specify their locations.
4) Whose prints were found on the evidence? Explain your reasoning using the latent prints and the AFIS file.
5) Who committed the burglary? Explain your reasoning.
6) Hypothesize on a motive to commit the crime.

Teacher Suggestions

Crime #2: "Evidence" crime

- Students will use processing techniques and fingerprint pattern classification and identification to solve a crime with physical evidence
- Some resources (e.g. handouts) included, others will need to be supplied (e.g. metal or plastic letter tray, manila envelope, CD case)
- Have enough materials for each crime team/lab group.
- Other materials: goggles, aprons, gloves, materials for processing evidence (dusting powders, Superglue, iodine, etc.), scanner/digital camera/Polaroid camera
- Number the evidence according to the crime team/lab groups. Place the evidence in various locations about the room so that the teams must locate their materials.

Instructions

- Present each crime team/lab group with a numbered file folder that contains the information/handouts (except for the AFIS results) and latent fingerprint cards
- There should be enough crime reports and AFIS results for each student.
- Instruct the students to make detailed observations of the crime scene and evidence and also to include a brief sketch.
- Instruct students that on the crime report under the "Details—Actions—Remarks", they should indicate why they chose the processing technique for that specific evidence (based on material).
- After the students have processed the prints, hand out the AFIS results and analysis questions.
- Students should return the file folder with all the information/handouts, each individual's AFIS results and analysis questions, and completed latent fingerprint cards or digital photos.

Expected Results

- Allow the students to decide how to process the evidence; guide as necessary
- You will need to supply the TEACHER print (your left thumb print) and the PERPETRATOR—Nate Naval—print (your right thumb print). Record an enlarged version of each on the AFIS results.
- Place right & left thumbprints on the tray, manila envelope, CD case, and possible the counter.
- To set up the crime scene again, wipe nonporous material with glass cleaner, replace the envelope, and lay your thumbprints on the evidence.

Name _____ Date _____

AFIS results: After running the prints your crime team lifted in the Automated Fingerprint Identification System, the computer produced these results:

Name/Description	Reason in AFIS	Print
Principal Ian Charge 55, Male, Caucasian	Educator	
Nate Naval 43, Male, Caucasian	Military	
Officer Dudly Duwright 32, Male, African American	Law enforcement	
Teacher 29, Female, Native American	Educator	
Hank Crank 16, Male, Caucasian	Offender (drugs)	

FLINN SCIENTIFIC INC.

"Your Safer Source for Science Supplies"

Material Safety Data Sheet (MSDS)

MSDS #: 407.00
Revision Date: November 25, 2002

Section 1 — Chemical Product and Company Identification

Iodine

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Iodine

CAS#: 7553-56-2

Section 3 — Hazards Identification

Gray-black flakes, metallic luster, characteristic odor.
Highly toxic by ingestion and inhalation.
Irritating and corrosive to skin. Avoid all body contact.

FLINN AT-A-GLANCE
Health-3
Flammability-0
Reactivity-2
Exposure-3
Storage-1

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Rinse out mouth, give 1 to 2 cups of water or milk, induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Non-flammable, noncombustible solid.
When heated to decomposition, emits toxic fumes of iodide and various iodine compounds.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Sweep up, place in sealed bag or container and dispose. Ventilate area and wash spill site after material pickup is complete. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Inorganic #2. Store with acetates, halides, sulfates, sulfites, thiosulfates and phosphates. Store in a cool dry place. Store in a Flinn Chem-Saf bag; the substance sublimes. Frequently oxidizes metal shelves or metal containers in proximity to the iodine. Use and dispense in a hood.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: ceiling 0.1 ppm (OSHA)

Section 9 — Physical and Chemical Properties

Gray-black flakes, metallic luster, characteristic odor.
Solubility: Soluble in alcohol and other organic solvents; not in water.
Formula: I2
Formula Weight: 253.80

Boiling Point: 185.24 C
Specific gravity: 4.98
Melting Point: 113.5 C

Section 10 — Stability and Reactivity

Avoid contact with magnesium, zinc, ammonia, aluminum, corrodes steel. Reacts violently with acetaldehyde.
Shelf Life: Fair; the substance sublimes. Frequently oxidizes metal shelves or metal containers in proximity to the iodine.

Section 11 — Toxicological Information

Acute effects: Highly toxic, harmful vapor, corrosive, severe lachrymatol, sensitizer, stomach pains, vomiting.
Chronic effects: Dermatitis
Target organs: Thyroid

ORL-HUM LD50: 2-4 gm for an adult
IHL-RAT LC50: N.A.
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method #12a is one option.

Section 14 — Transport Information

Shipping Name: Toxic solid, inorganic, n.o.s.
Hazard Class: 6.1 Keep away from food
UN Number: UN3288

N/A = Not applicable

Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (231-442-4), RCRA code D002.

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

FLINN SCIENTIFIC INC.
"Your Safer Source for Science Supplies"

Flinn Is No. 1 in Safety

flinn@flinnsci.com www.flinnsci.com
P.O. Box 219 Batavia IL 60510
(800) 452-1261 Fax (866) 452-1436

FLINN SCIENTIFIC INC.

"Your Safer Source for Science Supplies"

Material Safety Data Sheet (MSDS)

MSDS #: 420.00
Revision Date: March 14, 2001

Section 1 — Chemical Product and Company Identification

Isopropyl Alcohol

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Isopropyl Alcohol
Synonym: 2-propanol, rubbing alcohol
CAS#: 67-63-0

Section 3 — Hazards Identification

Clear colorless liquid; distinctive odor; like rubbing alcohol.
Irritant to body tissues. Slightly toxic by ingestion, inhalation, and skin absorption.
The single lethal dose for a human adult is about 250 mL, although as little as 100 mL can be fatal.
Class 1B flammable liquid.

FLINN AT-A-GLANCE
Health-1
Flammability-3
Reactivity-1
Exposure-1
Storage-3

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Class 1B flammable liquid.
Flash Point: 60 F Upper: 12% Lower: 2.5% Autoignition Temperature: 860 F
When heated to decomposition, emits acrid smoke and fumes.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
H-1
F-3
R-0

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #2. Store with alcohols, glycols, amines and amides.
Store in a dedicated flammables cabinet. If a flammables cabinet is not available, store in Flinn Saf-Stor can.
Store in a cool dry place. Use and dispense in a hood. Avoid prolonged storage (see section 10).

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: TWA 400 ppm, STEL 500 ppm (OSHA, ACGIH)

Section 9 — Physical and Chemical Properties

Clear colorless liquid.
Solubility: Water soluble, soluble in alcohol and ether.
Formula: C3H8O
Formula Weight: 60.11

Specific Gravity: 0.7863
Melting Point: -89 C
Boiling Point: 82.4 C
Vapor Pressure: 33 mm (20C)
Vapor Density: 2

Section 10 — Stability and Reactivity

Avoid contact with strong oxidizers, acetaldehyde, chlorine, ethylene oxide, acids, isocyanates.
Shelf life: Poor, organic peroxide development is possible when exposed to light and air. Organic peroxides can result in explosions, especially when distilled. Avoid prolonged storage.

Section 11 — Toxicological Information

Acute effects: Severe eye irritant, nausea, headache, vomiting
Chronic effects: N.A.
Target organs: Nerves, kidneys

ORL-RAT LD50: 5045 mg/kg
IHL-RAT LC50: N.A.
SKN-RBT LD50: 12800 mg/kg

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method #18a is one option.

Section 14 — Transport Information

Shipping Name: Isopropyl alcohol
Hazard Class: 3, Flammable liquid
UN Number: UN1219

N/A = Not applicable

Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (200-661-7), RCRA code D001.

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

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Material Safety Data Sheet (MSDS)

MSDS #: 509.00
Revision Date: March 14, 2001

Section 1 — Chemical Product and Company Identification

Methyl Alcohol

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Methyl Alcohol
Synonyms: methanol, wood alcohol
CAS#: 67-56-1

Section 3 — Hazards Identification

Clear, colorless liquid. Alcohol odor.
Toxic by ingestion (may cause blindness), inhalation or absorption. Irritating to body tissues.
Avoid body tissue contact.
Flammable liquid.

FLINN AT-A-GLANCE
Health-3
Flammability-3
Reactivity-1
Exposure-1
Storage-3

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Flammable liquid.
Flash Point: 54 F Upper 36% Lower: 6% Autoignition Temperature: 725 F
Dangerous fire risk. When heated to decomposition, emits acrid smoke and irritating fumes.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
H-1
F-3
R-0

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #2. Store with alcohols, glycols, amines and amides.
Store in a dedicated flammables cabinet. If a flammables cabinet is not available, store in Flinn Saf-Stor can.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: TWA 200 ppm, STEL 250 ppm (OSHA, NIOSH)

Section 9 — Physical and Chemical Properties

Clear, colorless, mobile, highly polar liquid. Alcohol odor.
Specific Gravity: 0.7924
Miscible with water, alcohol and ether.
Formula: CH3OH
Formula Weight: 32.05

Melting Point: -98 C
Boiling Point: 64.6 C
Vapor Pressure: 410 mm (50 C)
Vapor Density: 1.1

Section 10 — Stability and Reactivity

Avoid contact with acids, acid chlorides, acid anhydrates, oxidizers, reducers, alkali metals.
Shelf life: Indefinite.

Section 11 — Toxicological Information

Acute effects: Poison, irritant, GI disturbances
Chronic effects: N.A.
Target organs: Eyes, kidneys

ORL-RAT LD50: 5628 mg/kg
IHL-RAT LC50: 64000 ppm/4H
SKN-RBT LD50: 15800 mg/kg

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method 18a is one option.

Section 14 — Transport Information

Shipping Name: Methyl Alcohol
Hazard Class: 3, Flammable liquid
UN Number: UN1230

N/A = Not applicable

Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (200-659-6), RCRA code U154.

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

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Material Safety Data Sheet (MSDS)

MSDS #: 551.00
Revision Date: November 25, 2002

Section 1 — Chemical Product and Company Identification

Ninhydrin Solution

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Ninhydrin (485-47-2) .5%, Butanol (71-36-3) 99%
Synonym: 0.5% solution in butanol

CAS#: None Established

Section 3 — Hazards Identification

Amber colored liquid. Odor of butyl alcohol.
Moderately toxic by ingestion and inhalation. Severe body tissue irritant. Avoid body tissue contact.
Contains butanol, a flammable liquid.

FLINN AT-A-GLANCE
Health-2
Flammability-3
Reactivity-1
Exposure-2
Storage-3

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Class IC flammable liquid.
Flash Point: 95 F Upper: 11.2% Lower: 1.4% Autoignition Temperature: 649 F
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #2. Store with alcohols, glycols, amines and amides.
Store in a dedicated flammables cabinet. If a flammables cabinet is not available, store in Flinn Saf-Stor can.
Use and dispense in a hood.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: TWA 100 ppm, as butanol (OSHA)

Section 9 — Physical and Chemical Properties

Amber colored liquid. Odor of butyl alcohol.

Section 10 — Stability and Reactivity

Avoid contact with acid chlorides, acid anhydrides, oxidizing agents copper; sources of ignition; avoid body contact; avoid inhaling.
Shelf life: Indefinite.

Section 11 — Toxicological Information

Acute effects: Severe irritant, GI disturbances
Chronic effects: N.A.
Target organs: Central nervous system, ears, liver, kidneys, blood

ORL-RAT LD50:790 mg/kg as butanol
IHL-RAT LC50: 8000 ppm/4H as butanol
SKN-RBT LD50: 340 mg/kg as butanol

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method 18b is one option.

Section 14 — Transport Information

Shipping Name: Butanols
Hazard Class: 3, Flammable liquid
UN Number: UN1120

N/A = Not applicable

Section 15 — Regulatory Information

Not listed.

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

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Material Safety Data Sheet (MSDS)

MSDS #: 550.00
Revision Date: November 25, 2002

Section 1 — Chemical Product and Company Identification

Ninhydrin

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Ninhydrin
Synonyms: 1,2,3,-indantrione, monohydrate
CAS#: 485-47-2

Section 3 — Hazards Identification

White to yellowish crystals or powder; characteristic odor of fresh paint. Turns red when heated above 100C.
Irritant to skin and mucous membranes. May cause redding and inflammation to the skin.
Avoid all body tissue contact. Slightly toxic by ingestion.

FLINN AT-A-GLANCE
Health-1
Flammability-0
Reactivity-1
Exposure-1
Storage-1

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Give large quantities of water. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Non combustible solid.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Sweep up, place in sealed bag or container and dispose. Ventilate area and wash spill site after material pickup is complete. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #2. Store with alcohols, glycols, amines and amides.
Store in a cool dry place. Light sensitive, store in Flinn Chem-Saf bag. Use and dispense in a hood.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron.
Use exhaust ventilation to keep airborne concentrations low.

Section 9 — Physical and Chemical Properties

White to yellowish crystals or powder; characteristic odor of fresh paint. Turns red when heated above 100 C.
Solubility: Soluble in both water and alcohol.
Formula: C6H4-1,2-(CO)2CO H2O
Formula Weight: 195.15

Melting Point: 240-245 C

Section 10 — Stability and Reactivity

Avoid strong bases and amines.
Shelf life: Indefinite, but light sensitive.

Section 11 — Toxicological Information

Acute effects: Irritant, reddening and inflammation of skin.
Chronic effects: N.A.
Target organs: N.A.

ORL-RAT LD50: N.A.
IHL-RAT LC50: N.A.
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method 18b is one option.

Section 14 — Transport Information

Shipping Name: Not regulated
Hazard Class: N/A
UN Number: N/A

N/A = Not applicable

Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (207-618-1).

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

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Material Safety Data Sheet (MSDS)

MSDS #: 584.00
Revision Date: March 15, 2001

Section 1 — Chemical Product and Company Identification

Petroleum Ether

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Petroleum Ether
Synonyms: ligroine, naphtha
CAS#: 8032-32-4

Section 3 — Hazards Identification

Water-white liquid. Natural gas-like odor.
Irritating to body tissues. Avoid body tissue contact.
Flammable liquid. Serious fire risk.

FLINN AT-A-GLANCE
Health-0
Flammability-3
Reactivity-0
Exposure-1
Storage-3

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Give 1 to 2 cups of water or milk, followed by a gastric antacid, such as milk of magnesia. Do not induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Class IA flammable liquid.
Flash Point: -57 F Upper: 8% Lower: 1.1% Autoignition Temperature: 475 F
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
H-1
F-4
R-0

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #3. Store with hydrocarbons, esters, aldehydes, and oils.
Store in a dedicated flammables cabinet. If a flammables cabinet is not available, store in Flinn Saf-Stor Can.
Use and dispense in a hood.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron.
Use exhaust ventilation to keep airborne concentrations low.

Section 9 — Physical and Chemical Properties

Water-white liquid. Natural gas-like odor.
Solubility: Insoluble with water. Miscible with many organic solvents.
Not an ether, a low boiling fraction of petroleum distillate.

Specific Gravity: 0.640
Boiling Point: 36-60 C
Vapor Pressure: 400mm (20 C)
Vapor Density: 2.5

Section 10 — Stability and Reactivity

Avoid contact with strong oxidizers.
Shelf life: Indefinite, if stored safely.

Section 11 — Toxicological Information

Acute effects: Toxic, irritant
Chronic effects: Possible mutagen
Target organs: Central nervous system

ORL-RAT LD50: >5gm/kg
IHL-RAT LC50: N.A.
SKN-RBT LD50: >3gm/kg

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method #18a is one option.

Section 14 — Transport Information

Shipping Name: Petroleum Distillates, n.o.s.
Hazard Class: 3, Flammable liquid
UN Number: UN1268

N/A = Not applicable

Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (232-453-7), RCRA code D001.

Section 16 — Other Information

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The forger who fooled the world

Frank Wynne tells the extraordinary story of Han van Meegeren, the Dutch artist whose 'Vermeer' made him a folk hero

I've always loved a forger. It's difficult not to feel a surge of joy at the thought of an eminent critic waxing lyrical over the glories of a "17th-century masterpiece" on which the paint is barely dry. If the pinnacle of Western art is arguably Leonardo da Vinci, his shadow self in the pantheon of forgers is Han van Meegeren.

Han van Meegeren's The last supper (1940-1941)

In May 1945, shortly after the liberation of Holland, two officers arrived at the studio of van Meegeren, then just a little-known Dutch painter and art dealer. The officers, from the Allied Art Commission, were responsible for repatriating works of art looted by the Nazis. They had come about a painting discovered among the collection of Hermann Göring: a hitherto unknown canvas by the great Johannes Vermeer, entitled The Supper at Emmaus.

Since the Nazis had kept detailed records, it had been easy to trace the sale of the painting back to van Meegeren. Now, they wanted only the name of the original owner so that they might return his priceless masterpiece. When van Meegeren refused to name the owner, they arrested him and charged him with treason. If found guilty, he faced the death penalty.

The artist was entirely innocent of the charges against him, a fact he could easily have proved. But in doing so, he would have to confess to a series of crimes which he had plotted for decades and which, in five short years had earned him the equivalent of $60 million. Han van Meegeren was a forger.

He loathed modern art - he thought it childish and decadent, a passing fad for ugliness which would soon fade. For years he had eked out a living painting gloomy portraits of rich patrons in a faux-Rembrandt style and had winced as he heard his work ridiculed by his peers. A prominent critic reviewing van Meegeren's second solo exhibition wrote, "A gifted technician who has made a sort of composite facsimile of the Renaissance school, he has every virtue except originality."

The time had come, van Meegeren felt, to revenge himself on his critics. He devised a plan to paint a perfect Vermeer - neither a copy, nor a pastiche, but an original work - and, when it had been authenticated by leading art experts, acquired by a major museum, exhibited and acclaimed, he would announce his hoax to the world.

His first step was concocting an ingenious mixture of pigments that "would pass the five tests which any genuine 17th-century painting must pass". Now he had only to paint a masterpiece.

The Supper at Emmaus was unlike any acknowledged Vermeer. Van Meegeren, true to his perversely moral scheme, painted it in his own style, adding only subtle allusions to works by the Dutch master, before signing it with the requisite flourish. He had it submitted to Abraham Bredius, the most eminent authority on Dutch baroque art of his day, and the critic took the bait.

Writing in the Burlington magazine, Bredius opined: "It is a wonderful moment in the life of a lover of art when he finds himself suddenly confronted with a hitherto unknown painting by a great master… And what a picture! We have here a - I am inclined to say the - masterpiece of Johannes Vermeer of Delft."

"As the standard of his forgeries plummeted, still experts accepted them as genuine"

Suddenly the world was at van Meegeren's feet. The Supper at Emmaus was bought by the prestigious Boijmans Gallery in Rotterdam for the equivalent of $6 million. More importantly for van Meegeren, it was advertised as the centrepiece, the crowning glory of the gallery's exhibition, 400 Years of European Art.

During the exhibition, van Meegeren would loudly proclaim the painting a forgery, a crude pastiche, and listen as the finest minds of his generation persuaded him that his painting was a genuine Vermeer. His triumph was now complete. He had only to do what he had promised himself: to stand up and claim the work for himself, thereby making fools of his critics. Instead, within a month, he was working on a new forgery.

In less than six years, van Meegeren would paint a further six "Vermeers", earning the equivalent of $60 million. With money, came vice - he revelled in fine champagne, became addicted to morphine and was compulsively unfaithful to his wife.

He bought dozens of houses and hotels, but even then he could not exhaust his wealth, so he hid hundreds of thousands of guilders in gardens, heating ducts and under the floorboards of his many properties. Often he would forget where he had hidden the money, and 30 years after his death, the Dutch were still turning up cashboxes stuffed with pre-war notes.

As van Meegeren's addictions to alcohol and morphine took hold, and the standard of his forgeries plummeted, still experts accepted them as genuine. He discovered that, regardless of how incompetent his painting, how crude his anatomy, how uncertain the provenance, the most erudite Vermeer critics were prepared to sanctify his work. His one mistake had been to allow one of his paintings to fall into enemy hands.

No expert eye discovered van Meegeren's forgery. He was unmasked only because, after six weeks in prison, he cracked: "'Fools!" he roared at his jailers. "You think I sold a priceless Vermeer to Göring? There was no Vermeer - I painted it myself."

There was one thing van Meegeren had not counted on: no one believed his confession. It was one of the officers who naively suggested that if van Meegeren had painted Göring's Vermeer, he could paint a copy from memory. Van Meegeren arrogantly refused. "To paint a copy is no proof of artistic talent. In all my career I have never painted a copy! But I shall paint you a new Vermeer. I shall paint you a masterpiece."

And so, surrounded by reporters and court-appointed witnesses, and supplied with liberal quantities of alcohol and morphine, he worked for six weeks painting one final "Vermeer", in a desperate attempt to prove himself guilty.

Having been denounced by the press as a traitor, a "Dutch Nazi artist", van Meegeren was now a folk hero - the man who had swindled Göring. The Reichsmarschall was told that his beloved Vermeer was a forgery while awaiting execution in Nuremberg. According to a contemporary account: "[Göring] looked as if for the first time he had discovered there was evil in the world."In the wake of his confession and the scandal it caused, van Meegeren truly knew the fame he had craved. The trial, when it came, was a three-ring circus. Experts tripped over each other to exculpate themselves. Van Meegeren - more than the prosecuting counsel - was determined that he should be found guilty of committing these "masterpieces", but even now, experts conspired against him, arguing that at least one of his forgeries might be genuine.

In the end, however, van Meegeren got his wish: on November 12, 1947 he was found guilty of obtaining money by deception and sentenced to one year's imprisonment.But he would never serve a day of his sentence. While prosecution and defence wrangled to secure a full public pardon from the Queen, the forger - long a consummate hypochondriac - finally succumbed to angina. He was hospitalised on the day before he was scheduled to serve his sentence and died some weeks later.

Han van Meegeren's greatest gift to the art world is doubt. If forgers throughout the ages have taught us anything, it is to re-examine why we love what we love, to overcome our obsession with simple authenticity and appreciate the work for itself. Is a minor Rothko truly worth more than the finest Ellsworth Kelly? Are we captivated by the serenity and light of a Corot watercolour, or simply the signature?

"Perhaps," as the art critic Emily Genauer wrote, "we are almost at the point of sophistication where we are able to enjoy a work of art for what it is."

Perhaps. Then again, as Theodore Rousseau pointed out, "We should all realise that we can only talk about the bad forgeries, the ones that have been detected; the good ones are still hanging on the walls."

- Frank Wynne is the author of 'I Was Vermeer: The Legend of the Forger Who Swindled the Nazis', published by Bloomsbury (£14.99) on Mon.

Latent Fingerprints Experiment

There are many ways of developing fingerprints, below is one experiment that uses iodine as a method of developing fingerprints.

You will need: filter paper; a paper clip; iodine crystals; string; jar

1. Make a fingerprint on a small piece of filter paper by firmly pressing down.

2. Take a paper clip with a piece of string attached to it and clip this on to the filter paper. Place a few iodine crystals on the bottom of a screw top jar.

3. Hang the paper clip and filter paper inside the jar and put the lid on tightly trapping the string out the side of the jar and suspending the paperclip and filter paper.

3. After about ten minutes, the iodine will develop the print on the filter paper and the image should be clear enough to photograph.

Alternately, fingerprints can also be easily revealed by brushing a fingerprinted surface with iron filings or lifting it from a surface with adhesive tape - neither require 'developing'.