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# Forensic science

How can we identify metals in water?

Is it possible to identify chemicals in dust?

Let's find out...

## Equipment

Nichrome wire or alternative (four pieces), cork handle, small watch glass, Bunsen burner, heat-resistant mat, splints, 1 mol dm<sup>-3</sup> HCl solution, various unknown solutions (A-D), various solid samples (1-3) and X,Y and Z, test tubes, spatula, test tube rack, limewater, pipettes, safety goggles/specs.

## Keeping us safe

Safety goggles/specs must be worn at all times. Follow your usual safety precautions for using a Bunsen burner (close hole when lighting, tie hair back, etc.). Wash your hands immediately after using the chemicals or if you get any on your skin. Take care using glassware, broken glass can cut you. At the end of the practical, wash your hands.



## What poisoned my grandad?

In this activity you are going to test four solutions for copper ions.

The scenario: *Late one evening an ambulance was called to an elderly gentleman. He was being violently sick and had terrible stomach pains. He was taken to hospital and it was found that he had relatively high levels of copper in his blood. Samples were taken from his house for analysis.*

Before you start, you must be familiar with the colours obtained in flame testing metals. You may need to research this for yourself.

### Method

1. You have been given four solutions that contain metal ions. Each was taken from the elderly man's house. They are labelled A, B, C and D. You will test these for metal ions using the flame test.
2. Take a clean nichrome wire (mounted on a cork handle). Dip the wire into the HCl solution and then into a roaring flame (this should be a safety flame when not in use). This cleans the wire.
3. Dip the wire into solution A and then into the flame. Note any observations. Repeat to check that you have correctly noted what happens.
4. Take a clean nichrome wire and repeat stages 2 and 3 with sample B, then with samples C and D.
5. Record all observations.

What metals did you identify in each solution? Which solution contained copper ions? Why were you asked to change the wire for each different solution?

## Quarry break-in!

In this activity you will test dust samples for limestone (calcium carbonate).

The scenario: *In the early hours of the morning, police were called to a limestone quarry. There had been a break-in and thousands of pounds of damage had been caused to machinery. Police patrolled the area and picked up three people as suspects. Mud and dust samples were taken from the soles of their shoes for analysis.*

Before you begin, you need to find out how you might identify calcium carbonate, the main constituent of limestone.

### Method

1. Place a small amount of powder from sample 1 into a clean test tube. Add dilute HCl and record your observations.
2. If the sample fizzes (effervesces), repeat this test. This time, use a plastic pipette to suck up as much gas as you can and bubble this into a small amount (1 ml) of limewater (held in another test tube).
3. Record any observations.
4. Repeat stages 1-3 for samples 2 and 3.

What conclusions can you draw from your observations? Is this evidence sufficient for the police to ensure that the suspect is prosecuted? What other forms of evidence might be needed?

### Pharmacy break-in!

Scenario: *A local pharmacy was broken into and police are anxious to find the person who did this. No fingerprints were found and no CCTV was recorded, yet police did find a partial footprint left in some powder that was spilt on the floor. The powder was composed of lithium carbonate (a drug often used to help people with schizophrenia).*

Three people were found in the vicinity of the pharmacy and were taken to the police station, where materials from their shoes were sampled. The samples were labelled X, Y and Z.

Can you help the police to identify the powders to see if any of them are  $\text{Li}_2\text{CO}_3$ ?

## So, what's the scientific explanation?

### What poisoned my grandad?

Sample C gave a green flame, which is a positive test for copper.

It was later found that the elderly gentleman had been gardening. He had accidentally pierced a mains water pipe in an area where he had used large quantities of weedkiller. Weedkiller often contains copper compounds!

What other ions did you observe? Check with your teacher to see if you were correct. The wire was changed for each solution to avoid contamination.

### Quarry break-in!

Sample 3 fizzed (effervesced) with hydrochloric acid and the gas produced turned limewater cloudy, showing that it was  $\text{CO}_2$ . This is a positive test for  $\text{CaCO}_3$ .

The forensic evidence may suggest that the suspect was in the area, yet far more evidence would be needed to have a strong case against them. The police might also look for fingerprints, CCTV footage or footprints inside the quarry.

### Pharmacy break-in!

Lithium can be identified by using a flame test. A deep crimson red-coloured flame is a positive test for lithium. Adding dilute acid to the powder would provide a test for carbonate. If it fizzes (effervesces) and the gas turns limewater cloudy, you have a carbonate.

Y contained lithium carbonate.

### Key words for your glossary

Forensic science, flame test, carbonate test, limewater, evidence, contamination