

# Chemistry at the crime scene

This forensic science project is organised so that learners rotate around six stations, examining and making deductions about evidence.

Download the PowerPoint presentation, teacher notes, station instruction sheets and student workbook that accompany this resource at [rsc.li/3cjwxc9](https://rsc.li/3cjwxc9).

Arrange the room with six evidence stations. Learners visit each station once. Each station needs to accommodate a sixth of the learners present. So, if 60 learners attend, each station should have five sets of equipment to accommodate 10 learners working in pairs.

Read our health & safety guidance, available from [rsc.li/3IAmFA0](https://rsc.li/3IAmFA0), and carry out a risk assessment before running any live practical. Use the specific safety notes for the practicals included in this workshop to guide you.

The safety equipment suggested is in line with CLEAPSS requirements. For non-hazardous substances, wearing lab coats can help to protect clothes. The safety rules might be different where you live so it is worth checking local and school guidance.

### **Acknowledgements**

This resource was originally developed by Liverpool John Moores University to support outreach work delivered as part of the Chemistry for All project.

To find out more about the project, and get more resources to help widen participation, visit our Outreach resources hub: [rsc.li/3CJX7M3](https://rsc.li/3CJX7M3)

Note: all hazard symbol images are © Shutterstock.

## Chemistry at the crime scene: technician notes

Available from [rsc.li/3cjwxc9](https://rsc.li/3cjwxc9)

Ask two teachers or other staff members to voluntarily provide the sets of fingerprints for Station 2 and place the samples at the station before the learners arrive.

Station 4 involves the use of animal blood. Make learners aware of this before they start the practical and give them the option to avoid handling the clothing at that station. Any learners who do not wish to handle the clothing could collect the observations gathered from another group. This presents a good opportunity to discuss with the learners how forensic teams work with each other and the police to gather evidence when trying to solve crimes.

If the use of animal blood is not a suitable option, an alternative 'blood mixture' may be prepared using corn syrup, water, red food colouring and catalase (from liver, potato or horseradish), or an inorganic catalyst (such as manganese dioxide, potassium iodide, copper nitrate or ferric oxide).

Ask teachers or other staff members to voluntarily provide the hair samples for Station 5. Place the samples at the station before the learners arrive.

The equipment listed below is for each pair of learners. Where items are consumable, there needs to be enough for six groups to visit each station (that is, for the whole group to use).

Evidence items should be in separate, plastic evidence bags with tamper-evident labels giving the evidence number and description. Learners need to cut open the bags to investigate. After completing the station, they need to reseal the bags for the next group of learners with evidence tape. Alternatively, you could use zip-up freezer bags for the items of evidence so that learners can open them, analyse the evidence, and then reseal them without tape.

## Evidence labels for bags

Tag an evidence continuity label onto each evidence bag, complete with the evidence reference number, eg **EV1**.

Evidence reference number **EV** \_\_\_\_\_


Date opened	Signature of official plus witness


## Station 1: screwdriver cast

	Evidence	Equipment	Chemicals
<b>EV1</b>	<p><b>Screwdriver cast</b> from the victim's back door. These marks were made around the back door lock during the forced entry.</p> <p>The marks should be made with the flathead screwdriver labelled <b>EV4</b> (preferably with obvious damage) and the cast should show this as clearly as possible.</p> <ol style="list-style-type: none"> <li>1. Use the screwdriver <b>EV4</b> (used in the crime) to make a few deep marks in a small piece of wood. Make sure at least one of these shows the damage to the screwdriver head.</li> <li>2. Make a plaster cast of the marks, using a cardboard strip surrounding the marks (or the piece of wood) to form the edge of a mould for the cast.</li> <li>3. Take photos of the three different screwdrivers: flathead labelled <b>EV2</b>, crosshead labelled <b>EV3</b> and flathead of a different size to <b>EV2</b> labelled <b>EV4</b>, and print these off to be used at the evidence station. (Safety: do not give these screwdrivers to the learners.)</li> </ol>	<ul style="list-style-type: none"> <li>• Thin latex gloves</li> <li>• Plaster cast from a clearly damaged tool – which is provided as screwdriver <b>EV4</b>. Place the cast in a sealed 'evidence bag' labelled <b>EV1</b>.</li> <li>• Photos of three different screwdrivers: flathead labelled <b>EV2</b>, crosshead labelled <b>EV3</b>, and flathead of a different size to <b>EV2</b> labelled <b>EV4</b>. (<b>EV4</b> is the tool that learners must deduce was at the crime scene.) Ideally <b>EV4</b> has a corner chipped off or other obvious damage which will show up in the cast.</li> <li>• Mounting putty eg sticky tack (for making an impression of the cast)</li> <li>• 10 cm ruler</li> <li>• Magnifying glass for examining the tools and cast</li> </ul>	None

## Station 2: fingerprints

Ask two volunteers to prepare ten-print fingerprint cards for Suspect 1 and 2. The fingerprint lifts from the back door and baseball bat should match fingers from Suspect 2.

	Evidence	Equipment	Chemicals
<b>EV5</b>	<p>Aluminium powder fingerprint lift taken from the victim's back door.</p> <p>Ask volunteer/Suspect 2 to press their dominant hand's thumb onto a microscope slide. Place the slide onto a piece of paper and sprinkle the aluminium powder onto the print. Gently brush off any excess powder. Press the powdered print firmly with a piece of tape. Lift the tape and stick it onto paper to be able to see the fingerprint. The lift does not need to be perfect, but enough of the print should be visible so that learners can match it with Suspect 2's fingerprint card.</p>	<ul style="list-style-type: none"> <li>• Thin latex gloves</li> <li>• Fingerprint magnifier or large magnifying glass</li> <li>• Microscope slide</li> <li>• Fingerprint brush (small, soft bristles)</li> <li>• Clear tape</li> <li>• Fingerprint lift taken from the victim's back door (<b>EV5</b>)</li> <li>• Fingerprint lifts taken from the handle of the baseball bat (<b>EV6</b>)</li> <li>• Two labelled ten-print fingerprint card templates to make <b>EV7</b> and <b>EV8</b></li> <li>• Ink pad</li> </ul>	<ul style="list-style-type: none"> <li>• Aluminium powder (DANGER: flammable)</li> </ul> <div style="text-align: center;">  </div> <p>Wear eye protection.</p> <p>Disposal: collect and store for removal by a Registered Waste Carrier.</p>

	Evidence	Equipment	Chemicals
<p><b>EV6</b></p>	<p>Fingerprints taken from the handle of the baseball bat found in the garden of a street near to the victim's house.</p> <p>Repeat the process of lifting Suspect 2's fingerprints, described for <b>EV5</b>, for a few more fingers. The prints can be from both hands as if the suspect were holding a baseball bat.</p> <p>The lifts do not need to be perfect but enough of the prints should be visible so that learners can match them with Suspect 2's fingerprint card.</p>	<ul style="list-style-type: none"> <li>• Thin latex gloves</li> <li>• Fingerprint magnifier or large magnifying glass</li> <li>• Microscope slide</li> <li>• Fingerprint brush (small, soft bristles)</li> <li>• Clear tape</li> <li>• Fingerprint lift taken from the victim's back door (<b>EV5</b>)</li> <li>• Fingerprint lifts taken from the handle of the baseball bat (<b>EV6</b>)</li> </ul>	<ul style="list-style-type: none"> <li>• Aluminium powder (DANGER: flammable)</li> </ul> <div style="text-align: center;">  </div> <p>Wear eye protection.</p> <p>Disposal: collect and store for removal by a Registered Waste Carrier.</p>
<p><b>EV7</b></p>	<p>Ten-print fingerprint card from Suspect 1.</p> <p>Ask a volunteer to press one of their fingers onto an ink pad, covering its entire surface with ink, and transfer the print to a labelled fingerprint card. Repeat for the other nine fingers.</p>	<ul style="list-style-type: none"> <li>• Two labelled ten-print fingerprint card templates to make <b>EV7</b> and <b>EV8</b></li> <li>• Ink pad</li> </ul>	
<p><b>EV8</b></p>	<p>Ten-print fingerprint card from Suspect 2.</p> <p>Ask another volunteer to press one of their fingers onto an ink pad, covering its entire surface with ink, and transfer the print to a labelled fingerprint card. Repeat for the other nine fingers.</p>		

## Station 3: white powder

Run this activity either as a teacher demonstration or as a station. Determine the method used in discussion with the teacher or outreach provider.

The equipment listed below should be sufficient for each pair of learners.

Evidence	Equipment	Chemicals
<p><b>EV9</b> Bag of white powder found on the kitchen surface at the victim's house</p>	<ul style="list-style-type: none"> <li>• Bunsen burner</li> <li>• Heatproof mat</li> <li>• Matches</li> <li>• Splints</li> <li>• Safety goggles</li> <li>• Boiling tubes containing the pre-soaked splints marked up as <b>EV9, EV10 and EV11</b></li> <li>• Beaker of water (for the disposal of used splints)</li> <li>• Boiling tube rack</li> </ul>	<p>0.5 mol dm<sup>-3</sup> lithium chloride solution (marked up as <b>EV9</b>)</p> <p>0.5 mol dm<sup>-3</sup> sodium chloride solution (marked up as <b>EV10</b>)</p> <p>0.5 mol dm<sup>-3</sup> potassium chloride solution (marked up as <b>EV11</b>)</p> <p>Splints to be pre-soaked in water for 24 hours prior to the experiment.</p> <p>Approximately an hour before the experiment, please remove the splints from the water and soak them in the boiling tubes containing 25 cm<sup>3</sup> of lithium chloride solution, sodium chloride solution or potassium chloride solution. Soak the splints in the solutions for no more than an hour prior to the experiment.</p> <p>All solutions at this concentration are non-hazardous.</p> <p>Dispose of used splints in the normal waste.</p> <p>Retain used salt solutions for reuse; however, dispose of contaminated solutions. Dilute further and rinse away down the sink/foul-water drain.</p>
<p><b>EV10</b> Bag of white powder found on Suspect 1</p>		
<p><b>EV11</b> Bag of white powder found on Suspect 2</p>		

## Station 4: bloodstained clothing

**Note:** locate this station near a fume hood, if available, or in a well-ventilated area.

Clothing can be any suitable old clothes or scraps of material. Blood can be from meat (take hygiene precautions and take account of learners' cultural preferences).

If the use of animal blood is not a suitable option, an alternative 'blood mixture' may be prepared using corn syrup, water, red food colouring and catalase (from liver, potato or horseradish), or an inorganic catalyst (such as manganese dioxide, potassium iodide, copper nitrate or ferric oxide).


The method for preparing this alternative blood mixture is:

1. Mix a small amount of the corn syrup with water until the mixture appears to be the same consistency as blood.
2. Add the red food colouring a few drops at a time until you achieve the correct colour. Add a few drops of the catalyst to the mixture.

Cover the table with brown paper for learners to use when they examine the stained clothing.

Find the instructions for the Kastle–Meyer test in the station instruction sheets displayed at Station 4.



Evidence	Equipment	Chemicals
<p><b>EV12</b> Victim's clothing</p>	<ul style="list-style-type: none"> <li>• Safety goggles</li> <li>• Thin latex gloves</li> <li>• Brown paper – cover table where learners will examine clothes</li> <li>• Watch glass</li> <li>• Torch or moveable light</li> <li>• Whatman filter papers or swab sticks</li> </ul>	<p>Kastle–Meyer reagent in dropper bottle  <b>DANGER:</b> causes severe burns and irritation to eyes and skin. If ingested, causes severe internal irritation and damage. Highly flammable.</p> 
<p><b>EV13</b> Swab of red substance taken from the edge of the baseball bat found in the garden of a house in the street near to the victim's house</p>		<p>6% Hydrogen peroxide solution</p> <p><b>WARNING:</b> irritating to the eyes (and to the skin, although not officially classified as such).</p> <p>Deionised water</p> <p>Victim's clothing contaminated with blood (<b>EV12</b>)</p> <p>Swab of red substance taken from the edge of the baseball bat found in the garden of a house in the street near to the victim's house (<b>EV13</b>)</p>
<p><b>EV14</b> Suspect 1's clothing</p>		<p>Suspect 1's clothing contaminated with red ink (<b>EV14</b>)</p>
<p><b>EV15</b> Suspect 2's clothing</p>		<p>Suspect 2's clothing contaminated with blood (<b>EV15</b>)</p> <p>6% hydrogen peroxide solution can be poured down a foul-water drain. Contact your registered waste carrier for advice on disposing of Kastle–Meyer reagent.</p>

## Station 5: hair samples

Take hairs from volunteers for this station. The hair from the victim's clothing should match the hair from Suspect 2 (that is, from the same person). Ideally, the hair sample from Suspect 1 would be obviously different, for example have a different colour and texture.

Evidence		Equipment	Chemicals
<b>EV16</b>	Hair taken from victim's clothing	<ul style="list-style-type: none"><li>• Gloves, scissors and evidence tape</li><li>• Microscope</li><li>• Hair from the victim's clothing (<b>EV16</b>), Suspect 1 (<b>EV17</b>) and Suspect 2 (<b>EV18</b>) pre-mounted on labelled slides</li></ul>	None
<b>EV17</b>	Hair taken from Suspect 1's clothing		
<b>EV18</b>	Hair taken from Suspect 2's clothing		

## Station 6: fibre samples

Fibres from Suspect 2's clothing should match those found on the victim. The fibres should be from different materials and colours to help to distinguish the matching fibres from Suspect 2 and the victim from Suspect 1's fibres.

You could take fibres from the clothing used at Station 4.

Evidence		Equipment	Chemicals
<b>EV19</b>	Fibres taken from victim's clothing	<ul style="list-style-type: none"><li>• Gloves, scissors and evidence tape</li><li>• Microscope</li><li>• Fibres from the victim's clothing (<b>EV19</b>), Suspect 1's clothing (<b>EV20</b>) and Suspect 2's clothing (<b>EV21</b>) pre-mounted on labelled microscope slides</li></ul>	None
<b>EV20</b>	Fibres taken from Suspect 1's clothing		
<b>EV21</b>	Fibres taken from Suspect 2's clothing		