Every Contact Leaves A Trace

Topic

Locard's Exchange Principle

Introduction

This experiment tests Locard's Exchange Principle – the principle put forward by Dr. Edmond Locard, director of the world's first crime laboratory. It states the principle that when a suspect and a victim come into contact at a scene of crime, the suspect, the victim, and the scene of crime are all changed, and every contact leaves a trace. In the first part of this experiment, you will remove, identify, and record traces of materials adhering to the surface of clothes. From this information, you should be able to identify contacts made by the wearer of the clothes. You should be able to deduce, for example, if the wearer keeps pets (hairs should be found), if he has been walking through woodland areas (leaves and possibly plant seeds should be found), or if he is a messy eater. In the second part of this experiment, you will identify different surface conditions (asphalt, soil, grass) in the schoolyard or its immediate vicinity, and identify which area was visited by your fellow student.

Time required

Part A: 30 minutes
Part B: 1 hour

Materials

For Part A:
outer garment (sweater, wrap, pants) that has been worn at least once since being washed
translucent tape
hand lens
spatula
tweezers
Petri dishes or similar transparent containers
flashlight
labels
marker pen
30 cm ruler

For Part B:
old socks (to be worn outside over shoes)
2 sheets of white unlined paper ($8\frac{1}{2} \times 11$ inches)
3 index cards
pen
spatula
hand lens

Safety note

Before starting this experiment, make sure your hands are clean to prevent contamination of any traces. Wash your hands after completing Part B.

General procedure

Three methods are used in this experiment to separate traces of materials adhering to garments.

(1) *Lifting*: Press lengths of translucent tape onto the surface of the garment, taking care not to allow materials stuck to the tape to fall off by overloading the tape. Place the tape lifts in a transparent container such as a Petri dish, where they can be studied with a hand lens.

(2) *Picking*: Use clean forceps or tweezers to lift traces of materials from the garment onto a clean sheet of paper (to avoid loss of sample). Transfer the traces of materials to a transparent container such as a Petri dish, where they can be studied with a hand lens.

(3) *Scraping*: Use a clean spatula or similar tool to dislodge the traces of materials adhering to the garment's surface directly onto a clean sheet of paper. Transfer the traces of materials to a transparent container such as a Petri dish, where they can be studied with a hand lens. (This technique is particularly useful for dried splatters of liquids.)

Label all traces of materials removed from garments with the identity of the garment's owner.

Procedure

You will need a partner for this experiment.

Part A: Examining clothes

1. Observe the surface of the garment and identify any traces of materials adhering to the surface. If necessary, use a flashlight to illuminate the surface of the garment (traces of materials can be shown in greater detail if light is shone on the surface obliquely).
2. Remove traces of materials from the garment using the techniques described above, starting with lifting. If materials are found that cannot be removed in this way, move to picking. If the material adheres more strongly to the garment, use scraping.
3. Using a hand lens, identify the fragments of material found as far as is possible. For example, you should be able to identify hairs, threads of fabric, leaves, and seeds.
4. Identify the garment and its owner in data table A on the next page. Record the technique(s) used to remove the fragments of material and the part of the garment from which it was removed. If the traces of materials were in the form of stains (e.g., milk), use the ruler to measure the approximate area of the stain.

DATA TABLE A		
Type of garment		
Owner of garment		
Date		
Evidence found		
Identification of fragment (hair/thread/leaf/seed)	**Method of collection (lifting/picking/scraping)**	**Number of traces of this type found (for fragments) Area covered (if splashes or stains)**

Part B: Identifying ground conditions
Decide between you who is going to act as the "observer" and who as the "experimenter" in this part of the experiment.

1. Tour the schoolyard observing the surface conditions in different areas (e.g., path, grass, running track) and record your observations in data table B below.

DATA TABLE B	
Type of area (e.g., grass, running track, path)	**Surface**

2. Return to the classroom.
3. Discuss the surface conditions of different areas in the schoolyard and identify three areas with different surfaces.
4. Invite the "observer" to write the names of the three areas identified in data table B on three separate index cards. Place these face down on a table.
5. Invite the "experimenter" to take one of the notes (ensure that the "observer" doesn't see which it is) and to read which area is named.
6. "Experimenter:" taking the pair of old socks, go outside to the location on the note. When you get there, put on the socks over your shoes and walk around in them. Then remove the socks and return to the classroom.
7. "Observer:" take the socks and scrape a sample from the socks onto one of the clean pieces of paper using the spatula. Transfer the sample to a clean Petri dish and observe it using a hand lens. Identify the sample and use the observations made in data table B to deduce where the experimenter has been.
8. Repeat the experiment (from step 5) with the "experimenter" and "observer" changing roles.

Analysis

Part A: Examining clothes

1. Did you find hairs adhering to the surface of the fabric? Did the hairs look like human hair or animal hair? What can you deduce from this?
2. Did you find seeds on the garment? What can you deduce from this?
3. Did you find grass or traces of leaves on the garment? What can you deduce from this?
4. Did you find loose threads on the garment? What can you deduce from this?

Part B: Identifying ground conditions

1. Were you able to identify the places visited by your partner?

Want to know more?

Part A: Examining clothes

1. If you find a number of hairs that look like dog or cat hairs (see also Section 5: Trace Evidence Analysis), you can deduce that the owner has a pet. If the hair looks like human hair, looks similar to the hair of the garment's owner, and is present in small lengths, the garment's owner may just have had a haircut and cut ends were left on the garment.
2. If you find a number of seeds, try to identify the seeds. This will enable you to discover places visited by the garment's owner.
3. If you find traces of leaves, the garment's owner must have been in a place where such leaves were found. Try to identify it, but note that there will probably not be enough leaf present for identification.
4. If you find several threads of fabric, the garment's owner may sew for a hobby.

Part B: Identifying ground conditions

1. Discovering and observing material sticking to the soles of people's feet using a hand lens enables deductions to be made about places they have visited.

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 used 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

Settings And Warning Signs

Settings and hazard warning signs are used throughout the experiments to indicate where they should take place and where particular care should be taken with the materials involved.

SCHOOL LAB

HOME

TOXIC

SPLASH

WARNING

IRRITANT

NAKED FLAMES

HOT LIQUIDS

CORROSIVE

CUT / STAB HAZARD