

Loops, Whorls, And Arches



Topic

Study of fingerprint types

Introduction

If you examine the skin covering the top section of your fingers on the side opposite the nail, you will see that the surface of the skin is covered in a pattern of ridges and valleys. These ridges and valleys leave marks on surfaces – fingerprints – that scientists have studied for many years. Nineteenth-century scientists, such as Sir Francis Galton (1822–1911), discovered that everyone has a different arrangement of these patterns on his or her fingers; they do not change with time, and if the skin on the fingers is damaged, the fingerprints grow back into the original pattern. Scientists also discovered that the ridgelines and valleys in fingerprints form a limited number of overall patterns – loop, whorl, or arch (see diagram 3 on page 3.02–3). In 1894, detectives at London’s Scotland Yard began using fingerprints to identify criminals by comparing the pattern of a suspect’s fingerprint shapes with those of known criminals. In the first part of this experiment, you will take your fingerprints and look at them. In the second part, you will classify your fingerprint patterns as loop, whorl, or arch, and then compare your patterns with those of your fellow students. You will also investigate the distribution of these different patterns between the right and left hands of the group of students.

Time required

1 hour

Materials

For Part A:

No. 2 pencil
pencil sharpener
a roll of clear tape 25 mm wide
scissors
30 cm ruler
magnifying glass
8½ × 11 sheet of white unlined paper
table

For Part B:

collection of fingerprint patterns
from the class
2 sheets of graph paper

Safety note



Please read the general safety precautions.

Procedure

This experiment is a whole class activity.

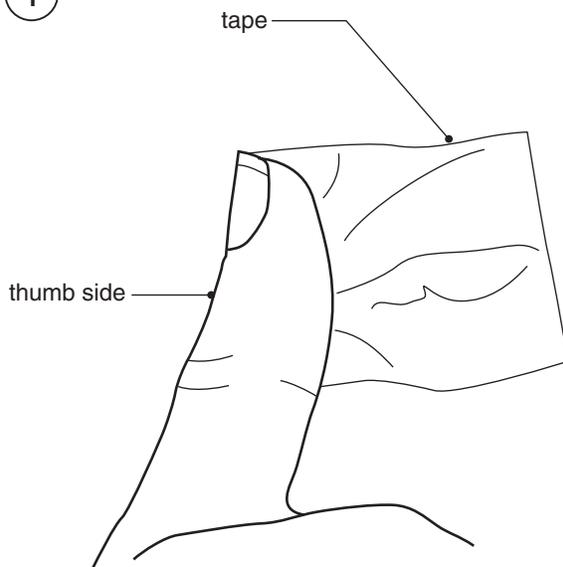
Part A: Taking your fingerprints

In this experiment, you use clear tape to “lift” your fingerprint and place it on the paper. This gives a reversed image of your fingerprint.



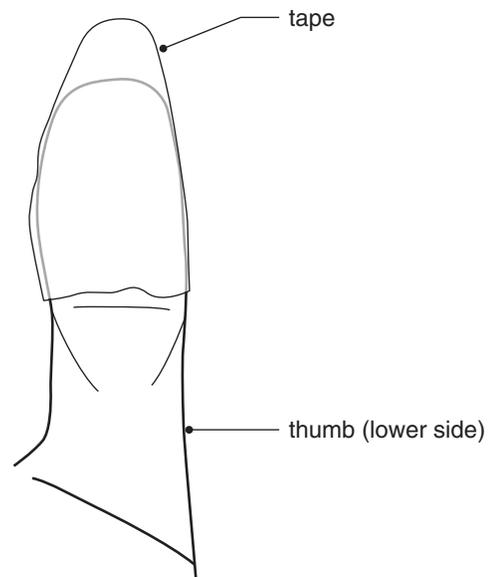
1. Cut 10 pieces of tape, each 35 mm long. Store these pieces carefully by touching one corner of each piece very lightly to the ruler (be careful to keep each piece separate).
2. Draw a square (4 × 4 cm) on the sheet of paper.
3. Rub the pencil over the square so that it is colored black and shiny all over.
4. Rub the skin between the top joint and the tip of your right thumb (the side opposite the nail) on the black square until the surface of your thumb is covered with graphite from the pencil.
5. Place one of the pieces of tape sticky side up on a table and then put one edge of your right thumb on the tape (see diagram 1 below).
6. Carefully press down your thumb onto the tape. Starting from one side of your thumb, roll it around on the tape until the tape covers the area of your thumb with graphite (see diagram 2 below).
7. Carefully remove the tape from your thumb and stick the tape in the box labeled “thumb” in the “right hand” section of data table A on the next page.
8. Repeat steps 3 to 7 for the other fingers of your right hand and for your left hand.

①



Placing the thumb on the tape

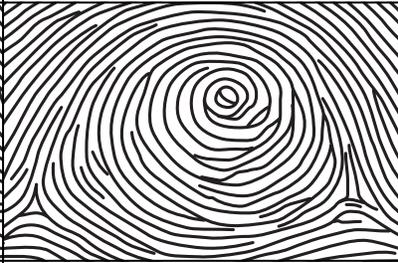
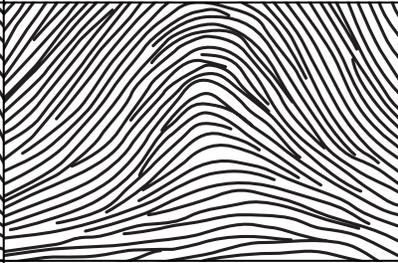
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Tape covering the area of the thumb with graphite

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



		
Loop	Whorl	Arch
<p>Lines form a loop and come from the same side of the finger.</p> <p>Loops can face in either direction. If a loop comes from the right, it is known as a radial loop; if it comes from the left, it is known as an ulnar loop.</p>	<p>Lines form circles making a whorl.</p> <p>As well as the simple whorl shape (a concentric circle), whorls can have more complex shapes – they can be formed of double loops or be enclosed within other lines.</p>	<p>Lines form an arch; they come from one side of the finger, rise in the center, and leave at the other side of the finger.</p> <p>An arch can be either plain (rounded top) or tented (pointed top).</p>

Different fingerprint patterns

Part B: Identifying fingerprint shapes and displaying the distribution of these shapes

- Using the patterns shown in diagram 3, identify the patterns of your prints as loop, whorl, or arch. Record your results in the first row of data table B on the next page using the suggested key.

DATA TABLE B										
Key: L = loop; W = whorl; A = arch										
	RIGHT HAND					LEFT HAND				
Student	Thumb	Index finger	Middle finger	Ring finger	Little finger	Thumb	Index finger	Middle finger	Ring finger	Little finger
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

2. Ask your fellow students for their results and record them in data table B.
3. Using data table B, count the total number of times the loop shape is recorded on the records of the right hands of all students. Enter this figure in data table C on the next page.
4. Repeat step 3 to find the total number of times the arch shape appears for the right hands of all students.
5. Repeat step 3 to find the total number of times the whorl shape appears for the right hands of all students.
6. Repeat steps 3 to 5 for the left hands of all students.
7. On a sheet of graph paper, draw a bar chart to display the numbers of each shape (loop, whorl, arch) counted for the right hands of the group of students.

DATA TABLE C		
	Right hand	Left hand
Loop		
Whorl		
Arch		

The chart will have three bars – one for each shape. Repeat for the left hands.

Analysis

Part A: Taking your fingerprints

1. Use a magnifying glass to look at your fingerprints in data table A. What do the shapes you recorded look like?
2. Do all the shapes you recorded look the same?

Part B: Identifying fingerprint shapes and displaying the distribution of these shapes

1. Look at data table B. Do any of your fellow students share the same pattern of loops, whorls, and arches?
2. Are the two bar charts the same shape?

Want to know more?

Part A: Taking your fingerprints

1. The shapes are made up of fine curving lines.
2. Some of the shapes have the same overall pattern, but no two are identical.

Part B: Identifying fingerprint shapes and displaying the distribution of these shapes

1. It is unlikely that two members of the group will share the same pattern of loops, whorls, and arches.
2. The bar chart for the left hands should be a different shape from that for the right hands. Scientists have shown that there tend to be more loops on left hands than on right hands, and more whorls on right hands than on left hands.

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