

Henry Number



Topic

Classification of fingerprints

Introduction

The pattern of ridgelines on a person's fingerprints gives a unique, unchanging identification of that person.

This discovery was of great use to detectives, but searching for a possible match for a suspect's fingerprints in an archive containing several thousand sets of fingerprints was not easy. A system classifying the records made this search easier, because it quickly narrowed down the search to a limited number of records. The Henry Primary Classification System, devised by Sir Edward Henry (1859–1931), uses the presence or absence of a whorl pattern on each fingerprint and calculates the "Henry Number" using the binary system (see diagram 1 below). This system remains at the heart of many modern fingerprint classification systems. Once the Henry Number of a set of fingerprints has been calculated, authorities need only compare a limited number of sets that share the same Henry Number. In the first part of this experiment, you will make two copies of your fingerprints and then try to match one copy with the other copy held in a set for the whole class. In the second part of the experiment, you will calculate the Henry Number for your fingerprints and then investigate how easy it is to find a copy of your fingerprints from the class set using the Henry Number of your fingerprints.

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| Decimal system | |
|----------------|----------|
| 1 | one |
| 10 | ten |
| 100 | hundred |
| 1000 | thousand |

| Binary system | |
|---------------|-------|
| 1 | one |
| 10 | two |
| 100 | four |
| 1000 | eight |

Decimal and binary systems

In the decimal system, each digit has ten times the value of the digit one place to its right. In the binary system, each digit has twice the value of the digit one place to its right.

Time required

Part A: 45 minutes

Part B: 45 minutes

Materials

No. 2 pencil
pencil sharpener
clear adhesive tape 25 mm wide
scissors
30 cm ruler
2 sheets of white unlined ($8\frac{1}{2} \times 11$) paper
table
magnifying glass

Safety note



Please read the general safety precautions.

Procedure

This experiment is a whole class activity.

Part A: Searching for matching fingerprints by eye

1. Make a copy of data table A below on each sheet of paper. Then use the procedure given in Part A of Experiment 3.02 to make a copy of your fingerprints on both sheets. Label both sheets on the back with your name.
2. Place one copy of your fingerprints with those of other class members in a pile.
3. Take your remaining copy and look for the matching set in the pile of class fingerprints. *Do not look at names on the backs of the sheets.*

| DATA TABLE A | | | | |
|---------------------|--------------|---------------|-------------|---------------|
| Right hand | | | | |
| Thumb | Index finger | Middle finger | Ring finger | Little finger |
| | | | | |
| Left hand | | | | |
| Thumb | Index finger | Middle finger | Ring finger | Little finger |
| | | | | |

Part B: Searching for matching fingerprints using the Henry Number

The teacher should return the fingerprint copies made in Part A to each student.

1. Use a magnifying glass, the patterns shown in diagram 3 of Experiment 3.02 (page 3.02–3), and data table A to identify which of your fingerprints are whorls. Record your results in the first row of data table B below by entering a “W” in the relevant column of “My record.”
2. Data table B assigns each digit a “digit number” from 1 to 10 starting with 1 for the thumb of the right hand. Data table B also groups the digits into “digit pairs” (i.e., the right thumb with the right index finger; the right middle finger with the right ring finger; the right little finger with the left thumb; the left index finger with the left middle finger; the left ring finger with the left little finger) and assigns each “digit pair” a number following the binary system.

| DATA TABLE B | | | | | | | | | | |
|---------------------|------------|--------------|---------------|-------------|---------------|-----------|--------------|---------------|-------------|---------------|
| | RIGHT HAND | | | | | LEFT HAND | | | | |
| | Thumb | Index finger | Middle finger | Ring finger | Little finger | Thumb | Index finger | Middle finger | Ring finger | Little finger |
| My record | | | | | | | | | | |
| Digit number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Digit pairs* | 16 | | 8 | | 4 | | 2 | | 1 | |
| Sum of X | | | | | | | | | | |
| Sum of Y | | | | | | | | | | |
| X/Y | | | | | | | | | | |

*In the binary system, the right-most place has the value 1, the place to its left 2, the place to its left 4, then 8, then 16, and so on.

3. The Henry Number for a set of fingerprints is calculated using the formula:

$$\text{Henry Number} = \frac{(\text{Sum of values for whorls of even-numbered digits}) + 1}{(\text{Sum of values of whorls of odd-numbered digits}) + 1}$$

$$= \frac{X + 1}{Y + 1}$$

where X is the sum of values for whorls on even-numbered digits and Y is the sum of values for whorls on odd-numbered digits.

Use the information in data table B to find the sum of values (X) for whorls on even-numbered digits:

The initial value of X = 0.

If there is a “W” present for digit number 2, add 16 to X.

If there is a “W” present for digit number 4, add 8 to X.

If there is a “W” present for digit number 6, add 4 to X.

If there is a “W” present for digit number 8, add 2 to X.

If there is a “W” present for digit number 10, add 1 to X.

Record the value of X in data table B.

4. Use the information in data table B to find the sum of values (Y) for whorls on odd-numbered digits:

The initial value of Y = 0.

If there is a “W” present for digit number 1, add 16 to Y.

If there is a “W” present for digit number 3, add 8 to Y.

If there is a “W” present for digit number 5, add 4 to Y.

If there is a “W” present for digit number 7, add 2 to Y.

If there is a “W” present for digit number 9, add 1 to Y.

Record the value of Y in data table B.

5. Calculate the Henry Number for your fingerprint record using the formula given in step 3 and record it in data table B.
6. Take the two copies of your fingerprints from Part A and mark your Henry Number on the front.
7. Place one copy of your fingerprints in a pile with others from the class with the same Henry Number.
8. Take your remaining copy and look for the matching set in the pile of class fingerprints with the same Henry Number. *Do not look at the names on the back of the sheets.*

Analysis

Part A: Searching for matching fingerprints by eye

1. Is it easy to find the matching set from the pile?

Part B: Searching for matching fingerprints using the Henry Number

1. Is it easier to find the matching set from the pile than it was in Part A?

Want to know more?

Part A: Searching for matching fingerprints by eye

1. You may take some time to find your copy because you have to look through all the fingerprint records until you locate the correct one.

Part B: Searching for matching fingerprints using Henry Number

1. You can find your copy more quickly because you need to search only one pile (i.e., the one with the particular Henry Number).

Special Safety Note To Experimenters

Each experiment includes any special safety precautions that are relevant to that particular project. These do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely essential that you read, copy, and remain mindful of the General Safety Precautions that follow this note. Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Be prepared for unexpected dangers by following basic safety guidelines the entire time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note: The book assumes that you will read the safety precautions that follow, as well as those in the box within each experiment you are preparing to perform, and that you will remember them. Except in rare instances, the general precautions listed below will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say **BE CAREFUL WITH HOT LIQUIDS** or **DON'T CUT YOURSELF WITH THE KNIFE** does not mean that you should be careless when boiling water or cutting a section of a stem for microscope work. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, wait to perform it until you find out from a qualified adult that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the individual experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARING:

- Clear all surfaces before beginning experiments
- Read the instructions before you start
- Know the hazards of the experiments and anticipate dangers

PROTECTING YOURSELF:

- Follow the directions step-by-step; only do one experiment at a time
- Locate exits, fire blanket and extinguisher, gas and electricity shut-offs, eyewash, and first-aid kit
- Make sure there is adequate ventilation
- Act sensibly at all times
- Wear an apron and safety glasses
- Do not wear open shoes, loose clothing, or loose hair
- Keep floor and workspace neat, clean, and dry
- Clean up spills immediately, being careful to follow the recommended procedure for dealing with the spilt substance
- Never eat, drink, or smoke in the laboratory or workspace
- Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USING EQUIPMENT WITH CARE:

- Set up apparatus far from the edge of the desk
- Use knives and other sharp or pointed instruments with caution
- Pull plugs, not cords, when removing electrical plugs

- Don't use your mouth to pipette liquids; use a suction bulb
- Check glassware is clean and dry before use
- Check glassware for scratches, cracks, and sharp edges
- Report broken glassware immediately so that it can be cleaned up by a responsible person
- Do not use reflected sunlight to illuminate your microscope
- Use only low voltage and current materials such as lantern batteries
- Be careful when using stepstools, chairs, and ladders

USING CHEMICALS AND BIOLOGICAL MATERIALS:

- Never taste or inhale chemicals
- Label all bottles and apparatus containing chemicals
- Read labels carefully
- Avoid chemical contact with skin and eyes (wear safety glasses, lab apron, and gloves)
- Do not touch chemical solutions
- Wash hands before and after using solutions
- Wipe up spills thoroughly
- Use sterile procedures when handling even common and harmless microorganisms
- Avoid contact with human blood
- Treat all living organisms with appropriate respect

HEATING SUBSTANCES:

- Wear safety glasses, apron, and gloves when boiling water
- Keep your face away from test tubes and beakers
- Use test tubes, beakers, and other glassware made of Pyrex™ or borosilicate glass
- Use alcohol-filled thermometers (do not use mercury-filled thermometers)
- Never leave apparatus unattended
- Use safety tongs and heat-resistant mittens
- If your laboratory does not have heat-proof workbenches, put your Bunsen burner on a heat-proof mat before lighting it
- Take care when lighting your Bunsen burner; use a Bunsen burner lighter in preference to wooden matches
- Turn off hot plates, Bunsen burners, and gas when you are done
- Keep flammable substances away from heat
- Keep sheets of paper and other flammable objects away from your Bunsen burner
- Have a fire extinguisher on hand

FIELDWORK:

- Be aware of environmental dangers (e.g., do not carry out fieldwork near dangerous roads, cliffs, or water)
- Remember that strong sunlight can be dangerous – pack sunscreen and a good supply of drinking water if you will be outside all day
- Never carry out fieldwork in areas where you cannot find your way to safety easily and quickly and never wander off on your own in search of new areas to study

FINISHING UP:

- Clean your work area and glassware (follow any instructions given by a supervising adult)
- Be careful not to return chemicals or contaminated reagents to the wrong containers
- Don't dispose of materials in the sink unless instructed to do so
- Wash your hands
- Clean up all residues and put in proper containers for disposal
- Dispose of all chemicals according to all local, state, and federal laws
- Dispose of all microbiological cultures by treatment with an appropriate disinfectant

BE SAFETY CONSCIOUS AT ALL TIMES