

TRANSITION YEAR SCIENCE MODULE

Developed by

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Sponsored by:

Forfas and the Irish Pharmaceutical and Chemical Manufacturers Federation

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Students who do Transition Year get better grades in the Leaving Cert than those who don't.

This claim was already made two years ago by the National Council for Curriculum and Assessment (NCCA), following a survey which revealed that students who took Transition Year achieved 42 additional CAO points compared to those who went straight into the Leaving Cert programme.

The claim is now further substantiated by a new report from the Economic and Social Research Institute (ESRI), which states that students who do the extra year show an average increase of eight per cent in Leaving Cert grades over those who skip the year. The findings are based on the Leaving Cert results of 1996 Junior Cert students, with the trend most evident in maths and English. The aim of this program is to provide science based resources suitable for the Transition Year curriculum. Transition Year is an ideal opportunity for students to gain exposure to extremely interesting aspects of everyday science that may not be on the Junior Certificate of Leaving certificate syllabus.

This programme will contain five distinct modules:

Forensic Science (January 2004)
Chemical Engineering (February 2004)
Sports Science (March 2004)
Cosmetic Science (April 2004)
Environmental Science (May 2004)

Each module cover a range of topics and recommend suggested practicals in addition to material suitable for the classroom. This programme also includes a variety of science based topics suitable for public speaking seminars.

We acknowledge this programme is in its infancy and welcome your feedback no matter how critical.

Yours sincerely,

Mark Glynn
Education Officer
IPCMF

Forensic

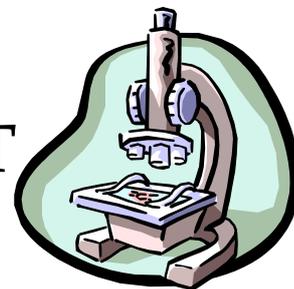


Scientist

By the end of this module you should:

1. Know what a forensic scientist does
2. Know what qualities and training is required to be a forensic scientist
3. Have experienced what it is like to work as a forensic scientist on a murder enquiry

THE FORENSIC SCIENTIST



What inspired you to enter this career?

I had done a degree and some research in Chemistry – but I wanted to apply what I knew to real life

What qualities do you need to succeed?

Technical skills- to carry out tests and comparisons accurately

Observation skills- important evidence is easily overlooked

Good judgement about what is important

Organisational skills- there is always too much to do!

Communication skills – to communicate scientific evidence to a non-technical audience

What advice would you give to someone choosing L.C. subjects who may wish to follow a career in Forensic Science?

Physics, Chemistry, and Biology are all useful – follow your interests and get a good basic science degree or technical qualification

A typical day in the life of a forensic scientist

9.00 Go through notes on a case coming up in court later in the day. Fragments of glass from a suspects clothes have been matched with a broken window in a burglary case

10.00 Urgent call from Gardai to take samples of paint from the clothing of the victim of a hit and run accident

11.00 Organise chemical analysis of paint and fragments of glass also found on the victims clothes

14.00 Consult data base in Germany and identify the make and colour of the car
Report back to Gardai

16.00 Give evidence in court

What are the highs and lows of a career in Forensic Science?

Higs

The direct application of scientific information generated making a genuinely valuable input into the justice process

LOWS

Frustration of trying to juggle priorities between the potential of the evidence and keeping within budget!

What qualifications do you need?

For entry at **technician** level

- an NCEA qualification in technical science

For entry at **professional** level

- a degree in Chemistry, Biology, Molecular biology

but in practice many entering at this level have higher degrees (M.Sc., Ph.D.)

What is the career structure after initial qualifications?

Technicians can progress through Technician Grade to senior technician Class 1 and 2

Those entering at Professional level can progress from Grade 3 to Grade 2. At this stage they may decide to develop their career in management (Grade 2 and Grade 1)



Career Profile

| | Career 1 | Career 2 |
|----------------------------------------------|----------|----------|
| Skills/Qualities Needed | | |
| Pro's, Advantages, Good Points | | |
| Cons, Disadvantages, Bad points | | |
| Leaving Cert subjects advisable | | |
| 3 rd Level Qualification required | | |

Questionnaire - Is Forensic Science for YOU?

1. Which of these is most like you?
 - a. I am good at getting the “big picture” and I don’t get bogged down in details
 - b. Details fascinate me
 - c. I like to carry out a routine methodically.
2. What kind of puzzles do you like?
 - a. I don’t understand why people like puzzle games.
 - b. I prefer jigsaw and logic type puzzles
 - c. I like action games and puzzles like computer games
3. My CDs are.....
 - a. In my room, the sitting room, my schoolbag or loaned to friends
 - b. In a rack, but not in any particular order
 - c. In a rack arranged in alphabetical order
4. In your house, when is the bin collection?
 - a. I have no idea which is bin collection day.
 - b. It’s a different day each week
 - c. I know which day is bin collection day, its _____
5. When you’re asked to speak in front of the class, which is most like you?
 - a. I love it, once I get started I can’t stop!
 - b. I am usually brief and to the point.
 - c. I really don’t enjoy it – I go red and forget what I was going to say
6. Is your bedroom (at this moment)
 - a. Tidy – everything put away in its place?
 - b. A total mess – it’s hard to walk over to the bed?
 - c. Something in between
7. Which of these sayings do you agree with most?
 - a. Too many cooks spoil the broth.
 - b. Many hands make light work.
 - c. Two heads are better than one.
8. When doing projects.....
 - a. I like working on my own. Other people annoy me when they don’t pull their weight, and I take pride in my own work
 - b. I like working in a group, you can share work around so that you each have less to do
 - c. I prefer groups – different people can do different tasks depending on what they’re good at.
9. How often do people ask you to explain homework to them?
 - a. Every day
 - b. Once a week
 - c. Never
10. Were the boxes on the previous page....don’t look back!!
 - a. same width, variable heights
 - b. same width, same height
 - c. variable width, same height

Results of Questionnaire

Allocate marks according to then scheme below

1. Problem solving skills

Q1 a=2 b=3 c=1

Q2 a=1 b=3 c=2

2. Observing skills

Q4 a=1 b=1 c=3

Q10 a=3 b=1 c=1

3. Organizational skills

Q3 a=1 b=2 c=3

Q6 a=3 b=1 c=2

4. Team-working skills

Q8 a=1 b=2 c=3

Q7 a=1 b=2 c=3

5. Communicating skills

Q9 a=3 b=2 c=1

Q5 a=2 b=3 c=1

Results:

| Total Points | Is forensics for you? |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 25-30 | You have all the skills you need to have the potential to become an excellent forensic scientist. This is certainly a career option for you |
| 20-25 | A few skill areas still need development, but you have definitely got what it takes to be a forensic scientist |
| 15-20 | Not sure that forensic science is for you. You have not shown the skills you need in this questionnaire |
| 10-15 | There are lots of careers in science other than forensics. Try one of them! |

Murder in Delahasey House

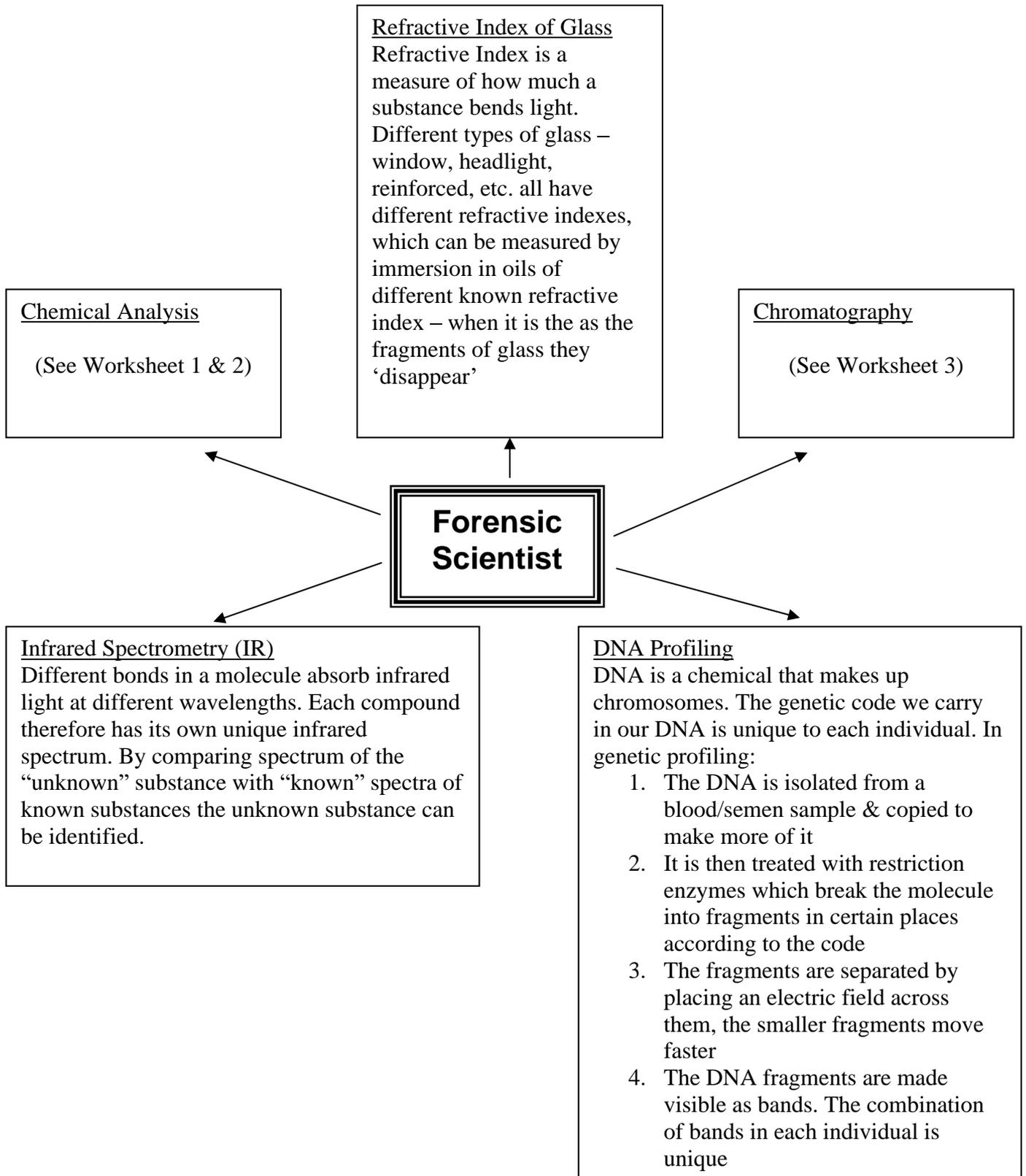
Forensic Scientists and detectives work closely together to solve crime. You are going to take on the role of these to solve the dastardly crime in Delahasey House.

As a forensic scientist the techniques available to you are shown on the next page. Some you can do yourself. Others you must send away for, and so cost you tokens (You may be given a limited number of tokens, **OR** the winner is the one who solves the crime with the least number of tokens). Work out a system of solving the crime without wasting resources!

A few hints:

1. Start by looking through what evidence was collected by the forensic team at the scene, and the statements collected by the Gardai. They have narrowed it down to five suspects, but now they are stuck.
2. No one type of evidence will give you the murder. You will need to gradually rule out the suspects until you are sure of who is guilty.
3. Record all your results meticulously on your master sheet.
4. Start with the analysis techniques that you can do yourself.
5. Remember that you can never get a conviction without corroborating evidence

Some techniques available to the Forensic Scientist



Murder in Delahasey House

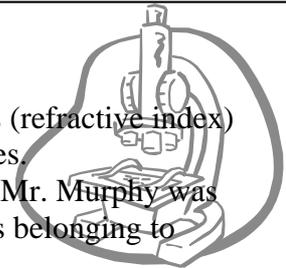
Report from Detectives & Forensic Scientists called to the scene

I arrived at the house at 2:30pm, after a 999 call at 2:07pm. James was in his pottery studio. He had been shot at point blank range. There was a suicide note and pen citing business difficulties as his reason for taking his own life. He was lying beside a chair he had been sitting in. There was broken glass on the floor - probably from a wine glass. He was found by his daughter and housekeeper who live in the house. Other people present in the house were the gardener, Jim Peel and a handyman, Paul Mahon. Mr. Murphy's son, Sean, lives nearby, and arrived soon afterwards.

Report from Forensic Scientist

Evidence from scene:

1. Glass broken beside body, and glass particles from shoes of suspects (refractive index)
2. Finger prints from gun – none – the dead man was not wearing gloves.
3. Threads – navy blue – collected from chair opposite the table where Mr. Murphy was working when shot, and samples of threads from navy blue garments belonging to suspects (IR)
4. Sample of ink from the suicide note, and sample of ink from pens belonging to the suspects (chromatography)
5. Sample of dirt from the floor of the studio, and sample of dirt from the shoes of suspects (chemical analysis)
6. Blood samples from the victim, and blood samples from the clothes of the suspects (DNA profiling)



Murder at Delahasey House - Garda Interviews

Interview with housekeeper – Mrs. Doyle

Q: Was Mr. Murphy often in his studio?

A: *Yes. He loved his pottery. It was a relaxation from his business, and he often took a glass of wine to the studio after lunch*

Q: What happened on the day of his death?

A: *I gave Mr. Murphy his lunch as usual. He seemed in good form. He had had a row with his son about the business but he did not seem put out – they argued so often. I went for a sleep – I often do after lunch – and called into the studio on my way downstairs to see if he wanted some tea, and that is when I found him*

Q: There are blood spots on your clothes – can you explain that?

A: *Yes, I cut myself in the kitchen with a knife by mistake*

Interview with gardener

Q: Where were you on the day of Mr. Murphy's death?

A: *I was in the garden all day. I was working in the rose garden weeding and spreading fertilizer in the beds in front of the house.*

Q: Did you see anyone arrive or leave the house?

A: *Mr. Sean Murphy arrived early and left soon afterwards. I saw the handyman, Paul Mahon, arrive at about 8:30 and the housekeeper Mrs. Doyle at about 9:00*

Q: We found some blood spots on your clothes – any idea how they got there?

A: *Why yes, I cut myself with a knife while opening the fertilizer bags*



Interview with handyman – Paul Mahon

Q: Tell me about the day of Mr. Murphy's death

A: *I arrived at about 8:30 or a little after. Mr. Murphy was pacing about the hall in an agitated way. He asked me how the plastering of the new dining room was going. I said "Why don't you come and have a look?" He said he had something to attend to but would be down later to pay me. I went down to the dining room and worked all morning. I went to the kitchen for my lunch and then into the garden for a smoke. Then the police arrived*

Q: Did you get on with Mr. Murphy? What was he like as an employer?

A: *Class! In spite of all his money he was a genuine bloke. He supported Newcastle and I support Spurs – we always had a little wager on when they played. The night before he died Spurs won, actually.*

Interview with son – Sean Murphy

Q: How did you get on with your father?

A: *Great! He is my mentor and role model – I idolize him! I just can't believe it!*

Q: Did you see him on the day of his death?

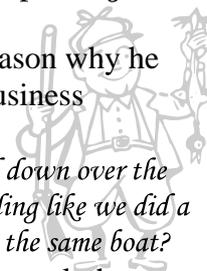
A: *I called in early on my way to the office to get his signature on a few documents – I was planning to meet him for dinner later on*

Q: Can you think of any possible reason why he should take his own life? Any business problems?

A: *None! Profits have been a bit up and down over the last few years and we are not expanding like we did a few years ago – but isn't everyone in the same boat?*

Q: There are some blood spots on your clothes, can you explain that?

A: *Yes – when I called in to see Dad he had cut himself shaving, and it wouldn't stop bleeding. I helped him put a plaster on it!*



Interview with daughter – Rebecca Murphy

Q: How did you get on with your father?

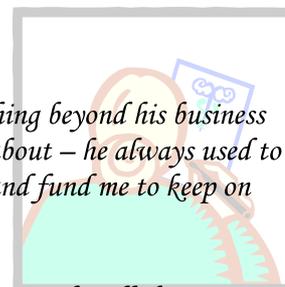
A: *To be honest – not very well. We just had no interests in common. He could not see anything beyond his business and his little pots. My art means nothing to him. He has no idea what modern art is all about – he always used to ask me what my pictures were. He did not have a clue. However, he did give me a home and fund me to keep on painting, he knew his paternal duties*

Q: Where were you on the day of his death

A: *I got up around 11 and was in my studio – the old stables in the yard – all day until Mrs. Doyle called me.*

Q: We have found some blood spots on your clothes – could you tell us how they got there?

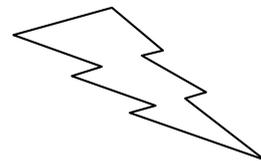
A: *Yes – I often cut myself when trimming canvas' in the studio.*



| <u>Suspects</u> Techniques | Suspect 1 Son Sean Murphy | Suspect 2 Gardener Jim Peel | Suspect 3 Housekeeper Mrs. Doyle | Suspect 4 Daughter Rebecca Murphy | Suspect 5 Handyman Paul Mahon |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------------|--------------------------------------------|
| <u>Chromatography</u> <i>Ink on suicide note</i> Blue= Yellow+Red | | | | | |
| Chemical Analysis On dust from shoes Cations (flame tests) plaster = pottery clay = | | | | | |
| <u>Chemical Analysis</u> Anions Plaster = Clay = Fertilizer = | | | | | |
| <u>IR</u> On navy threads on seat in studio | | | | | |
| <u>Refractive Index</u> <i>Of broken glass at scene</i> | | | | | |
| <u>DNA Profile</u> | | | | | |

Murder at Delahasey House

Worksheet 1 - Flame Tests



Testing for cations (positive metal ions)

1. Place wooden splints into a beaker of water (so that they don't burn in the Bunsen flame)
2. Dip the damp splint into one of the known samples
3. Hold for a short time in a blue Bunsen flame and observe. Record results below
4. Repeat for all 'known' samples using a new splint for each sample

Results of known samples:

| <u>Sample</u> | <u>Result</u> |
|----------------|---------------|
| Lithium Salt | |
| Potassium Salt | |
| Calcium Salt | |

5. Using new splints for each sample now test the plaster and pottery clay, and the samples from the shoes of each suspect recording observations and conclusions carefully

Results of unknown samples:

| <u>Sample</u> | <u>Result</u> |
|-----------------------------|---------------|
| Plaster | |
| Pottery Clay | |
| Fertilizer | |
| Dirt from shoes – Suspect 1 | |
| Dirt from shoes – Suspect 2 | |
| Dirt from shoes – Suspect 3 | |
| Dirt from shoes – Suspect 4 | |
| Dirt from shoes – Suspect 5 | |

Conclusions:

What are your conclusions from these tables? Transfer the results to the master sheet.

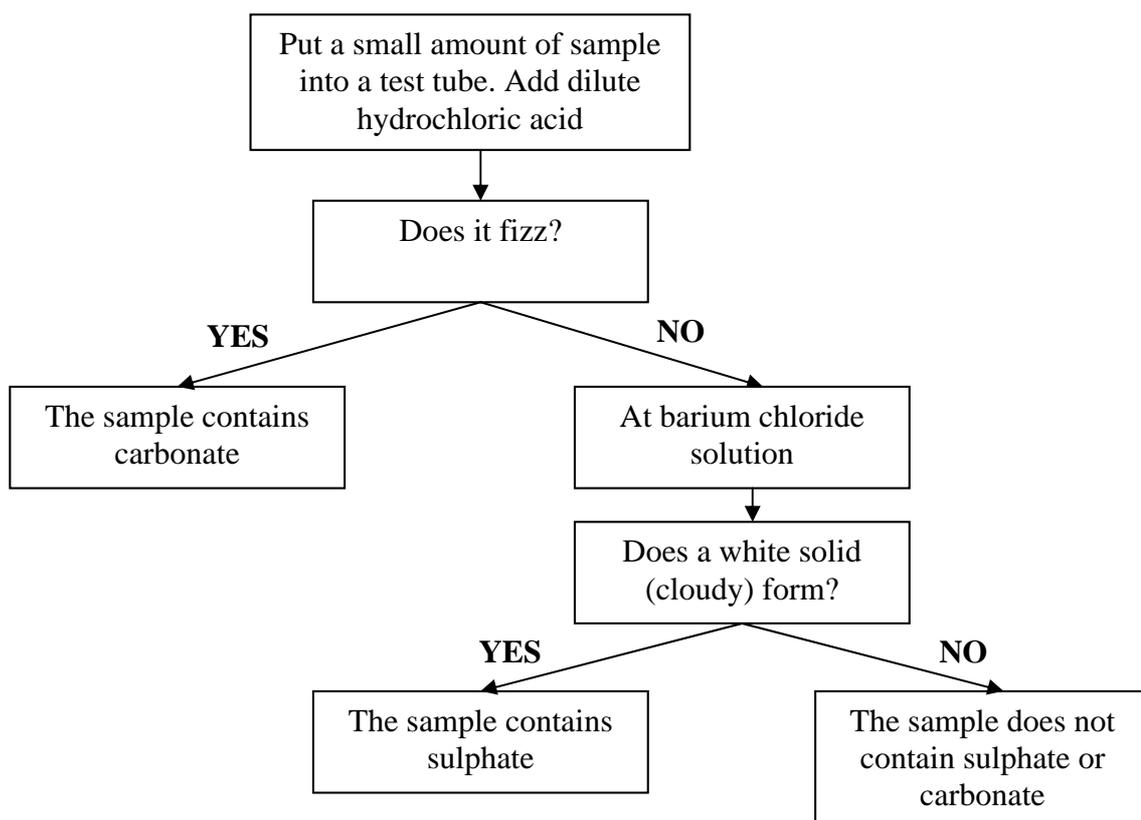
Murder at Delahasey House

Worksheet 2 - Test for carbonates/sulphates

Testing for anions (negative ions)



Follow this procedure on known samples of carbonate and sulphate, fertiliser, plaster and clay. Then carry out the same analysis on the purified samples from the shoes of the 5 suspects



Results(known samples):

| Sample | Carbonate | Sulphate |
|------------|-----------|----------|
| Carbonate | | |
| Sulphate | | |
| Fertiliser | | |
| Plaster | | |
| Clay | | |

Results(unknown samples):

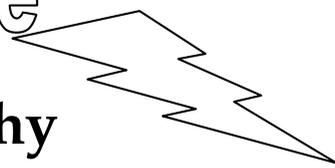
| | | |
|-----------|--|--|
| Suspect 1 | | |
| Suspect 2 | | |
| Suspect 3 | | |
| Suspect 4 | | |
| Suspect 5 | | |

Conclusions:

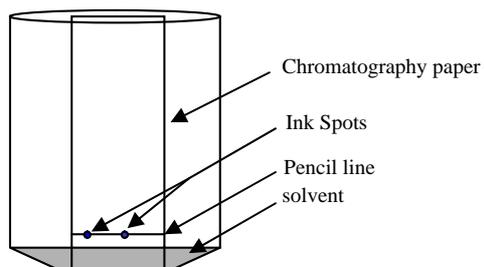
What have you found out from these tests? Transfer your findings to the master results sheet

Murder at Delahasey House

Worksheet 3 - Chromatography



1. Draw a pencil line about 3cm from the base of 3 pieces of chromatography paper
2. Use the droppers/capillary tubes to make spots of ink on the pencil line as shown



In each case allow the spot to dry and then add another spot to get a very concentrated spot.

3. Suspend the chromatography paper in a beaker/gas jar
4. Leave until the solvent has almost reached the splint, and compare

Results:

Sketch your chromatograms

| Ink from note | Suspect 1 | Suspect 2 | Suspect 3 | Suspect 4 | Suspect 5 |
|---------------|-----------|-----------|-----------|-----------|-----------|
| | | | | | |

Conclusions:

What conclusions can you draw from these experiments? Transfer the results to the master sheet.

Final Report

-

Murder at Delahasey House

1. Who do you think is the murderer. Give reasons for your choice.

2. For each of the other suspects explain clearly why you think the evidence indicates they are NOT the culprit

Suspect ():

Forensic

Science

Teacher's Resources

| Lesson (40 mins each) | Content | Advanced Preparation | Equipment Required | Chemicals Required |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Introduction – what is the module all about? Read sheet on Forensic Scientist Fill in career information sheet Do Questionnaire, work out results | Photocopy Student Material Pg. 1-15 (1 per group) | | |
| 2 | Introduction to the murder Techniques available to a forensic scientist Flame tests | | Per group: 10 splints, beakers, water, Bunsen, Safety Glasses | Lithium chloride, Potassium chloride, strontium nitrate, calcium chloride Labelled: “plaster”=calcium sulphate “pottery clay”=potassium chloride “fertilizer”=potassium sulphate “suspect 1”=potassium chloride “suspect 2”=potassium sulphate “suspect 3”=potassium chloride “suspect 4”=potassium chloride “suspect 5”=strontium/calcium sulphate |
| 3 | Tests for Carbonates and Sulphates | | Per Group: Dilute Hydrochloric Acid(circa 0.2M), Barium chloride solution (circa 1M – dissolve 50g BaCl ₂ .2H ₂ O in 200cm ³ water) | Labeled “carbonate”=calcium carbonate Labeled “sulphate”=potassium sulphate Plaster, pottery clay, fertilizer and suspect 1-5 as shown above |
| 4 | Chromatography | | Per group: Beakers x2/3 Chromatography paper, wooden splints | Labeled: “Suicide note”=Ink +yellow+red food colouring “suspect 1”=Mixture as above “suspect 2”=Ink only “suspect 3”= Mixture as above “suspect 4”= Mixture as above “suspect 5”= Mixture as above |

| | | | | |
|---|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--|--|
| 5 | Buying results of Refractive index, DNA, IR Coming to conclusions Writing Report | Photocopy 12 sets of results which can be bought (1 per group) (pages 21-23) 20 copies of token (page 20) | | |
| 6 | Communicating report to class in group Questions from class | | | |

| <u>Suspects</u> Techniques | Suspect 1 Son Sean Murphy | Suspect 2 Gardener Jim Peel | Suspect 3 Housekeeper Mrs. Doyle | Suspect 4 Daughter Rebecca Murphy | Suspect 5 Handyman Paul Mahon |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------------|--------------------------------------------|
| <u>Chromatography</u> <i>Ink on suicide note</i> Blue= Yellow+Red | <i>Match</i> | <i>No Match</i> | <i>Match</i> | <i>Match</i> | <i>Match</i> |
| Chemical Analysis On dust from shoes Cations (flame tests) plaster = <i>calcium</i> pottery clay= <i>potassium</i> fertiliser = <i>potassium</i> | <i>Potassium</i> | <i>Potassium</i> | <i>Potassium</i> | <i>Potassium</i> | <i>Calcium</i> |
| <u>Chemical Analysis</u> Anions Plaster = <i>Sulphate</i> Clay = <i>Neither</i> Fertilizer = <i>Sulphate</i> | <i>Neither</i> | <i>Sulphate</i> | <i>Neither</i> | <i>Neither</i> | <i>Sulphate</i> |
| <u>IR</u> On navy threads on seat in studio | <i>Match</i> | <i>No Match</i> | <i>Match</i> | <i>Match</i> | <i>No Match</i> |
| <u>Refractive Index</u> <i>Of broken glass at scene</i> | <i>No Match</i> | <i>Match</i> | <i>Match</i> | <i>Match</i> | <i>No Match</i> |
| <u>DNA Profile</u> | <i>Father's blood</i> | <i>Own blood</i> | <i>Own Blood</i> | <i>Father's blood</i> | <i>None</i> |



Token

-exchange for 1
test result

Exchange 5 tokens
for 1 complete set of
results (5 suspects
plus murder
victim/sample at
scene



Token

-exchange for 1
test result

Exchange 5 tokens
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test result

Exchange 5 tokens
for 1 complete set of
results (5 suspects
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victim/sample at
scene

Evidence from DNA Profiles

DNA Profiling Results
James Murphy (deceased)

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DNA Profiling Results
Suspect 1

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DNA Profiling Results
Suspect 2

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=====

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DNA Profiling Results
Suspect 3

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=====

=====

DNA Profiling Results
Suspect 4

=====

=====

=====

DNA Profiling Results
Suspect 5

NONE

Evidence from Refractive Index of glass fragments from shoes of suspects

Refractive Index Results
At Crime Scene

Broken Wine Glass

Refractive Index Results
Suspect 1

Does not match glass at crime scene

Refractive Index Results
Suspect 2

Matches glass at crime scene

Refractive Index Results
Suspect 3

Does not match glass at crime scene

Refractive Index Results
Suspect 4

Matches glass at crime scene

Refractive Index Results
Suspect 5

Does not match glass at crime scene

Evidence from IR

