Researchers in Schools

Solving Crimes or Treating Disease:
How Analytical Chemistry Changes the World
Key Stage 4 Programme

Pupil Name	
Coursebook Designed by	Dr McCabe

Contents

Uni Pathways launch event **3**
Introduction to Uni Pathways 3
Pupils' experience of Uni Pathways 4
Virtual campus tours 4
Meet university students! 5
Reflection 5
Timetable and Assignment Submission **7**
Timetable – Tutorials 7
Timetable – Homework Assignments 7
Assignment Submission – Lateness and Plagiarism 7
Course Rationale **8**
Uni Pathways Mark Scheme **9**
Baseline Assignment: Pupil Feedback Report **10**
Final Assignment: Pupil Feedback Report **11**
Subject Vocabulary **12**
Tutorial 1 – Importance of Analytical Chemistry **13**
What is the Purpose of Tutorial 1? 13
Activity 1 – What and Why? 14
Activity 2 – Analytical Chemistry in School 15
Activity 3 – Analytical Chemistry in Our World 16
Tutorial Glossary 18
Notes 18
Homework – Baseline Assignment 19
Tutorial 2 – Analytical Techniques **22**
What is the Purpose of Tutorial 2? 22
Activity 1 – It's All About the Technique 23
Activity 2 – What are they used for? 24
Activity 3 – Technique Specificity 25
Activity 4 – Advantages/Limitations 25
Tutorial Glossary 26
Notes 26
Homework – Categorising Analytical Techniques 27
Tutorial 3 – In the Laboratory **28**
What is the Purpose of Tutorial 3? 28
Activity 1 – Good Laboratory Practice 29
Activity 2 – Health and Safety in the Lab 30
Activity 3 – What do I do? 31
Tutorial Glossary 32
Notes 32
Homework – Rules for Your Laboratory 33
Tutorial 4 – Results and Data **34**

What is the Purpose of Tutorial 4? 34
Activity 1 – Repeat or Reproduce? 35
Activity 2 – Data, Data, Data 37
Activity 3 – Using Statistics 38
Activity 4 – Graphical Data 39
Tutorial Glossary 40
Notes 40
Homework – Other Graph Types 41
Tutorial 5 – Displaying Results 42
What is the Purpose of Tutorial 5? 42
Activity 1 – Show, Write, Tell 43
Activity 2 – Style vs. Substance 45
Tutorial Glossary 46
Notes 46
Homework – Final Assignment 47
Tutorial 6 – Feedback tutorial 48
What is the Purpose of Tutorial 6? 48
Final assignment feedback from your Uni Pathways Teacher 48
Tutorial 7 – Final tutorial 50
Appendix 1 – Referencing correctly 52
How do I reference? 53
Appendix 2 – Forensic Science Article 54
Appendix 3 – Airport Security Article 55
Appendix 4 – Food Science Article 56
Appendix 5 – Medicine Article 58
Appendix 6 – Chemical Presumptive Tests for Drugs 59
Notes 61

Uni Pathways launch event

Welcome to Uni Pathways! We are delighted to be able to launch the Uni Pathways programme with you. We hope that you are ready to embark on your Uni Pathways journey and that you enjoy the video.
You will be asked to pause the video at times to complete some work in this workbook, so make sure you have a pen / pencil to hand when you start the video.

By the end of the video, you will have

- Learnt about what studying at university means
- Learnt about some of the skills that you will develop during Uni Pathways
- Heard from pupils who have participated in Uni Pathways or The Scholars Programme (which is the same programme!)
- Heard from current university students talking about what life is like at university

If you are in school your teacher will play the video. If you are at home and logged in to a session with your teacher, your teacher will play the video and show it to you. If you are participating independently your teacher will email you the link to the video or the video file. There are opportunities for you to answer some questions, and you will be told when to pause the video to answer them.

Introduction to Uni Pathways

1. Write down what you think a supra-activity is

_____
_____
_____

2. Independent learning is

_____
_____
_____

3. Write down in your own words what resilience means, and come up with a different example to the one mentioned in the PowerPoint.

_____
_____
_____
_____

4. Why do you think analysis and evaluation skills are useful in your academic career?

_____
_____
_____
_____
_____

5. Why do you think analysis and evaluation skills are useful in life in general?

_____
_____
_____
_____
_____

6. What are the different types of learning that university students do?

Pupils' experience of Uni Pathways

You will now watch some pupils talk about their experience of learning a PhD topic and producing a final assignment. Some may refer to The Scholars Programme rather than Uni Pathways. As you heard in the introduction PowerPoint, The Scholars Programme is a very similar programme to Uni Pathways. Listen carefully and then respond to the questions below. Be prepared to share some of your responses with your peers.

1. How did the pupils describe talking about writing a long essay for their final assignment?

2. Write down something that one of the pupils mentioned was particularly interesting in their course.

3. What were some challenges that the pupils met?

Virtual campus tours

You will now go on a virtual tour of some universities! Once you have seen some of the university campuses, respond to the questions below.
Note down something that you liked out of any of the campus tours you saw. It may be a particular building, space, city etc.

1. Were there any similarities between the different university campuses? If so, what are the similarities?

2. If you had to pick one of those universities to go and visit in person, which one would it be and why?

3. Note down some of the societies that you could join at different universities

Meet university students!

You are about to virtually meet or hear from some current university students.
If you are virtually meeting them, think about what questions you would like to ask the students, share your questions with a partner and note those questions down in the space below.

If you are not meeting them but watching some videos that they have made, use the space below to note down what else you would like to find out about university. You can then ask your teacher during Uni Pathways tutorials!

Reflection

Congratulations on completing the launch of the Uni Pathways programme. Before you go, take some time to reflect on what you have learnt by answering the following questions:

1. Are there any aspects of university style learning that you would look forward to? If so, what are they?

2. What challenges do you think students face when learning at university? How would you try to overcome these challenges?

3. What skills do you hope to develop during your Uni Pathways course?

4. What part of Uni Pathways seems the most challenging for you?

5. What are you most looking forward to about Uni Pathways?

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline Assignment	
Tutorial 2	Categorising Analytical Techniques	
Tutorial 3	Rules for Your Laboratory	
Tutorial 4	Other Graph Types	
Tutorial 5	Final Assignment	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on 9th August	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Course Rationale

Analytical chemistry is a major tool in science and a fundamental part of answering questions in a variety of fields. From forensic science, where it can be used to check for blood at a crime scene or illegal substances in luggage at airport security, to medicine, where it can be used to visualise cells or inform research into the delivery of drugs to fight disease, the uses of analytical chemistry and analytical techniques are vast and wide-reaching.

This course will give you an understanding of analytical chemistry as a technique and why it is such a fundamental part of experimental chemistry. It will delve into many of the considerations that need to be taken into account when setting up analytical experiments, including:

- The rationale for setting up experiments – what questions do you want answered?
- The various analytical techniques available – are they suitable for the questions you want answered?
- The use of a laboratory – how do I carry out my analysis?
- The results generated - what are you expecting to achieve?

We will also look at ways to overcome the challenges and shortcomings of various analytical techniques, the different ways data can be presented and reported, and the need for accountability, reproducibility and reliability in results.

Uni Pathways Mark Scheme

	Subject Knowledge	Critical Thinking	Written Communication
1st	The work shows a depth of knowledge and understanding of key concepts and scientific methods, through engaging with relevant sources. Knowledge is used to build and support highly effective scientific arguments and explanations.	Analyses key scientific evidence, arguments, and reasoning. Interprets meaning and makes connections. Identifies and critically evaluates key scientific arguments and evidence, deciding on their credibility, strength, and relative significance, drawing convincing conclusions.	The work has a coherent flow and is well structured. The writing style is appropriate; scientific language and key scientific terms are used accurately and effectively to support the arguments and explanations made. There are no, or very few, errors in spelling or grammar. Consistent referencing, appropriate paragraphing and use of correctly labelled tables and graphs matching the style taught in the course.
2:1	The work shows an understanding of key concepts and scientific methods, drawing on relevant sources. Knowledge is used to build and support effective scientific arguments and explanations.	Analyses relevant scientific evidence, arguments, and reasoning. Identifies and critically evaluates relevant scientific arguments and evidence, deciding on their credibility and strength, drawing reasonable conclusions. Shows some understanding of the relative value of evidence and arguments.	The work is well-structured. The writing style is appropriate; scientific language and key terms are used correctly. There are few errors in spelling or grammar. Mostly consistent referencing and use of tables and figures; matching the style taught in the course.
2:2	The work shows an understanding of key concepts and scientific methods, with no major misconceptions. Beginning to apply this knowledge to build and support effective scientific arguments and explanations.	Identifies and uses basic scientific evidence, arguments, and reasoning. Showing some understanding of the quality of scientific arguments and evidence. Not yet showing understanding of the relative value of evidence and arguments.	The work has some structure. The writing style can sometimes be informal; occasionally scientific language and key terms are not used when it would be appropriate to do so. There are some errors in grammar and spelling do not get in the way of communicating the content. Referencing has some consistency; matching the style taught in the course Limited use of tables and graphs.
3rd	Shows a developing understanding of key concepts and scientific methods, with some misconceptions. Does not yet apply this knowledge to build and support scientific arguments and explanations.	Beginning to analyse scientific evidence, arguments, and reasoning. Describes evidence and arguments, while not yet evaluating them.	The grammar, spelling, style, and structure of the work need improving in order to communicate ideas to the reader. Scientific language, key terms and references are not always used correctly. Limited, or no use of tables and graphs.

Baseline Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Final Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark
Problem Set	
Comment	*mark*

Subject Vocabulary

Word	Definition	In a sentence
Analysis	The process of examining something in detail to learn more about it	
Concentration	The amount of a particular substance in a volume	E.g. The high concentration of salt in sea water is what makes you thirsty if you drink it
Solubility	The degree to which a substance can be dissolved in a liquid	E.g. Sugar has a high solubility in water which makes it suitable for adding to tea and coffee
Spectroscopy	A scientific method of examining and measuring matter that interacts with or emits electromagnetic radiation	
Chromatography	A scientific method of separating the chemicals in a substance by making it pass through a material such as paper	
Microscopy	A scientific method of examining something using microscopes	
Qualitative	Relates to the identity of a substance	
Quantitative	Relates to the amount of a substance present	
Contamination	Containing unwanted substances	
Repeatable	Carrying out the same experiment with the same conditions will produce the same results	
Reproducible	An experiment can be carried out by another researcher following the same procedure and conditions and the same results will be produced as the original researcher	
Statistics	Measurements performed on numerical data	

Tutorial 1 – Importance of Analytical Chemistry

PROBLEM → → **ANALYSIS** → → **SOLUTION**

What is the Purpose of Tutorial 1?

This tutorial will focus on introducing Analytical Chemistry as a scientific discipline and understanding its importance in a variety of areas.

We will cover what chemical analysis means, examples of its use both within school and the broader world, and what to consider before setting up an analytical chemistry experiment.

By the end of this tutorial, you should be able to:

- Define what chemical analysis is
- List different examples of analytical chemistry experiments
- Recognise the importance of analytical chemistry in today's world

Activity 1 – What and Why?

Analytical chemistry is an important part of science and scientific investigations. Analysis can be described as the process of examining something in detail to learn more about it. When applying that to chemistry, chemical analysis involves examining chemical compounds to determine what they consist of. Analytical chemistry or chemical analysis is defined in the following ways:

"Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter." – **American Chemical Society**

"The resolution of a chemical compound into its *proximate* or *ultimate* elements; the determination of the elements of which it is composed" – **Oxford English Dictionary**

Chemical analysis is the "determination of the physical properties or chemical composition of samples of matter." – **Encyclopaedia Britannica**

"Analytical chemistry studies and uses instruments and methods used to separate, identify, and quantify matter." - **Wikipedia**

After having read these definitions, what does chemical analysis mean to you? Try describing it in your own words below.

Why do you think it is an important part of science? Write your ideas below and be prepared to share with the group.

Activity 2 – Analytical Chemistry in School

Think about any practical experiments you've carried out so far in school, or the experiments that your science teachers may have demonstrated to you. Fill in the table with the experiment name or description and decide whether it's an example of analytical chemistry. Share your answers with the group.

Experiment Detail	Analytical Chemistry?	Why/Why Not?

Activity 3 – Analytical Chemistry in Our World

In pairs, discuss why analytical chemistry might be used in each of the 4 areas shown in the pictures. Use the information in Appendices 2 – 5 to help with your discussion. Write your ideas in the space below.

Are there any other areas you can think of that analytical chemistry might be useful?

Tutorial Glossary

Write down any new words or words you would like to remember in the space below.

Word	Definition	In a sentence

Notes

Homework – Baseline Assignment

The process of Analytical Chemistry can be described using the following flow chart:

Write an essay (approx. 300 words) explaining each step and its importance. Use the information in Appendix 6 to give examples of each stage. You may also include examples from other sources.

Success Criteria

- Your essay must be logically structured and written in clear sentences
- Give appropriate examples for at least two of the stages
- If using external sources as examples they should be correctly referenced
- Use scientific terms correctly and appropriately
- Use accurate spelling, grammar, and punctuation

Tutorial 2 – Analytical Techniques

What is the Purpose of Tutorial 2?

This tutorial will focus on the different analytical techniques that can be used within the field of Analytical Chemistry.

We will cover a range of examples of analytical techniques, their advantages and disadvantages, in what situations they might be used and the types of results they produce.

By the end of this tutorial, you will be able to:

- List different analytical techniques and their uses
- Understand the difference between destructive and non-destructive techniques
- Understand the difference between qualitative and quantitative results

Activity 1 – It's All About the Technique

The table below lists some analytical techniques, specific examples of each technique and what they are commonly used for. Many of the examples are techniques that would be frequently used at university-level and in analytical chemistry and other science careers.

Analytical Technique	Definition
Chemical Tests	An investigative procedure that identifies or quantifies a chemical compound or group
Spectroscopy	A scientific method of examining and measuring matter that interacts with or emits electromagnetic radiation
Chromatography	A scientific method of separating the chemicals in a substance by making it pass through a material such as paper
Microscopy	A scientific method of examining something using microscopes

Analytical Technique	Examples	Uses
Chemical Tests	Flame test	Detecting presence of metal ions
	Iodine test	Detecting presence of starch in food and plants
	Kastle-Meyer test	Detecting presence of blood
Spectroscopy	Ultraviolet-visible spectroscopy	Identifying metal ions present in solutions
	Nuclear magnetic resonance spectroscopy	Identifying types of carbon-based molecules
Chromatography	Thin layer chromatography	Identifying types of inks used in pens
	High performance liquid chromatography	Identifying quantity of nutrients in blood or urine
Microscopy	Optical microscopy	Looking at small substances, e.g. cells, fibres, in greater detail
	Electron microscopy	Looking at very small particles, e.g. nanoparticles, nanotubes

In pairs, choose one of the analytical techniques above and use the examples to discuss why these techniques are important. Think about the areas of science that these techniques might be used e.g. forensic science, food science, medicine, pharmaceutical manufacturing, research.

Activity 2 – What are they used for?

Explain each technique in your own words using examples to help you remember.

Chemical Tests

Microscopy

Chromatography

Spectroscopy

Activity 3 – Technique Specificity

Match the experiment with the analytical technique used

Testing for illicit substances at airport security	Microscopy
Testing for presence of sodium ions	Chromatography
Testing for different inks within a mixture	Spectroscopy
Comparing markings on bullets	Flame Test
Testing the quantity of analytes in a solution	Chemical Test

Activity 4 – Advantages/Limitations

Explain the difference between a destructive technique and a non-destructive technique.

Explain the difference between a result that is quantitative and a result that is qualitative.

Tutorial Glossary

Write down any new words or words you would like to remember in the space below.

Word	Definition	In a sentence

Notes

Homework – Categorising Analytical Techniques

Using the information in the table in Activity 1, pick at least one example from each of the analytical techniques and sort them into the following columns. Each example should fit into at least two columns but some techniques may fit into multiple columns.

Destructive Technique	Non-Destructive Technique	Qualitative Result	Quantitative Result

Tutorial 3 – In the Laboratory

What is the Purpose of Tutorial 3?

This tutorial will focus on the need to use good laboratory practice when carrying out analytical chemistry experiments in a lab.

We will cover health and safety in the lab, what good laboratory practice means and why it is important, and how we might recognise and overcome problems that occur in the lab during the analysis stage.

By the end of this lesson, you should be able to:

- Understand the need for good laboratory practice
- Recognise health and safety symbols within a laboratory
- Identify problems that might occur in the lab and evaluate strategies for coping with these problems

Activity 1 – Good Laboratory Practice

What do we mean when we talk about good laboratory practice? Write down your explanation below.

Why do you think it is important to have good laboratory practice? What might be the consequences for not following this practice? Share your ideas with the group.

Activity 2 – Health and Safety in the Lab

Match the following warning symbols with their meaning and a chemical example. Some chemicals may apply to more than one hazard symbol.

Oxidising	Sulfuric Acid, H_2SO_4
Corrosive	Nitrogen, N_2
Health hazard	Ammonium Nitrate, NH_4NO_3
Explosive	Chloroform, $CHCl_3$
Environmental hazard	
Hazardous	Ethanol, C_2H_5OH
Flammable	Hydrogen Peroxide, H_2O_2
Compressed gas	Arsenic, As
Toxic	Pesticides, e.g. DDT

Activity 3 – What do I do?

In pairs, discuss why your statement is a problem and what you might do to fix or overcome the problem.

Pair 1 – "I only have a very small quantity of the powder I want to identify."

Pair 2 – "I didn't write down the details of the experiment I carried out."

Pair 3 – "Everyone in the lab uses the same spatula to weigh out different chemicals."

Tutorial Glossary

Write down any new words or words you would like to remember in the space below.

Word	Definition	In a sentence

Notes

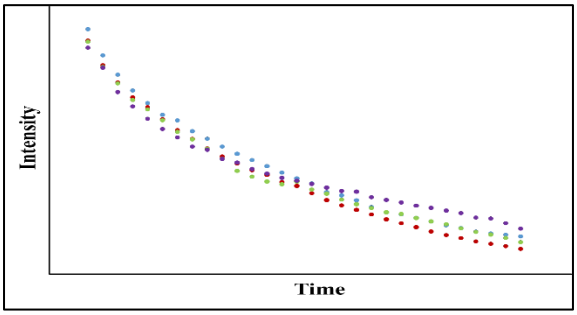
Homework – Rules for Your Laboratory

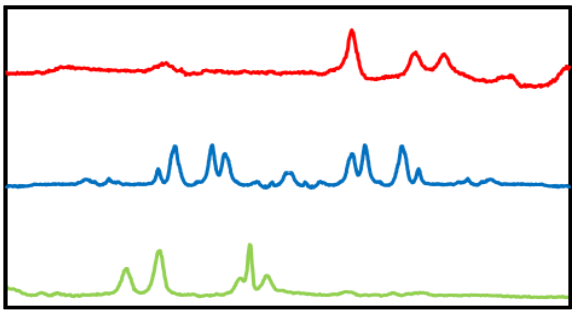
Imagine you are the supervisor of a scientific laboratory. Design an A4 poster showing the rules for your lab. Discuss how you would describe the importance of your rules and good laboratory practice to any new scientist that come to work in the lab.

Success Criteria:

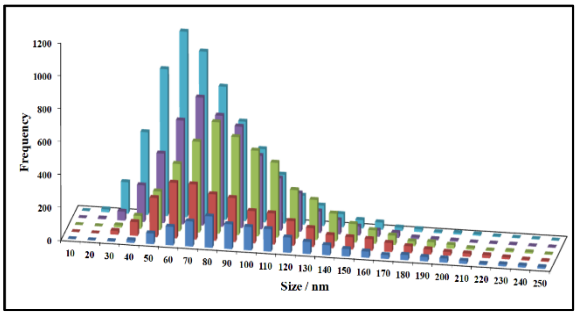
- Your poster should include at least 5 rules
- Rules should cover a range of ideas covered in the tutorial from health and safety to preventing contamination of results
- Your poster should be well presented and your rules should be clear
- Use accurate spelling, punctuation and grammar

Tutorial 4 – Results and Data





	A	B	C	D	E	F	G	H	I	J	K	L	M
1		0.25 M			0.125 M			0.0625 M			0.025 M		
2	Time (s)	1	2	3	1	2	3	1	2	3	1	2	3
3	10	285	169	221	178	163	259	333	173	189	387	219	275
4	12	443	276	345	243	223	417	460	243	265	465	317	358
5	14	461	317	403	281	262	463	459	268	300	485	491	471
6	16	456	323	440	303	289	488	473	309	302	478	518	501
7	18	461	323	446	316	302	502	477	332	311	473	528	520
8	20	478	333	441	323	310	506	484	354	336	502	520	548
9	22	465	338	447	335	322	511	502	370	345	547	516	565
10	24	448	339	461	331	326	534	533	364	366	580	525	573
11	26	450	346	449	346	343	530	530	363	392	585	530	580
12	28	450	347	461	350	333	528	516	370	383	580	540	578
13	30	462	350	461	345	337	524	537	378	380	594	552	568
14	32	461	359	461	357	336	510	563	382	396	596	573	577
15	34	471	354	464	363	343	549	574	381	392	603	581	570
16	36	463	363	458	362	339	546	585	382	394	611	590	569
17	38	465	362	462	376	337	543	587	396	387	630	610	568
18	40	458	368	470	376	346	558	585	405	386	623	611	558
19	42	464	369	475	375	353	560	588	407	392	622	605	565
20	44	454	374	477	367	352	561	597	406	390	622	609	574
21	46	457	385	470	374	359	566	598	409	386	635	608	566



What is the Purpose of Tutorial 4?

This tutorial will focus on the range of results that can be generated from chemical analysis and ways in which this data can be used effectively.

We will cover how to produce reliable results, how to use statistical analysis on data to add weight to your findings and how to represent data in different graphical formats

By the end of this tutorial, you should be able to:

- Understand the difference between repeatability and reproducibility
- Analyse data using statistics
- Understand how to use graphs to present data

Activity 1 – Repeat or Reproduce?

Draw a picture of a house in the space provided below.

Draw the same picture again in the space provided below.

Imagine you are describing how to draw your picture to someone else. Write down a list of instructions for someone wanting to recreate your drawing.

Pass your workbook to another student. Once you have another student's workbook, draw a picture in the space provided below, following the instructions written above.

Activity 2 – Data, Data, Data

What is the importance of using statistics when analysing data?

Below is a list of commonly used terms in statistics. Match each term with its definition.

Mean	**The middle number in a data set when written in ascending order**
Mode	**The average of all numbers in a data set**
Median	**A measure of how spread out the data is**
Range	**The number that occurs most often in a data set**

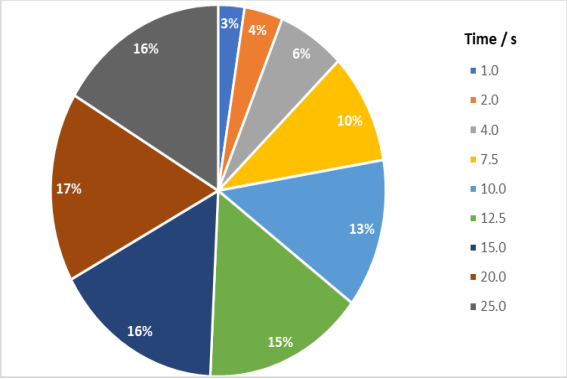
Activity 3 – Using Statistics

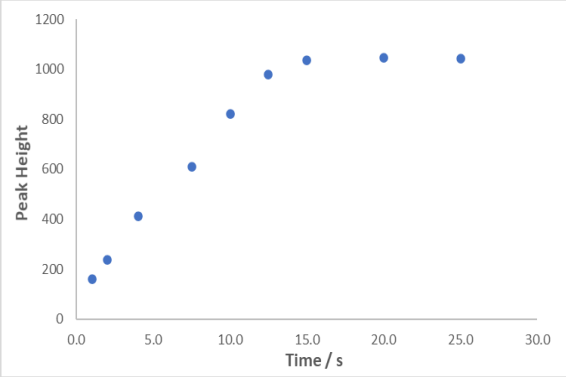
An experiment was carried out using spectroscopy to measure how the height of a particular peak in the results changed over time. The experiment was carried out 3 or 4 times and the results are given in the table below. Fill in the average column to give the average peak height at each time.

Time / s	Results – Peak Height				Average Peak Height
	Run 1	Run 2	Run 3	Run 4	
1.0	193	91	197	-	
2.0	268	209	231	-	
4.0	404	434	392	-	
7.5	578	614	597	653	
10.0	671	834	815	968	
12.5	798	1030	900	1185	
15.0	913	1093	1004	1128	
20.0	868	1067	1051	1194	
25.0	951	1143	974	1099	

Activity 4 – Graphical Data

Numerical data can be represented using graphs but it is important to recognise the type of graph used matches the data set it represents. The average data from the table in the previous activity is represented as both a **Pie Chart** and a **Scatter Graph**.





The scatter graph would be considered the most appropriate way of displaying the data from the table. Explain why this might be.

Tutorial Glossary

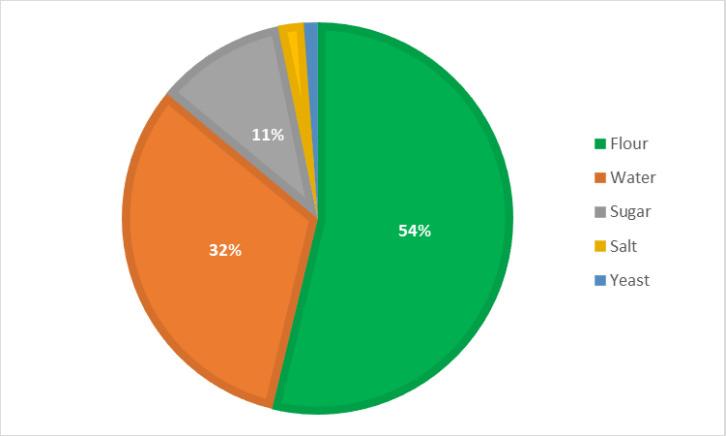
Write down any new words or words you would like to remember in the space below.

Word	Definition	In a sentence

Notes

Homework – Other Graph Types

Appendix 4 discusses the amount of sugar found in Subway bread. The contents of bread could be represented as the pie chart as shown below.



Explain why a pie chart is the most appropriate way of representing this data.

Research what other types of graphs can be used to represent data and what data they might be used with.

Tutorial 5 – Displaying Results

What is the Purpose of Tutorial 5?

This tutorial will focus on how to display and present the results produced from analytical chemistry experiments.

We will cover how to present results using visual, oral, and written communication styles and how to adapt results presentations for various different audiences.

By the end of this tutorial, you should be able to:

- Recognise the different ways that results can be presented
- Construct visual, written, and oral representations of results
- Evaluate the different requirements for presenting results to various target audiences

Activity 1 – Show, Write, Tell

Draw a picture of a laboratory in the space below.

Write a description of a laboratory, explaining why it's used and what you might find in it. You can make reference to your picture.

In pairs, imagine one of you has a background in science and one of you doesn't. Explain what a laboratory is to each other. What differences are there in the way you explain a laboratory to each person.

Activity 2 – Style vs. Substance

In pairs, discuss what might be the similarities and differences between how would you explain your experiment and its results in the following scenarios:

Pair 1 – At an interview for a science job vs. Talking with your family

Similarities	Differences

Pair 2 – In a scientific journal vs. Presenting a poster at a scientific conference

Similarities	Differences

Pair 3 – At a school/university open day for prospective students vs. Giving a talk on your work to your teacher and classmates

Similarities	Differences

Tutorial Glossary

Write down any new words or words you would like to remember in the space below.

Word	Definition	In a sentence

Notes

Homework – Final Assignment

Part One – Essay Question (50 %)

'Designing and setting up an experiment is the most important stage of the analytical chemistry process'

Do you agree with this statement?

Write an essay discussing this statement and your opinion on it, making references to examples discussed throughout this course. Your essay should be approximately 1000 words.

Success criteria:

- Demonstrates an evaluation of the different stages of the analytical chemistry process
- Opinion well-argued and supported by evidence/reasoning
- Research obtained from a variety of sources and correctly referenced
- Scientific terms used correctly and appropriately
- Accurate spelling, grammar, and punctuation

Part Two – Problem Set (50 %)

You will be given a set of data and a brief description of the experiment used to collect the data.

(a) From the data, calculate the mean for each variable

(b) Present the data in a graphical form using your calculated mean from part (a)

(c) Discuss the outcome of the data – what the data shows

(d) Choose two target audiences. Compare and contrast how you would present the data and experiment information to each group

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should you use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Forensic Science Article

Northern Ireland forensics helping Polish probe President's air crash

By Staff Reporter, Belfast Telegraph
November 03 2017 02:30 AM

Forensic experts in Northern Ireland have been drafted in to help the Polish authorities solve a mysterious plane crash seven years ago that killed the country's President Lech Kaczynski.

All 96 people on board the aircraft, including Mr Kaczynski, his wife Maria and other members of a delegation from Warsaw travelling to Russia to commemorate the Katyn massacre, were killed on April 10, 2010.

The Tupolev Tu-154M plane crashed while approaching Smolensk Air Base. At the time pilot error and bad weather had been blamed for the disaster.

But a new inquiry has been launched after a member of the Polish Government said there may have been an explosion.

The BBC has reported that samples arrived at the forensic labs near Carrickfergus, Co Antrim, last month.

The National Prosecution Office in Warsaw said it had signed a contract with Forensic Science Northern Ireland (FSNI) to "perform explosive trace analysis on samples preserved during the ongoing investigation into the crash of TU- 154M No.101 aircraft".

"FSNI's work under this contract is purely scientific and routine" said the National Prosecution Office on its website.

"FSNI will not make any comment on the potential causes of the crash, nor offer an opinion or interpretation of the analysis results in such context."

The leading forensic adviser to the National Prosecution Office in Warsaw, Pavel Rybicki, travelled to Northern Ireland.

"What we would like to establish is if there are explosive residues on the samples taken from Poland by the prosecutors," Mr Rybicki told the BBC.

He added that forensic scientists in Northern Ireland had been chosen to help because of their recognised expertise in explosives analysis.

"We would like to confirm the presence of residues of explosive, or not, and all the results of the analysis will be taken into account in the further stage of the investigation," Mr Rybicki said.

The Department of Justice confirmed that the forensic service has been engaged by the Polish National Prosecution Office to conduct scientific work on their behalf.

Belfast Telegraph (2017) *Northern Ireland forensics helping Polish probe President's air crash*. Available at: https://www.belfasttelegraph.co.uk/news/northern-ireland/northern-ireland-forensics-helping-polish-probe-presidents-air-crash-36284599.html [Accessed 16/10/20)

Appendix 3 – Airport Security Article

Boosting the sensitivity of airport security screening

ACS News Service Weekly PressPac: December 12, 2012

"Adhesion of Standard Explosive Particles to Model Surfaces"
The Journal of Physical Chemistry C

Scientists are reporting a simple way to improve the sensitivity of the test often used to detect traces of explosives on the hands, carry-ons and other possessions of passengers at airport security screening stations. Their report appears in ACS' *The Journal of Physical Chemistry C*.

Yehuda Zeiri and colleagues explain that most tests for traces of explosives begin by rubbing a swab made from glass fiber, Teflon or cotton over the suspect material. Analysis of the swab in a detector — usually a device called an ion mobility spectrometer — alerts agents to any explosive residues on the swab material. Common explosives like TNT are solids with very low vapor pressure at room temperature, so the best way to detect them is to search for particulate traces that rub off on clothing and luggage. To help security agencies prevent attacks more successfully, the researchers studied how explosive particles adhere to surfaces and how they could improve swabs to pick up even smaller amounts of explosives.

Using an atomic force microscope to measure the adhesive forces between explosive particles and different self-assembled monolayers, the scientists concluded that swab fabrics could be improved to collect smaller amounts of explosives by peppering them with hydroxyl, phenyl and amine functional groups. They believe that such additions could enhance the binding between the swab and irregularly shaped explosive particles.

American Chemical Society (2012) *Boosting the sensitivity of airport security screening*. Available at: https://www.acs.org/content/acs/en/pressroom/presspacs/2012/acs-presspac-december-12-2012/boosting-the-sensitivity-of-airport-security-screening.html [Accessed 16/10/20]

Appendix 4 – Food Science Article

Subway bread is not bread, Irish court rules

Sam Jones and Helen Sullivan, The Guardian
Thu 1 Oct 2020 17.33 BST

Judge finds that sugar content of US chain's sandwiches exceeds stipulated limit and they should thus be classified as confectionery

Those wrestling with the great culinary-philosophical dilemmas of our time – are jaffa cakes actually cakes or just up-themselves biscuits, is putting chorizo in paella really an act of gastronomic terrorism, and what kind of monster doesn't love Marmite? – can give thanks to the Irish supreme court. Earlier this week, it brought clarity to an important, if less bitterly contested, debate.

In a judgment published on Tuesday, the court ruled that the bread served at Subway, the US chain that hawks giant sandwiches in 110 countries and territories, could not in fact be defined as bread because of its high sugar content.

The ruling followed an appeal by Bookfinders Ltd, Subway's Irish franchisee. The company had argued that the bread used in Subway sandwiches counted as a staple food and was consequently exempt from VAT.

However, as the court pointed out, Ireland's Value-Added Tax Act of 1972 draws a distinction between staple foods – bread, tea, coffee, cocoa, milk and "preparations or extracts of meat or eggs" – and "more discretionary indulgences" such as ice-cream, chocolate, pastries, crisps, popcorn and roasted nuts.

The clincher was the act's strict provision that the amount of sugar in bread "shall not exceed 2% of the weight of flour included in the dough".

Subway's bread, however, contains five times as much sugar. Or, as the supreme court put it: "In this case, there is no dispute that the bread supplied by Subway in its heated sandwiches has a sugar content of 10% of the weight of the flour included in the dough."

The appeal arose from a claim by Bookfinder Ltd that there were owed a refund from January/February 2004 to November/December 2005, when they paid VAT at a composite rate of 9.2%. They argued that they should instead have been subjected to 0% VAT. But Mr Justice O'Donnell was not persuaded and the appeal was dismissed.

"The argument depends on the acceptance of the prior contention that the Subway heated sandwich contains 'bread' as defined, and therefore can be said to be food for the purposes of the second schedule rather than confectionery," he ruled. "Since that argument has been rejected, this subsidiary argument must fail."

In a statement sent to the Guardian a spokesperson for Subway said: "Subway's bread is, of course, bread."

The ruling is not the first slice of controversy for the brand. In 2014, Subway decided to start removing the flour whitening agent azodicarbonamide from its baked goods after a petition circulated online. The ingredient is commonly used in the manufacture of yoga mats and carpet underlay and has been banned by the European Union and Australia from use in food products.

The classification of certain food has long exercised the minds of retailers, lawyers and philosophers. In 1991, a VAT tribunal famously turned its attention to the vexed question of jaffa cakes, the sweet snacks that hover on what it termed "the borderline between cakes and biscuits".

After noting, among other things, that the name was "a minor consideration", the tribunal eventually accepted United Biscuits arguments' and ruled that jaffa cakes had "enough characteristics of cakes to be accepted as such", and they were therefore zero-rated.

The Guardian (2020) *Subway bread is not bread, Irish court rules.* Available at: https://www.theguardian.com/world/2020/oct/01/irish-court-rules-subway-bread-is-not-bread [Accessed 16/10/20]

Appendix 5 – Medicine Article

Scientists discover novel anticancer substances searching for COVID-19 medicine

TASS, Coronavirus Pandemic, 22 Sep, 09:46

The substances discovered can potentially be used against neuroblastoma

Members of the Faculty of Chemistry and Pharmacy of the North Caucasus Federal University (NCFU) together with their US colleagues while searching for an active compound to fight the coronavirus (COVID-19) infection have discovered substances which can potentially be used against neuroblastoma. The results of their research were published in the Organic & Biomolecular Chemistry journal.

"The researchers described the synthesis of a substance which will help humankind to fight neuroblastoma, one of the most dangerous types of cancer. Initially the chemists were trying to obtain the compounds to fight COVID-19, however, the anticancer activity of these substances turned out to be much higher," the NCFU press service told TASS on Tuesday.

The research was conducted under the leadership of the NCFU professors in organic and analytical chemistry Nikolai Aksenov and Alexander Aksenov jointly with the Texas State University. The method used in this research is called the Aksenov reaction and was discovered in 2010.

"(The reaction) is based on introducing an amine group to an aromatic substance and is very promising," professor Alexander Aksenov was quoted as saying. This development, as the scientists note, has a great significance for the obtainment of such compounds from accessible raw materials. This will allow decreasing the cost of therapy for cancer patients.

TASS (2020) *Scientists discover novel anticancer substances searching for COVID-19 medicine*. Available at: https://tass.com/science/1203457 [Accessed 18/10/20]

Appendix 6 – Chemical Presumptive Tests for Drugs

Adapted from 2013 University of Strathclyde MSc Forensic Science Course Manuals

Introduction

There are many chemical tests used within analytical chemistry but for analysing bulk chemical samples to test for illicit substances within the area of Forensic Science, a particular test called 'chemical presumptive tests' are most often used. Presumptive tests are early stage tests which will give an indication of whether an illicit substance is present in a sample, and are usually followed by more in-depth techniques to confirm the analysis. Chemical presumptive tests will show a simple colour change when a drug or explosive is present and this colour change is known as a 'presumptive positive' result.

In a recent analysis of a crime scene, four small packets, each containing a quantity of unidentified powder, were recovered. The objective of the forensic scientist was to assess the powder, determine if the packets contained illicit substances and if so, give a presumptive indication of the type of drug that had been recovered.

Experimental

The experiment to test for the presence of illicit substances involved the use of three reagents regularly used in testing for illicit substances and four 12-well spotting tiles. Spotting tiles are commonly used pieces of equipment in colour change indicator tests. They contain indents known as wells which are used to hold or mix small volumes of chemicals and these wells are arranged in four rows of three wells each.

In spotting tile 1, a small quantity of the first unidentified powder was added to three wells in the first row. The second row was left blank and then a small quantity of known illicit substances were added to the third row as positive controls. The same set-up was used for the three other unidentified powders on spotting tiles 2, 3 and 4.

To the first well of each unidentified powder, 3 drops of Reagent A were added. Reagent A was also added to the positive control well and to a blank well in the fourth row of each spotting tile which acted as a negative control. Any colour change that was observed was recorded.

To the second well of each unidentified powder, 3 drops of Reagent B were added, as well as to the positive and negative controls, and any observed colour change was recorded.

To the third well of each unidentified powder, 3 drops of Reagent C were added, along with positive and negative controls, and any colour change observed was again recorded.

Results

Each of the unidentified powder samples were tested following the above method and the results are shown in the table:

Powder	Reagent A	Reagent B	Reagent C
1	No colour change	No colour change	Blue colour observed
2	No colour change	Yellow colour observed	No colour change
3	Orange colour observed	No colour change	Blue colour observed
4	No colour change	No colour change	No colour change

The first powder only showed a colour change when a few drops of Reagent C were added which presumptively indicates the presence of heroin.

The second powder showed a colour change when Reagent B was used and the colour change to grey/purple indicates a presumptive positive for ecstasy.

The third powder produced a blue colour when a few drops of Reagent C were added which could indicate a presumptive positive for heroin, as with Powder 1, but there was also an orange colour observed when a few drops of Reagent A were added to the sample which indicates a presumptive positive result for cocaine.

The fourth powder did not appear to react with any of the reagents, as no colour change was observed. All positive and negative controls carried out were suitable, so this indicates that Powder 4 is unlikely to be an illicit substance.

Conclusion

The four recovered unidentified powders were each tested with three different reagents, which were chosen because between them they can provide presumptive positives for a range of different illicit substances.

Powder 1 was presumptively identified as Heroin; Powder 2 was presumptively identified as Ecstasy; and Powder 3 was presumptively identified as Cocaine. There was no reaction with any of the reagents with Powder 4 indicating that Powder 4 is unlikely to be an illicit substance.

It is recommended that Powders 1, 2 and 3 be submitted for further appropriate confirmatory analysis based on the findings given here.

Notes

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