

crime scene
investigation



fighting crime
protecting communities

TOUGH-CALL.CO.UK

Investigation pack

Name:

Tutor group:

Teacher:



CSI survey

School:

Age:

Tutor group:

Date:

Where do you live? Wirral / Sefton / Knowsley / St Helens
North Liverpool / South Liverpool

Read the statements below and CIRCLE how much you agree with each of them on a scale of 1 to 10, where 1 is "Not at all" and 10 is "100% agree".

1	Guns ruin lives and destroy communities.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
2	Gun crime is a problem in Merseyside.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
3	We should just accept the fact that, in a place like Merseyside, some people are going to get hold of guns.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
4	If people work with the police, they can help to stop gun crime.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
5	If you know someone who carries or hides guns, you should report it.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
6	If you tell the police about things you hear, you are a grass.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
7	The police are doing enough to tackle gun crime in Merseyside.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
8	I know people who have been affected by gun crime.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree
9	If I was worried that someone I knew was involved in gun crime, I'd report it to: Police / Crimestoppers / Teacher / Parent or guardian / Other (please state)										

About gun crime

For a small number of people in Merseyside, carrying a gun or living in fear of gun crime is part of everyday life.

People carry guns for all sorts of reasons – to protect themselves, to look hard in front of their mates or, because they might be getting pressure from the gang.

But guns are dangerous. They can kill and injure people, and damage property. They ruin communities and destroy lives, more than you'd think.

In this project, you will see how...

- Merseyside Police will act on all information given to them about gun crime.
- People who carry guns for protection are more likely to get injured themselves.
- Anyone convicted of having a gun will receive a minimum of 5 years in prison.
- You don't have to be the person carrying the gun to be sent to jail for gun crime offences.
- People who carry guns put the rest of their friends' and family's lives at risk.



Do you know someone who carries or hides guns or are you just worried about someone close to you who you think may be in trouble?

Visit **TOUGH-CALL.CO.UK** for help.

The assignment

At approximately 6.30pm last night, a young lad called Dean was shot in a local park. Police are investigating the shooting and need your help to find out who's responsible.



Police have collected evidence at the scene where Dean was shot. You will be working as a Forensic Scientist to analyse this evidence and help to convict the guilty person.

You're going to find out how bullets move in the air and how they behave when they hit other objects. You'll also look at some of the substances found on a number of suspects' clothing and shoes to see if you can match them to the crime scene and a gun that was found buried nearby.

Your teacher will demonstrate the experiments and will provide all the equipment you need. It's your job to ensure that the evidence you gather is robust and accurate enough to stand up in court. In fact, you'll be putting together a summary of your findings, and presenting it to the Senior Investigating Officer and a judge and jury, after you've completed your tests.

So, good luck with finding the evidence you need. Let's hope you can help to secure a conviction...



Physics tests



In this section, you're going to apply some of the principles you learn in Physics to help you understand a real-life crime scene.

You will conduct a series of ballistics tests about aerodynamics, projectiles and angles of deflection

to identify the speed the bullet was travelling when it went through Dean's leg.

This information will help you find the bullet that's currently missing from the crime scene and significantly move the investigation forward.

OK – let's get to work...

Angle of deflection

We know that Dean was shot in the leg and the bullet hit him at an angle of between 35 and 45 degrees. You're going to perform an experiment, using your knowledge of angles of deflection, to try and determine where the bullet could have deflected when it went through Dean's leg.

The Task

To do this, you are going to fire a ball bearing against a hard, smooth surface (similar to the density of bone) at 35, 40 and 45 degrees. This will help you work out the angle at which the bullet could have deflected when it went

through Dean's leg. You will use the results of this experiment later on in the project to narrow down the search for the missing bullet.

ANGLE OF INCIDENCE	ANGLE OF DEFLECTION			AVERAGE $\frac{T1+T2+T3}{3}$
	TEST 1	TEST 2	TEST 3	
35°				
40°				
45°				

Task 1 – Fire the ball bearing at 35 degrees

Fire a ball bearing at a smooth, hard surface at an angle of 35 degrees and measure the angle of deflection. Repeat this three times to make sure your data is reliable.

Task 2 – Fire the ball bearing at 40 degrees

Repeat step 1 at an angle of 40 degrees.

Task 3 – Fire the ball bearing at 45 degrees

Repeat step 1 at an angle of 45 degrees.

Speed and distance

We know that the missing bullet was deflected when it hit the bone in Dean's leg and slowed down as it passed through the tissue. This experiment will demonstrate how a bullet slows down when it passes through a dense medium such as human muscle.

The Task

You are going to measure the change in speed of a ball bearing travelling through air compared to when it travels through a dense object such as human muscle.

You will use a ball bearing to imitate a bullet, and glycerol to simulate human muscle, as they have similar densities.

	TIME 1 (sec)	TIME 2 (sec)	TIME 3 (sec)	AVERAGE TIME $\frac{T1+T2+T3}{3}$	DISTANCE (m)	SPEED cm/sec $\frac{\text{DISTANCE}}{\text{AVERAGE TIME}}$
BALL BEARING TRAVELLING THROUGH AIR					1 METRE	
BALL BEARING TRAVELLING THROUGH GLYCEROL					1 METRE	

Task 1 – Collect experimental data as the ball bearing travels through air

Drop a ball bearing down a 1.25 acrylic metre tube filled with air and use a stop clock to time how long it takes the ball bearing to travel 1 metre. Repeat this three times to make sure your data is reliable.

Task 2 – Collect experimental data as the ball bearing travels through glycerol

Repeat the process using a 1.25 acrylic metre tube filled with glycerol.

Task 3 – Calculate average times

Calculate the average time that the ball bearing takes to travel 1 metre through both air and glycerol.

Task 4 – Calculate the average speeds

Calculate the average speed of the ball bearing as it travels through both air and glycerol. You can use this equation:

$$\text{SPEED} = \frac{\text{DISTANCE}}{\text{AVERAGE TIME}}$$

The results of this experiment will help you narrow the search for the missing bullet later on in the project.

Measuring impact

There are a number of factors that affect how much impact a bullet has when it hits its target – speed being one of the most important. In this experiment, you are going to fire a ball bearing at an object at different speeds to measure the impact it has on the target.

The Task

You're going to use a piece of apparatus to fire a ball bearing at plasticine from different elastic displacements. This will help to demonstrate the effects of speed on the impact of a bullet.

Task 1 – Perform the experiment three times at each distance, making sure conditions are the same for each experiment.

Task 2 – Record the results in the table below.

ELASTIC DISPLACEMENT	WIDTH OF IMPACT			AVERAGE $\frac{T1+T2+T3}{3}$
	TEST 1	TEST 2	TEST 3	
5cm				
10cm				
15cm				

Chemistry tests



Eliminating suspects through forensic chemistry experiments.

Crime scene investigators have collected different types of evidence at the crime scene. You will carry out experiments on this evidence and will later try and link it to a list of potential suspects.

Flame testing different compounds

Eight suspects have been arrested and forensic scientists have found different substances on their clothes. You are going to find out if any of these substances are found in gunpowder, and therefore may link some of these suspects to the crime scene.

The Task

Carry out flame tests on four different compounds to find out which one contains the same elements as gunpowder. You will use the results of this experiment later on, to help find out who may have fired the gun.

	COMPOUND A	COMPOUND B	COMPOUND C	COMPOUND D
COLOUR OF FLAME				
NAME OF COMPOUND				
WHAT IS THIS COMPOUND CLOSELY ASSOCIATED WITH IN EVERYDAY LIFE?				

Task 1 – Perform the flame test on each of the compounds.

Task 2 – Use the table on the next page to identify what the compound is.

Task 3 – Write down what types of things this compound is often found in.

Compound properties

COMPOUND	PROPERTIES	FLAME COLOUR	USES
SODIUM CHLORIDE	<ul style="list-style-type: none"> • Has a cubic crystalline structure • Is clear when pure, although may also appear white, grey or brownish, depending upon purity • Is soluble in water • Is slightly soluble in other liquids • Is odourless • Has a characteristic taste • Molten sodium chloride is an electrical conductor 	Yellow	<ul style="list-style-type: none"> • Windows for analytical instruments • De-icing • Food and cooking • High power lasers • To produce chlorine and sodium • Historically it has been used as a form of currency
CALCIUM CARBONATE	<ul style="list-style-type: none"> • Produces CO₂ when in contact with acids • Crystals are usually white or transparent • Crystals can cause double refraction of light ionic 	Red	<ul style="list-style-type: none"> • Building • Optical applications • Paper, plastics, paints and coatings • Antacids
POTASSIUM CHLORIDE	<ul style="list-style-type: none"> • Has a cubic crystalline structure • It will precipitate insoluble chloride salts when added to a solution of an appropriate metal ion 	Lilac	<ul style="list-style-type: none"> • Medicine • Food processing • Fertilisers • Lethal injections
LEAD CHLORIDE	<ul style="list-style-type: none"> • White solid poorly soluble in water • Occurs naturally in the form of the mineral cotunnite • It is colorless, white, yellow, or green toxic 	Blue/white	<ul style="list-style-type: none"> • Production of glass • Bullet manufacture
COPPER SULPHATE	<ul style="list-style-type: none"> • Reacts with more reactive metals than copper 	Blue/green	<ul style="list-style-type: none"> • Pesticide • Fungicide • Herbicide • Test blood for iron and anaemia

Fingerprinting

Fingerprints are unique to one person. If you find any at the scene of a crime and can successfully match them to an individual, it can help lead to a prosecution.

The Task

Although no two people have exactly the same fingerprints, there are only three basic 'types' of fingerprint: arches, loops and whorls.

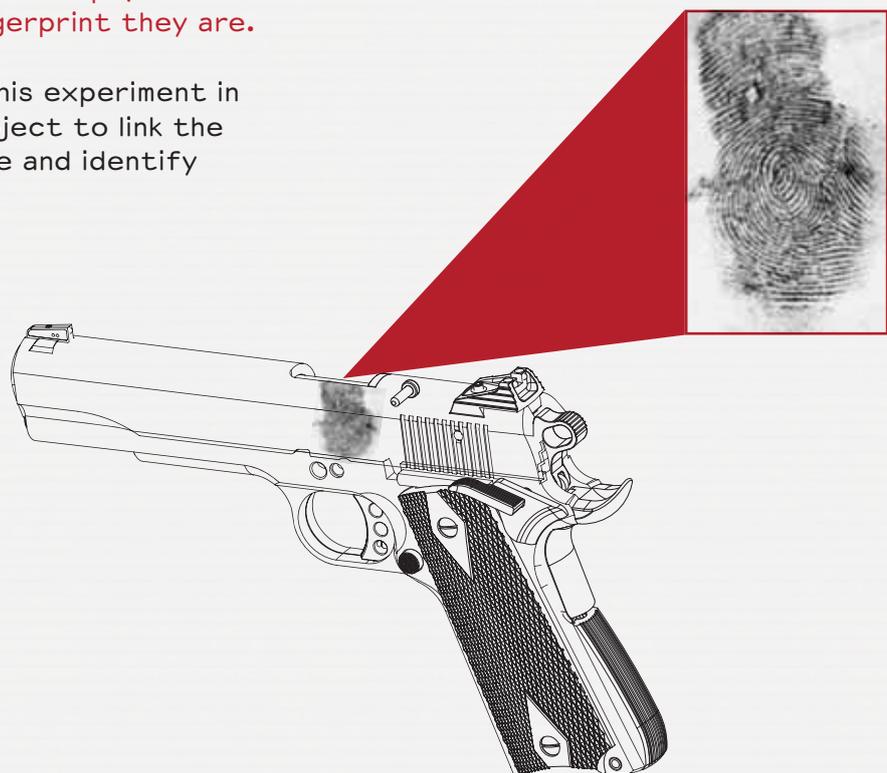
So, we can eliminate people from the investigation by finding out which type of fingerprint was on the gun.

Task 1 – First, you will analyse your own fingerprints to see what type you have. Your teacher will demonstrate how to do this.



Task 2 – Then you'll analyse the fingerprints found on the gun, using a microscope, to determine which type of fingerprint they are.

You will use the results of this experiment in the final section of this project to link the suspects to the crime scene and identify the shooter.



Testing the pH of soil

Police have found a gun buried in a field a mile away from where Dean was shot. They believe it belonged to the shooter. You need to work out if any of the soil samples found on the suspects' shoes match the soil the gun was buried in.

The Task

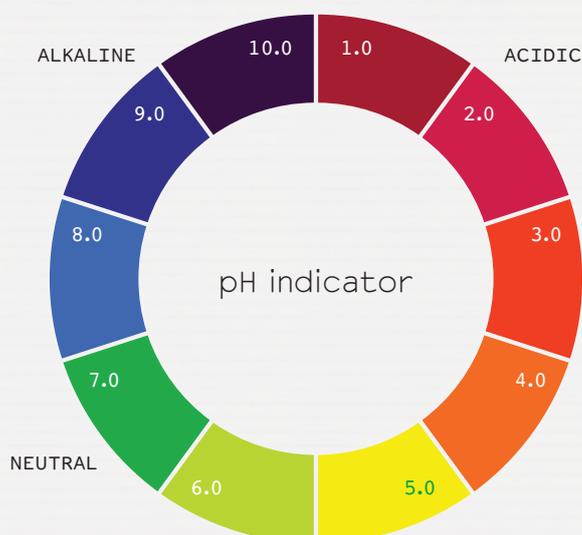
The police found the gun buried in soil that was very acidic. Your task is to carry out experiments to work out which of the three soil samples found on the suspects' shoes is neutral, alkaline or acid. Once you have found which sample is the acidic one, you can eliminate more suspects from the crime.

	SOIL SAMPLE A	SOIL SAMPLE B	SOIL SAMPLE C
pH VALUE			
ACIDITY			

Task 1 – Use the pH meter to test the soil samples found on the suspects' shoes.

Task 2 – Record your results in the table.

You will use the results of this experiment in the final section of this project to link the suspects to the crime scene and identify the shooter.



Microscopic analysis of fibres

The gun that police believe was used in the shooting was wrapped in a red polyester scarf when it was found buried in a field nearby. By matching fibres from this scarf to fibres found on the suspects' clothes, you can determine who may have been present at the shooting.

The Task

Four different red fibres were found on the suspects' clothes. Your task is to analyse these fibres to determine what they are and establish if one of them could be the same as the fibres found on the gun.

	FIBRE A	FIBRE B	FIBRE C	FIBRE D
DESCRIPTION				
SKETCH				
FIBRE TYPE				

Task 1 – Analyse the four red fibres A, B, C, D to determine what they are. Write a brief description of the fibre and draw a sketch of what it looks like under a microscope.

You will use the results of this experiment in the final section of this project to link the suspects to the crime scene and identify the shooter.

Presenting your evidence



Building a case and securing a conviction.

Your final task is to present the results from your forensic science investigation, first of all to the Senior Investigating Officer who is leading this investigation and then to a judge and jury in a court of law.

You will meet the Senior Investigating Officer, Chief Inspector Lewis, and then Judge Aston who will provide you with instructions. But, before you make your presentations, you need to spend a little time organising your evidence so that you can present it properly.

Presenting evidence from your physics tests...

to narrow the search for the missing bullet

The final critical piece of evidence that is missing is the bullet that passed through Dean's leg. This is needed so that police can prove that the gun they have found is the one used in the shooting.

Police have been looking for the bullet in the park but have had no success. Use your results from experiments 1.1 – 1.3 to narrow down the search.

Review of Section 1.1 – Angle of deflection

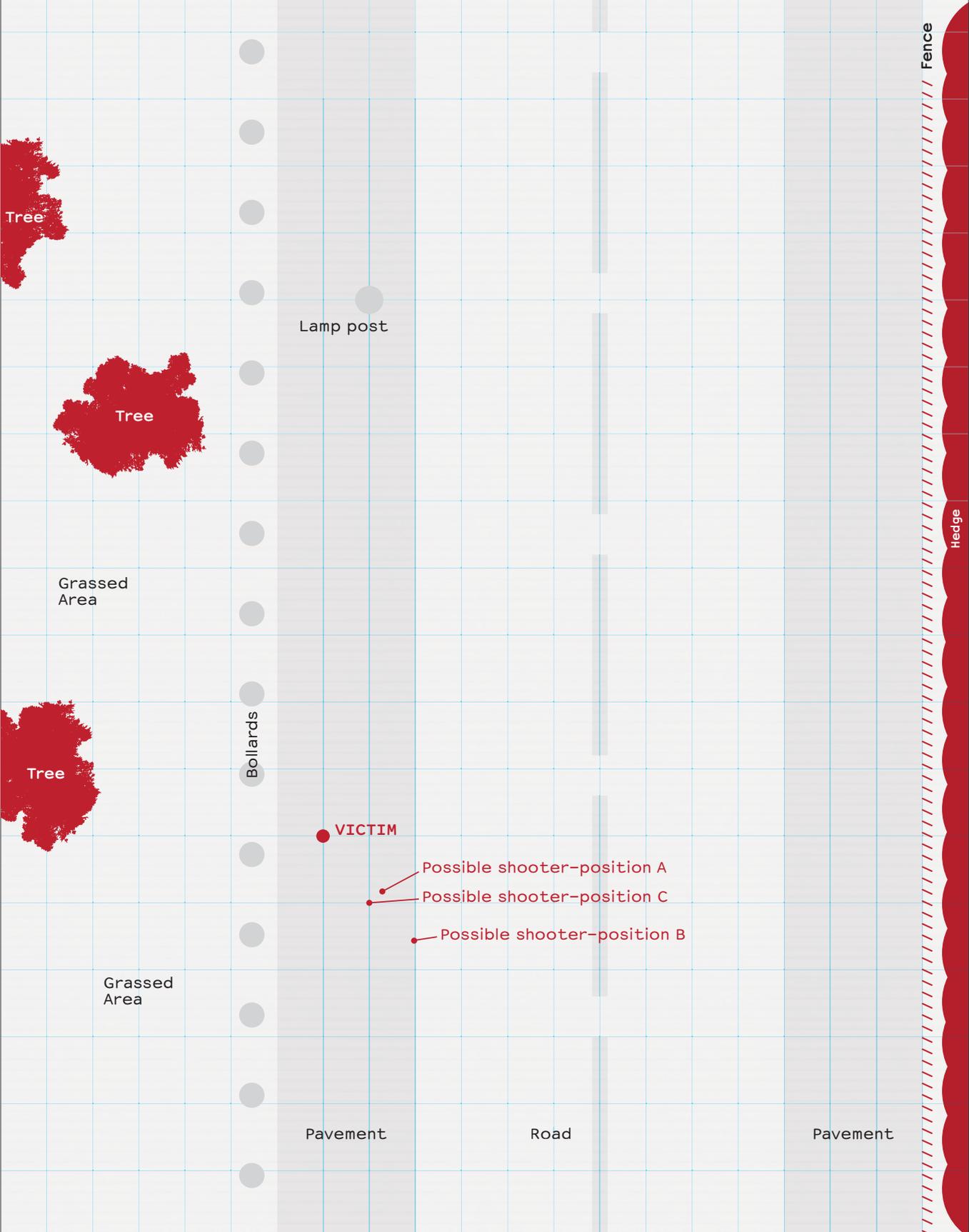
Witnesses came forward and gave police three possible positions from where Dean was shot (These positions are marked on the crime scene map on the next page).

Using a pair of compasses and your results from section 1.1, draw the average angles of deflection at 35, 40 and 45 degrees onto the crime scene map to help work out where the bullet could have gone when it passed through Dean's leg.

A B C D E F G H I J K L M N O P Q R S T U

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

The Crime Scene
This map will help you record the results of two experiments and narrow down your search for the bullet.



SECTION 3.1 CONTINUED

Review of Section 1.2 – Speed and distance

We know the bullet went through Dean's leg, which would have slowed it down and affected how far it travelled. Use your results from experiment 1.2 to complete the table below, to help you work out how far the bullet may have travelled and narrow down the search for the missing bullet.

Fill in the table below to show how fast the ball bearing travelled through air compared to glycerol, which is a similar density to human muscle.

	AVERAGE TIME	DISTANCE	SPEED = $\frac{\text{DISTANCE}}{\text{AVERAGE TIME}}$
BALL BEARING TRAVELLING THROUGH MUSCLE (SIMULATED BY GLYCEROL)		1 METRE	
BALL BEARING TRAVELLING THROUGH AIR		1 METRE	

ESTIMATE THE DISTANCE THE BULLET MAY HAVE TRAVELLED BY WORKING OUT THE CHANGE IN SPEED OF THE BALL BEARING THROUGH AIR COMPARED TO GLYCEROL.

$$\frac{\text{SPEED THROUGH GLYCEROL}}{\text{SPEED THROUGH AIR}} \times 100$$

$$\text{—————} \times 100 = \text{——} \%$$

BULLETS TRAVELLING THROUGH AIR USUALLY TRAVEL AT LEAST 100M*. USE YOUR CALCULATIONS TO ESTIMATE HOW FAR THE BULLET COULD HAVE TRAVELLED AFTER IT PASSED THROUGH DEAN'S LEG. THE FORMULA BELOW WILL HELP.

$$\text{PERCENTAGE CALCULATED ABOVE} \times \text{DISTANCE TRAVELLED THROUGH AIR (100M)} =$$

$$\text{—————} \times 100 = \text{——} \%$$

*estimated for the purposes of this project

Use the map and your results from this section to draw the distance the bullet may have travelled when it went through Dean's leg.

SECTION 3.1 CONTINUED

DISCUSS ANY PROBLEMS WITH THIS EXPERIMENT E.G. ARE THERE ANY ERRORS? DOES THIS EXPERIMENT ACCURATELY REPLICATE A BULLET PASSING THROUGH DEAN'S LEG?

DISCUSS THE RELIABILITY AND ACCURACY OF THE DATA YOU RECORDED. WHAT DOES THIS MEAN FOR THIS INVESTIGATION?

LIST ANY SUGGESTIONS YOU HAVE TO IMPROVE THIS EXPERIMENT TO MAKE IT MORE ACCURATELY REFLECT A BULLET PASSING THROUGH MUSCLE.

Review of Section 1.3 – Measuring impact

The experiment in section 1.3 helped to demonstrate important factors, which affect the impact of a bullet.

WHAT DOES THE DATA THAT YOU COLLECTED FROM YOUR EXPERIMENT TELL US ABOUT THE RELATIONSHIP BETWEEN THE MOMENTUM OF A BULLET AND THE IMPACT THAT IT MAKES?

DISCUSS THE RELIABILITY AND ACCURACY OF THIS EXPERIMENT AND THE DATA YOU RECORDED. DOES THIS ACCURATELY REFLECT THE ACTION OF A BULLET TRAVELLING THROUGH MUSCLE?

WHAT COULD YOU DO TO IMPROVE THE RESULTS TO MAKE THEM MORE ACCURATE?

Conclusion

IN THIS SECTION, YOU WILL PRESENT YOUR FINDINGS FROM THE PHYSICS EXPERIMENTS TO THE SENIOR INVESTIGATING OFFICER, TO HELP HIM NARROW DOWN THE SEARCH FOR THE MISSING BULLET.

PRESENT CHIEF INSPECTOR LEWIS WITH THE CRIME SCENE MAP AND EXPLAIN HOW YOU HAVE NARROWED DOWN AN AREA FOR HIS OFFICERS TO SEARCH.

USE THIS PAGE TO MAKE NOTES TO MAKE SURE YOU'RE PREPARED.

Presenting evidence from your chemistry tests...

to eliminate suspects

Now that you have helped police narrow down their search for the bullet, you can concentrate on presenting the evidence from your forensic chemistry experiments to the court.

Use the suspects list on page 23 to help you narrow down your search for the shooter.

Review of Section 2.1 – Flame testing different compounds

<p>WHAT COMPOUND IS FOUND IN GUNPOWDER?</p>	
<p>WHICH OF THE SUSPECTS WERE FOUND WITH THIS COMPOUND ON THEIR CLOTHING? (REFER TO THE SUSPECTS LIST ON PAGE 23)</p> <p>(CIRCLE THE LETTER (A,B,C OR D) WHICH REPRESENTS THE GUNPOWDER COMPOUND, UNDER THOSE SUSPECTS WHO HAD IT ON THEIR CLOTHING.</p>	<ol style="list-style-type: none"> 1. 2. 3. 4. 5. 6.
<p>DISCUSS THE RELIABILITY AND ACCURACY OF THIS EXPERIMENT AND THE DATA YOU RECORDED.</p>	

Review of Section 2.2 – Fingerprinting

<p>WHAT TYPE OF FINGERPRINT WAS FOUND ON THE GUN?</p>	
<p>WHICH OF THE SUSPECTS HAVE THIS TYPE OF FINGERPRINT?</p> <p>CIRCLE THE FINGERPRINT TYPE (ARCHES, LOOPS OR WHORLS) UNDER THOSE SUSPECTS WHO HAVE THE SAME TYPE)</p>	<ol style="list-style-type: none"> 1. 2. 3.
<p>DISCUSS THE RELIABILITY AND ACCURACY OF THIS EXPERIMENT WHEN LINKING THESE SUSPECTS TO THE CRIME SCENE.</p>	

SECTION 3.2 CONTINUED

Review of Section 2.3 – Testing the pH of soil

THE GUN WAS FOUND BURIED IN ACIDIC SOIL. WHICH OF THE SUSPECTS WERE FOUND WITH THIS TYPE OF SOIL ON THEIR CLOTHES?

(CIRCLE THE ACIDIC SOIL SAMPLE (A,B OR C) UNDER THE SUSPECTS WHO WERE FOUND WITH IT ON THEIR CLOTHING)

- 1.
- 2.
- 3.

DISCUSS THE RELIABILITY AND ACCURACY OF THIS EXPERIMENT AND THE DATA YOU RECORDED.

Review of Section 2.4 – Microscopic analysis of fibres

WHICH SUSPECTS WERE FOUND WITH RED POLYESTER FIBRES ON THEIR CLOTHES, AND THEREFORE COULD BE LINKED TO THE CRIME SCENE?

(CIRCLE THE POLYESTER FIBRE (A,B,C OR D) UNDER EACH OF THE SUSPECTS WHO HAD IT ON THEIR CLOTHING)

- 1.
- 2.
- 3.

DISCUSS THE RELIABILITY AND ACCURACY OF THIS EXPERIMENT AND THE DATA YOU RECORDED.

Suspects

Police have arrested the following eight suspects because they believe they were somehow involved in the shooting.

If you link evidence gathered at the scene

to the substances found on the suspects' clothing, circle it under the name of that suspect. The person with the most evidence found on them will be your prime suspect.



Stephen McNally
Compounds found:

A C

Fingerprint type:

ARC

Soils found:

C

Fibres found:

B



Sophie Jones
Compounds found:

a d

Fingerprint type:

WHORL

Soils found:

b c

Fibres found:

B d



James Taylor
Compounds found:

a b c

Fingerprint type:

LOOP

Soils found:

a

Fibres found:

a c



Kev Dixon
Compounds found:

c d

Fingerprint type:

ARC

Soils found:

a

Fibres found:

a



Chantelle Williams
Compounds found:

a b

Fingerprint type:

ARC

Soils found:

a b c

Fibres found:

a b d



Thomas Richards
Compounds found:

c

Fingerprint type:

LOOP

Soils found:

c

Fibres found:

a c



Ryan Stephens
Compounds found:

c d

Fingerprint type:

WHORL

Soils found:

a b

Fibres found:

a b d



James Smith
Compounds found:

a c

Fingerprint type:

WHORL

Soils found:

c

Fibres found:

a

Conclusion

YOU SHOULD NOW HAVE LINKED THE EVIDENCE FOUND AT THE SCENE TO SOME OF THE SUSPECTS ON PAGE 23. THE PERSON WITH THE MOST EVIDENCE FOUND ON THEIR CLOTHING IS YOUR PRIME SUSPECT TO THE SHOOTING.

YOUR FINAL TASK IS TO PRESENT THIS EVIDENCE TO A JUDGE AND JURY IN COURT TO TRY AND HELP SECURE A CONVICTION.

GIVE THE JURY THE NAME OF YOUR PRIME SUSPECT AND USE THE INFORMATION IN THE REVIEW SECTION 2.1–2.4 TO JUSTIFY YOUR REASONS.

USE THIS PAGE TO MAKE NOTES TO MAKE SURE YOU ARE PREPARED.

GOOD LUCK!

CSI survey

School:

Age:

Tutor group:

Date:

Where do you live? Wirral / Sefton / Knowsley / St Helens
North Liverpool / South Liverpool

Look at the statements below and CIRCLE how much you agree with each of them on a scale of 1 to 10, where 1 is "Not at all" and 10 is "100% agree".

1	Guns ruin lives and destroy communities.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree

2	Everybody should help the police to stop gun crime										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree

3	If you tell the police about things you hear, you are a grass.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree

4	This session has made me much more aware of the problems associated with gun crime.										
Not at all	1	2	3	4	5	6	7	8	9	10	100% Agree

5	If I was worried that someone I knew was involved in gun crime, I'd report it to:										
	Police / Crimestoppers / Teacher / Parent or guardian / Other (please state)										

It's a tough call walking away from gun crime.

For more information about the
consequences of gun crime and
where to get help visit:

TOUGH-CALL.CO.UK

This project is supported by:



The Granada
Foundation