

Clue 1 Shoe scrapings



Introduction

Edmond Locard, who some people call the grandfather of forensic science, said that 'every contact leaves a trace'. He was talking about the fact that when two surfaces come into contact, they often leave bits of themselves on each other.

In this investigation, you are looking for the presence of a chemical called sodium bicarbonate in the debris scraped from each suspect's shoes. The culprit may have picked this chemical up on their shoes when entering and exiting the crime scene!

Sodium bicarbonate is used for all sorts of things. It is called baking soda when used for cooking and is an ingredient in many cakes and biscuits. It is also very good at absorbing smells and is sometimes used in commercial deodorisers which are sprinkled on carpets before vacuuming.

The carpet adjacent to the crime scene had been treated with a carpet deodoriser containing sodium bicarbonate, possibly only moments before the theft.

Crime scene investigators made a note of the presence of the powder and requested scrapings from all the suspects' shoes to be collected upon apprehension for questioning.

Sodium bicarbonate reacts with acids to produce visible bubbles of carbon dioxide gas. You will observe this reaction using acetic acid (vinegar) and a small amount of pure sodium bicarbonate before you begin.

You will then test for the presence of sodium bicarbonate in the debris sample collected from each suspect's shoes.



Equipment

Each group will need:

Test tube ¹	Small spoon
Small funnel ²	Acetic acid (vinegar)
Pair of scissors	Paper towels to clean spills

¹ *Alternative: transfer the evidence into another container such as a zip lock bag and use the plastic vial as a test tube*

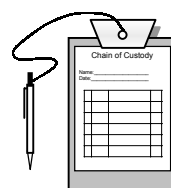
² *Alternative: make a small funnel using paper and sticky tape*



Procedure

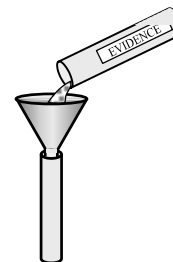
Before you begin, review your Forensic Laboratory Code of Practice and ensure that each group member is aware of his or her responsibilities (refer to the Job Descriptions Wall Chart if necessary).

- 1 Evidence Officer only:** Collect the evidence from the central store and record all details of the transaction on the Chain of Custody form.



- 2** Carefully pour the powder into a test tube.

NOTE: this is a destructive test – once you have performed it, the evidence is changed. Leaving some spare powder ensures further tests can be conducted if required.



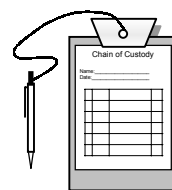
- 3** Watch carefully for the presence or absence of bubbles! Use the eyedropper to carefully add the acetic acid (vinegar) to the material in the test tube.



- 4** Record your observations carefully. Be sure to be clear and concise so other investigators can clearly interpret your results. Be prepared to discuss your results with other investigators in your team at the end of the session.



- 5** Return any remaining powder to the Evidence Store. Ensure you make a note to explain the reduced quantity when you sign the Chain of Custody form.



- 6** Return equipment, wash out the test tubes and clean workbenches.



Discussion and conclusions

In the class discussion, each group should present the outcomes of their analysis. Re-examine the crime scene plan and make group notes after your discussions.

Some questions to consider:

Did your analysis implicate any of the suspects in the crime? If so, who and how?
Are there other possible reasons for sodium bicarbonate being present on a suspect's shoes?

Remember, all the suspects were invited to the reception area after BUSTED'S performance. Study the crime scene map and think of other reasons why a suspect may have tested positively.

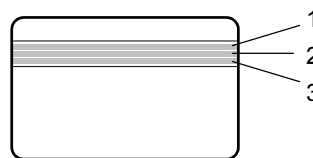
Clue 2 Magnetic Swipe Card



Introduction

In the Planet Science Whodunit, the magnetic strip on the security access card can reveal the exact time the culprit entered the crime scene.

Track 1 is encoded to allow access to the storeroom in the backstage area. Track 2 is encoded with the time of day *every time* the card is used. This time code remains unchanged until the card is used again. Track 3 is not used on this card.



Track numbers on a magnetic strip

Using the magnetic powder supplied, you will establish the exact time the card was used to break into the storeroom. You will then use a map of Birmingham to determine which suspects had sufficient time to commit the crime and reach their alibi.



Equipment

Each group will need:

Magnetic powder*

Birmingham map

Sticky tape

Compass

4/5 sheets of white paper

Rulers with millimetre (mm) marks

* Provided with the Evidence Kit – the powder is attracted to magnets but is not actually magnetic itself and won't damage the encoding on the card. It is non-toxic but take care not to get the powder on your fingers. If you do, wash your hands with soapy water to prevent the powder spreading or getting in your eyes.

① **VERY IMPORTANT NOTE:** Be very careful with the magnetic powder – only a very small amount is supplied but it is enough to conduct the test several times. Working over a sheet of white paper to catch excess powder will ensure the test can be conducted many times.

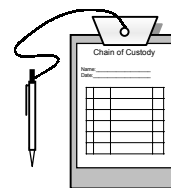


Procedure

Before you begin, review your Forensic Laboratory Code of Practice and ensure that each group member is aware of his or her responsibilities (refer to the Job Descriptions Wall Chart if necessary). Read ALL THE INSTRUCTIONS before beginning.

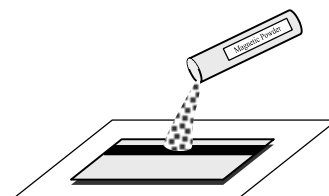
Step 1 – Determine the time card was used

- 1 Evidence Officer only: Collect the security access card from the central store and record all details of the transaction on the Chain of Custody form.



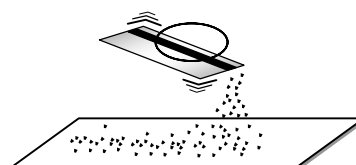
- 2** Make sure the card is clean and free of smudges and fingerprints. Gently tap the powder container to carefully sprinkle a small amount of the magnetic powder along the length of the magnetic strip.

IMPORTANT NOTES: Only a small amount is supplied. To ensure clear results, make sure card is clean before you start – use soapy water to remove fingerprints if necessary and thoroughly dry the card before testing.



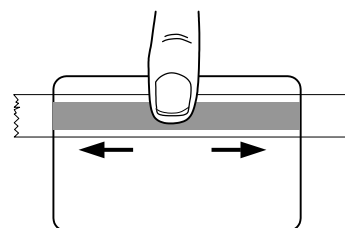
Work over a sheet of white paper to catch excess powder.

- 3** Being careful not to touch the magnetic strip, gently tap the edge of the card over the paper to shake off excess powder. Tap the card against the table gently several times until individual lines of powder appear as illustrated on page 28.

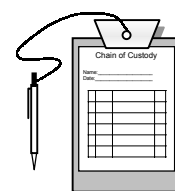


- 4** REPEAT THIS STEP TWICE: the second 'lift' may yield a better result.

Carefully lay the card on the workbench (*NOT* on a piece of paper). Lay a piece of sticky tape on the stripe with the adhesive side down to 'lift' the code. Ensure the magnetic powder adheres to the tape by carefully rubbing the surface of the tape back and forth. Peel the tape off the card and adhere to a fresh sheet of white paper for analysis. Repeat with a second piece of tape if the first lift is unclear.



- 5** Before continuing, carefully return the excess powder to its container. Return the powder and security card to the central evidence store or pass over to the next group's Communication Officer (ensure each transaction is recorded on the Chain of Custody form!).

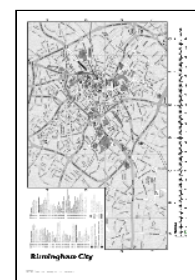


- 6** Using the coding information provided on page 28, determine the time the card was last used and record the result in your note book.

Step 2 – Determine earliest possible arrival time

Now that you know the time the culprit entered the store room, you can determine which suspects had sufficient time to commit the crime and reach their alibi. To do this, you will need to measure the distances between the crime scene and each alibi location using the map and information provided. You will then determine how much time it would take to travel that distance using a simple mathematical equation.

- 1 For each suspect, you will measure and record the length of each individual street travelled using the map of Birmingham. You will then add all the distances measure to calculate the total distance from the crime scene to the suspect's alibi.



Decide on a suitable method to accurately measure the street distances.

NOTE: All suspects reached their alibi by car. Use the locations given as start and end points, follow the streets and roundabouts as close as possible and don't take short cuts.

- 2 Convert each map measurement to kilometres using the scale provided on the map and record your results.

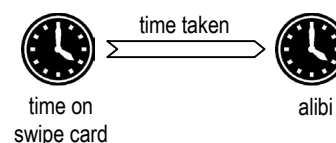


- 3 You will now calculate the time it would take to travel from Centenary Square to the suspect's alibi location.

$$\text{Speed (Velocity)} = \frac{\text{Distance}}{\text{Time Taken}}$$

- 4 You will need to convert the results of your calculation to minutes.

- 5 You now know approximately how long it takes to travel from Centenary Square to the suspect's alibi. If the suspect *had* set off at the time encoded on the card, would they have arrived earlier or later than the time of their alibi?



Discussion and conclusions

In the group discussion, discuss the results and consider which suspects are incriminated by your results. Consider the meaning of 'average speed'. Does this test alone provide sufficient evidence against any suspect? Is it *impossible* for any of the suspects to have reached alibi locations in the amount of time between the encoded time on the swipe card and the alibi time?

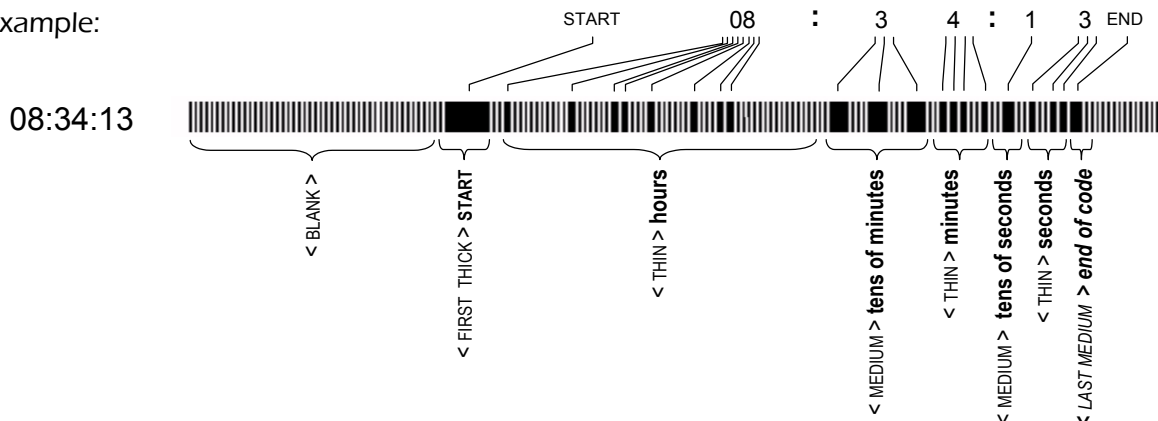
Time encoding and sample code

Use the information and the sample time code below to decode the card. The number of bars (medium, and thin) and the order in which they appear reveals the time. The space between bars is not important information and does not need to be recorded.

TIME FORMAT AND SAMPLE CODE:

START CODE	HOUR	TENS OF MINUTES	MINUTES	TENS OF SECONDS	SECONDS	END CODE
1 thick bar (always 1)	thin bars (max:23)	medium bars (max: 5)	thin bars (max: 9)	medium bars (max: 5)	thin bars (max: 9)	1 medium bar (always 1)

Example:



Confirmed alibi information

Alibis for each suspect from impartial, reliable witnesses, confirmed by investigators are provided below. Use the roundabout on Cambridge Street as the starting point for your measurements. Use an average speed (velocity) of 15km/hr for all your calculations.

Suspect	Alibi location	Time / Alibi	Route travelled from Centenary Square (Map Ref D3) to alibi location
S Club	(67) Museum of the Jewellery Quarter Map Ref D4	13:35 Eyewitness	Cambridge St ⇒ Paradise Circus ⇒ Gt Charles St ⇒ Constitution Hill ⇒ Gt Hampton St ⇒ Vyse St □ (Use Vyse St / Branston St intersection for end point)
Ms Dynamite	(74) Think Tank Map Ref G3	13:50 Eyewitness	Cambridge St ⇒ Paradise Circus ⇒ Gt Charles St ⇒ St Chads Queensway ⇒ Corporation St ⇒ Dartmouth Middleway ⇒ Lawley St ⇒ Curzon St □ (Use Curzon St / Cardigan St intersection for end point)
Blazin' Squad	Bordersley Train Station Map Ref G2	13:25 Train tickets	Cambridge St ⇒ Paradise Circus ⇒ Suffolk St Queensway ⇒ Bristol St ⇒ Wrentham St ⇒ MacDonald St ⇒ Alcester St ⇒ High St Deritend □ (Use the High St Deritend / train line intersection for end point)
James Beattie	(61) Birmingham Botanical Gardens Map Ref B1	13:20 Eyewitness	Cambridge St ⇒ Paradise Circus ⇒ Broad St ⇒ Calthorpe Rd ⇒ Westbourne Rd □ (Use Westbourne Rd / Vicarage Rd intersection for end point)
Zach Shaw	Five Ways Train Station Map Ref D1	13:35 Train tickets	Cambridge St ⇒ Paradise Circus ⇒ Broad St ⇒ Islington Row □ (Use Islington Row / train line intersection for end point)