Researchers in Schools

From pain relievers to antibiotics: how has organic synthesis changed the world?

Key Stage 4 Programme

Pupil Name

Coursebook Designed by Dr Mary Okoh

Contents

Timetable and Assignment Submission 4
Timetable – Tutorials 4
Timetable – Homework Assignments 4
Assignment Submission – Lateness and Plagiarism 4
Course Rationale 5
Uni Pathways Mark Scheme 2020 – science-based assignments 6
Baseline Assignment (essay based): Pupil Feedback Report 8
Final Assignment (problem-set): Pupil Feedback Report 9
Subject Vocabulary 11
Launch Event 12
Tutorial 1 – Organic Synthesis and its importance 13
What is the Purpose of Tutorial 1? 13
Activity 1 – Importance of organic synthesis 15
Activity 2 – Write-Pair-share 16
Homework 1 – Baseline Assignment 17
Tutorial 2 – Representing organic synthesis using Reaction schemes 18
What is the Purpose of Tutorial 2? 18
Activity 1 – What a reaction scheme is 20
Activity 2 – Components of a reaction scheme 21
Activity 3 - Components of a reaction scheme 22
Homework 2 – Natural products and writing reaction schemes 23
Tutorial 3 – Designing an organic synthesis 24
What is the Purpose of Tutorial 3? 24
Activity 1 – Designing an organic synthesis 26
Activity 2 – Retrosynthesis 27
Homework 3 – Retrosynthesis 28
Tutorial 4 – Green chemistry in organic synthesis 29
What is the Purpose of Tutorial 4? 29
Activity 1 – Green chemistry in organic synthesis 31
Activity 2 – Atom economy calculations. You have 10 minutes. 32
Activity 3 – Hazards (Think-Pair-Share) 34
Homework 4 – Atom economy 35
Tutorial 5 – Chemophobia 36
What is the Purpose of Tutorial 5? 36
Activity 1 – Bursting chemical myths 38
Activity 2 – Whole class discussion (15 minutes) 39
Homework 5 – Final Assignment 40
Tutorial 6 – Feedback tutorial 42
What is the Purpose of Tutorial 6? 42
Final assignment feedback from your Uni Pathways Teacher 42
Tutorial 7 – Final tutorial 44
Appendix 1 – Referencing correctly 46

How do I reference? 47
Notes 48

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	Impact of Organic synthesis	
Tutorial 2	Natural products and writing reaction schemes	
Tutorial 3	Retrosynthesis	
Tutorial 4	Atom economy	
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

Organic synthesis is an important field in science that deals with synthesising (making) new organic compounds or already existing organic compounds. Many of these compounds are either known to have useful biological activities or are suspected (based on their chemical structure) of having useful biological activities. Some biological activities include antibacterial, anticancer, anti-inflammatory, and anti-oxidising properties, making compounds possessing these activities useful as antibiotics, pain relievers, anti-aging cosmetics and chemotherapy medicines.

This course will give you an overview of organic synthesis and its impact and how synthetic chemists design reactions towards useful organic compounds.

In tutorial 1, organic synthesis and its importance would be briefly introduced. Students will begin to understand the difference between natural, non-natural, and synthetic products (organic compounds).

In tutorial 2, we will discuss what reaction schemes are and how to use them in representing organic synthesis reactions.

In tutorial 3, we will discuss some factors to consider when designing the synthesis of an organic compound. We will also briefly consider the concept of retrosynthesis.

In tutorial 4, we will consider green chemistry in organic synthesis and the importance of carrying out chemical risk assessments before making a compound in the laboratory.

In the final tutorial, the concept of chemophobia will be introduced. Students will understand that chemicals are not to be feared but handled with care.

Uni Pathways Mark Scheme 2020 – science-based assignments

	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.	Beginning to analyse scientific evidence, arguments, and reasoning.	The grammar, spelling, style, and structure of the work need improving in order

	Does not yet apply this knowledge to build and support scientific arguments and explanations.	Describes evidence and arguments, while not yet evaluating them.	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 (essay based): Pupil Feedback Report

Name of Pupil	
Name of School	Avonbourne Academies
Name of RIS teacher	Dr Okoh
Title of Assignment	Impact of Organic synthesis

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 (problem-set): Pupil Feedback Report

Name of Pupil	
Name of School	Avonbourne Academies
Name of RIS teacher	Dr Okoh
Title of Assignment	How has organic synthesis changed the world?

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
Synthesise	To make or produce by deliberately mixing specific chemical compounds together.	I mixed chemical A and chemical B to synthesise chemical C.
Synthetic	Made by mixing specific chemical compounds together.	I will extract some natural glucose from the plant, but I will buy some synthetic glucose from the store.
Organic compound	Compounds that contain basically carbon and hydrogen atoms joined together. They could also contain other atoms in them.	Compound A is an organic compound because it contains carbon and hydrogen atoms joined together.
Chemical structure	A structure showing how the various atoms in a chemical compound are joined together.	The chemical structure of compound A shows that it contains carbon and hydrogen atoms joined together.
Chemical reaction	A chemical change that occurs when two or more chemical compounds combine to form a new chemical compound.	A chemical reaction occurred when I mixed chemical A with chemical B.
Target	A chemical compound desired to be synthesised (made) in a chemical reaction.	My target was not synthesised in the chemical reaction; instead, another chemical was made.
Precursor	A chemical compound from which another chemical compound is made.	The precursor to chemical A is chemical B.
Risk assessment	Determination of how dangerous a chemical compound is.	The risk assessment of chemical A shows that it is a respiratory irritant.
Hazardous	Involving or exposing one to danger	You need to take caution while using chemical C because it is very hazardous.
Functional group	Specific atoms bonded in a certain arrangement that give a compound certain physical and chemical properties.	The functional group in compound A makes the compound highly reactive.

Launch Event

The launch event is your opportunity to learn more about this course and Uni Pathways. You will watch some videos, listen to your teacher and have some discussion. Below is some room to make notes for some of the videos you will watch during the event.

Virtual Campus Tours

Notes…

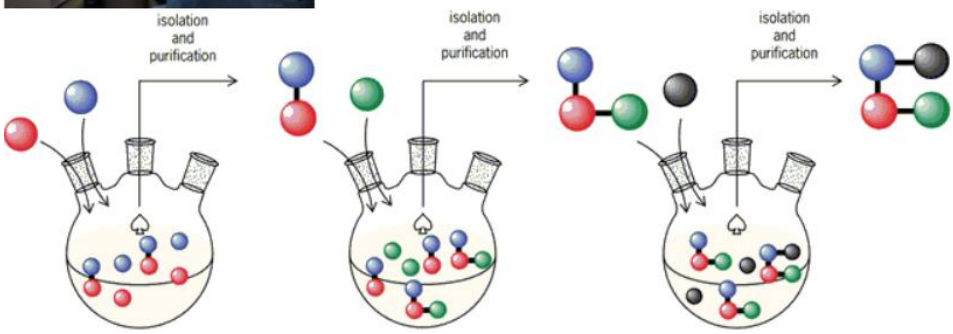
The Scholars Programme Alumni

Notes…

Student Ambassadors

Notes…

Tutorial 1 – Organic Synthesis and its importance



What is the Purpose of Tutorial 1?

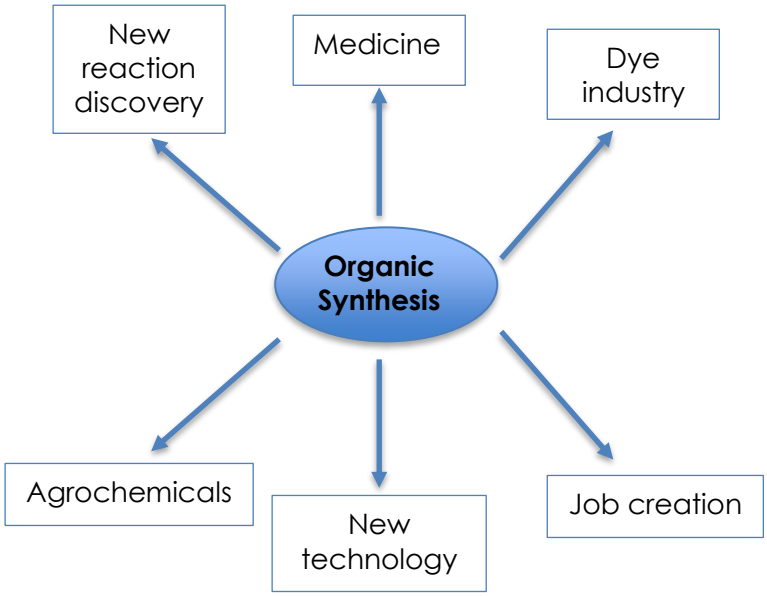
This tutorial will introduce you to organic synthesis and its importance. We will discuss the differences between natural, non-natural, and synthetic products (all organic compounds) and we will consider some useful products that has been made through the field of organic synthesis.

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

- explain the importance of organic synthesis.
- describe the difference between a natural product and a non-natural product.

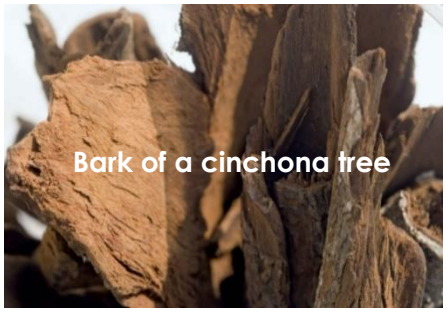
Tutorial 1 Notes

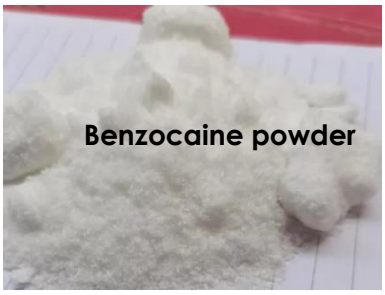
Activity 1 – Importance of organic synthesis



In your own words, write down what you understand about how organic synthesis has benefitted the world. Be prepared to share with the group. You have 3 minutes

Activity 2 – Write-Pair-share





Read the statements below and answer the questions. You have 3 minutes

1) Quinine, used in treating malaria, is found in the bark of the South American cinchona tree. Is Quinine a natural or non-natural product?
   Answer: _____
2) The anticancer drug, paclitaxel is derived from the yew tree. Is paclitaxel a natural or non-natural product?
   Answer: _____
3) Benzocaine is a pain reliever. It is not produced by any living organism and was first synthesised in 1890 by a German Chemist called Eduard Ritsert. Is Benzocaine a natural or non-natural product?
   Answer: _____
4) Morphine is a pain medication, found in the poppy plant. The first man-made synthesis of morphine was in 1952. Other methods of synthesising morphine have also been designed after then. Is Morphine a natural or non-natural product?
   Answer: _____

In pairs, discuss your answers to the questions above and how natural products differ from non-natural products. Write down your ideas below. You have 2 minutes

_____

_____

_____

_____

_____

Homework 1 – Baseline Assignment

Research and write on the impact of organic synthesis including knowledge you have learnt in tutorial 1 today. (400 – 500 words).

Success criteria – how to structure your assignment and what to include

1.) Include a brief introduction to organic synthesis.
2.) Include both positive and negative impacts of organic synthesis.
3.) Include a description with examples, of natural and non-natural compounds.
4.) Include how natural compounds differ from non-natural compounds.
5.) Ensure that all content included is relevant to the topic and to the specific question.
6.) Scientific terms are defined and used accurately throughout.
7.) Ensure all your sources are correctly referenced.
8.) Ensure that you use accurate spelling, grammar, and punctuation.

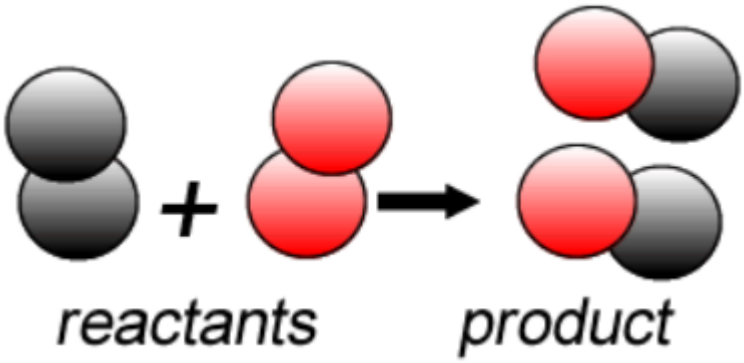
In this assignment, show me that you **understand**:

1.) What natural compounds are.
2.) What non-natural compounds are.

Show me that you **are able to**:

1.) Present ideas in paragraphs and arrange them in a logical structure that is appropriate for the assignment.

Tutorial 2 – Representing organic synthesis using Reaction schemes



What is the Purpose of Tutorial 2?

This tutorial will introduce you to reaction schemes and their importance in organic synthesis. We will discuss the various components of a reaction scheme and how to identify them in a given reaction.

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

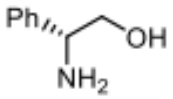
- define what a reaction scheme is.
- describe the various components of a reaction scheme.
- apply the knowledge gained in learning outcome 2 to identify each component in any given reaction.

Tutorial 2 Notes

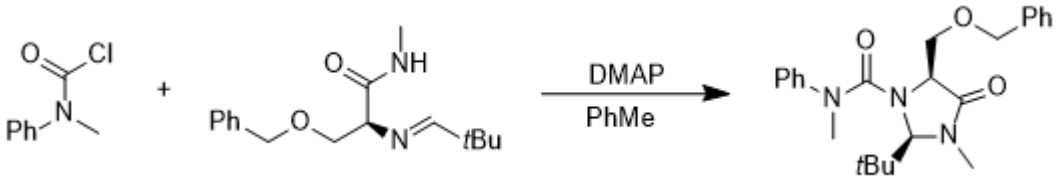
Activity 1 – What a reaction scheme is

Now that you know what a reaction scheme is, circle any option below which is *not* a correct representation of a reaction scheme. You have 3 minutes

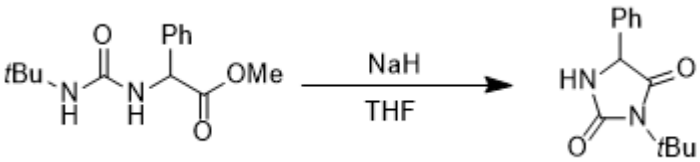
a)



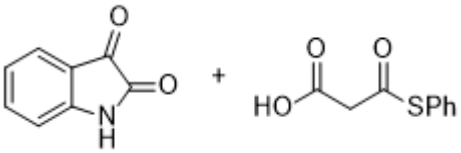
b)



c)



d)



Write down below why the options you circled are not correct representations of a reaction scheme. You have 3 minutes

_____

_____

_____

_____

_____

_____

_____

Activity 2 – Components of a reaction scheme

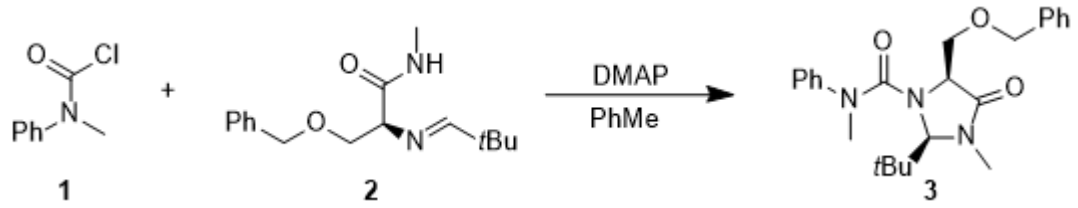
Draw lines to match the components on the left to their definitions. You have 2 minutes.

Reactant	It shows the direction of the reaction.
Product	A substance at the tail of the arrow. It changes into a product when it combines with another substance in a chemical reaction.
Arrows	The substance in which the reactants and reagents are dissolved. It usually does not take part in the reaction.
Reagent	A substance at the head of the arrow. It is formed when a chemical reaction occurs.
Solvent	A substance added to cause a chemical reaction to occur.

Activity 3 - Components of a reaction scheme

Identify the various components in each of these reaction schemes (Watch out for the direction of the arrows!) – You have 8 minutes

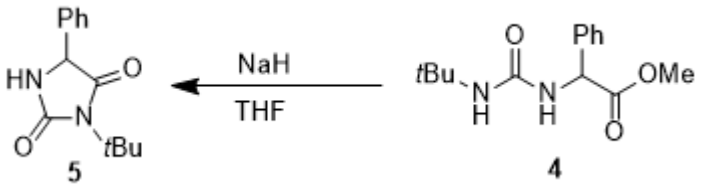
1)



1 is _____ **3** is _____ PhMe is _____

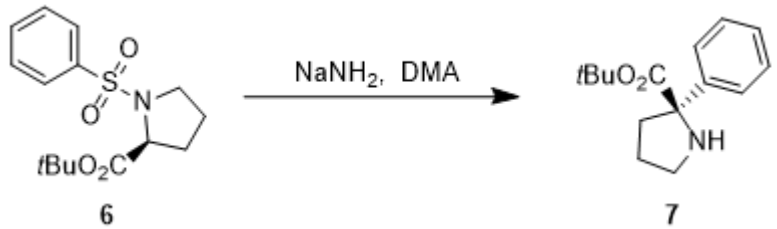
2 is _____ DMAP is _____

2)



4 is _____ NaH is _____ **5** is _____ THF is _____

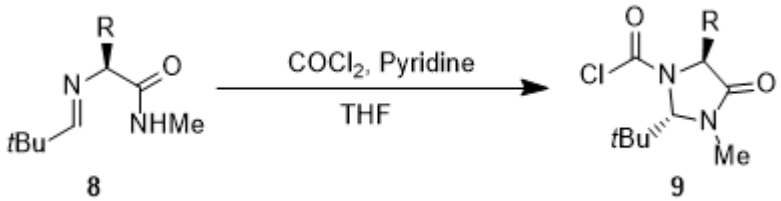
3)



6 is _____ $NaNH_2$ is _____ **7** is _____ DMA is _____

<u>CHALLENGE! (TIP: Compare the structure of the product to the reactant)</u>

4)



8 is _____ $COCl_2$ is _____ Pyridine is _____

THF is _____ **9** is _____

Homework 2 – Natural products and writing reaction schemes

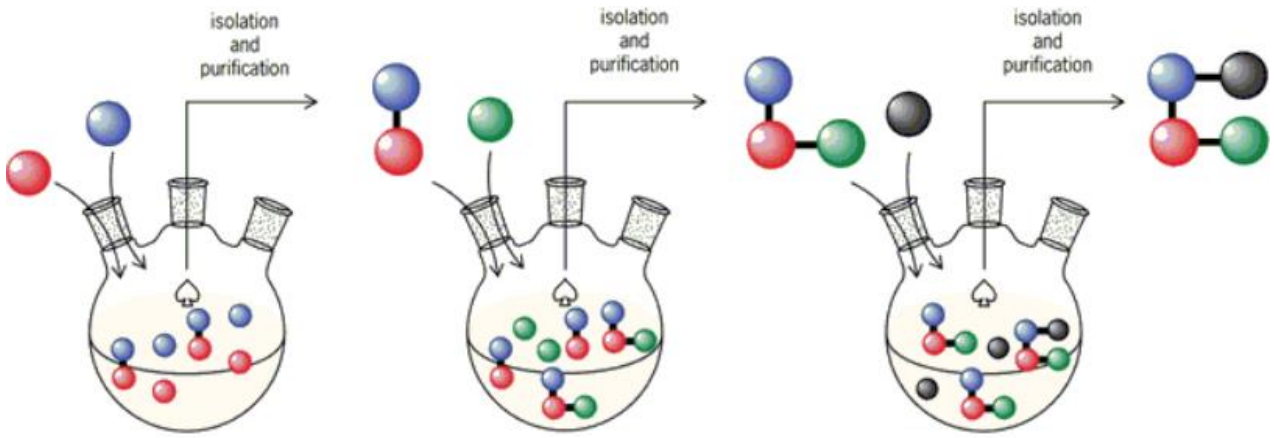
In the first tutorial, we looked at some natural products that have been made by synthetic chemists. Today, we looked at how we can represent organic syntheses using reaction schemes. Your homework is to research any natural product of your choice.

Success criteria – how to structure your assignment and what to include

1.) Include when it was discovered and its biological activity.
2.) Include a labelled reaction scheme showing how it has been synthesised by man. In each step of the reaction scheme, state what the reactants are and what products they are forming.

Note that you don't have to label each reactant and product with their names. You can just label them using numbers or letters as done on the previous page.

Tutorial 3 – Designing an organic synthesis



What is the Purpose of Tutorial 3?

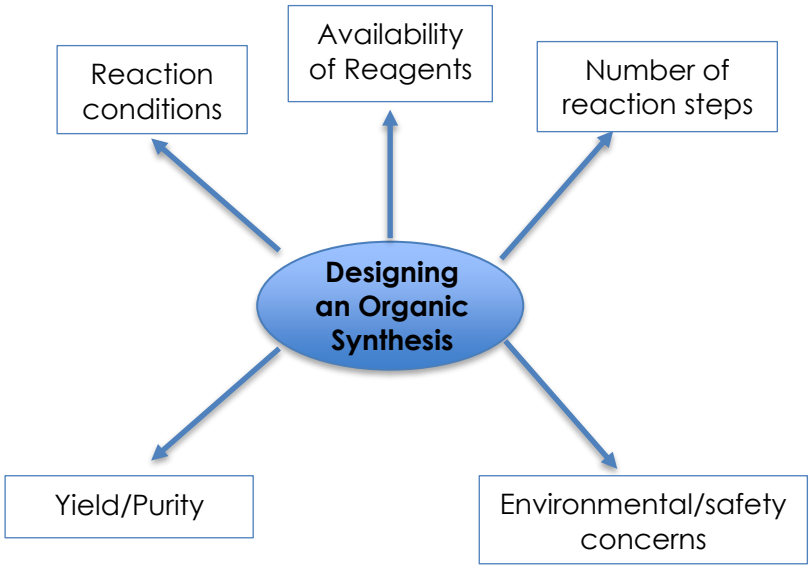
This tutorial will introduce you to the basics of designing an organic synthesis. We will discuss the factors to consider when designing one. You will also be introduced to basic retrosynthesis.

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

- Compare several synthetic routes to a given product for their efficiency.
- Carry out simple retrosynthesis if given the target product and precursor.

Tutorial 3 Notes

Activity 1 – Designing an organic synthesis



Natural product C, isolated from a frog, was shown to have some medicinal properties. A synthetic chemist wants to make C in the laboratory. Bearing in mind the factors to consider when designing an organic synthesis, critique the synthetic routes designed below towards medicine C. Which of the routes do you consider is the most efficient? You have 5 minutes.

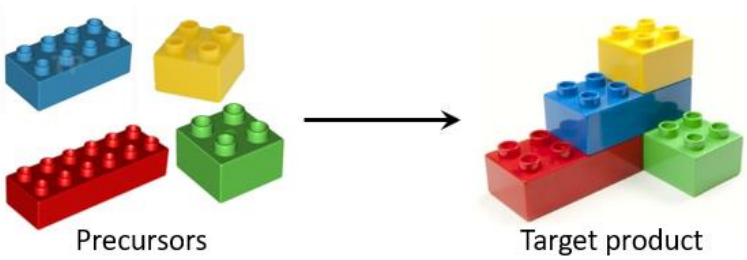
a) Reactant A + Reactant E ⟶ Target Product **C**. Complete in 16 hours

b) Reactant B + Reactant F ⟶ Target Product **C** + Product D. Complete in 14 hours

c) Reactant G + Reactant H ⟶ Product A – Step 1. Complete in 1 hour

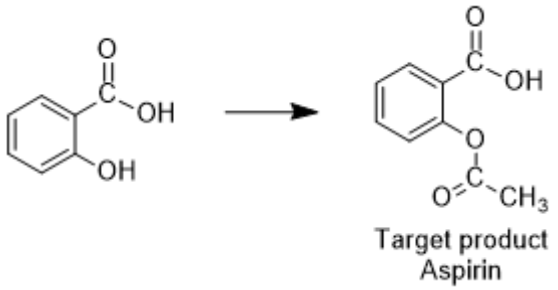
Reactant A + Reactant E ⟶ Target Product **C** – Step 2. Complete in 1 hour

Activity 2 – Retrosynthesis

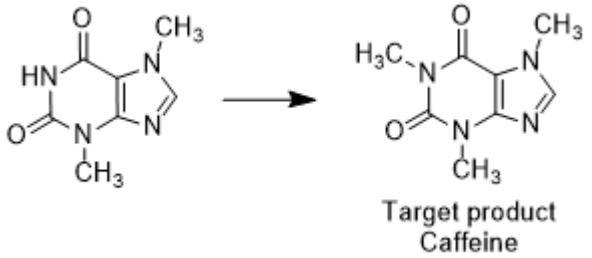


Draw dividing lines across the targets to show what portion of the target comes from its precursor. You have 5 minutes.

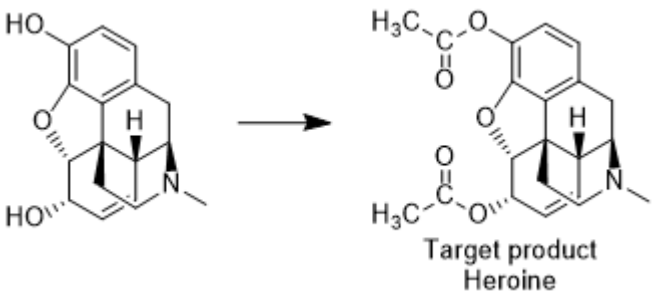
1)



2)

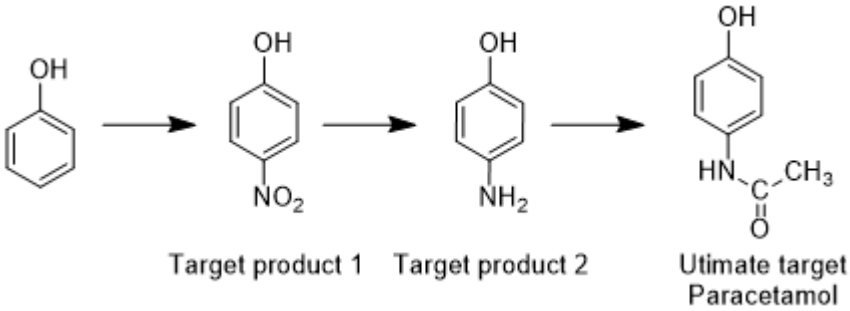


3)



CHALLENGE!

4)



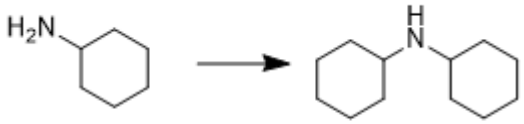
Homework 3 – Retrosynthesis

Draw dividing lines across the targets to show what portion of the target comes from its precursor. Also indicate where there is a functional group interconversion.

1.)

Target product
Nicotine

2.)

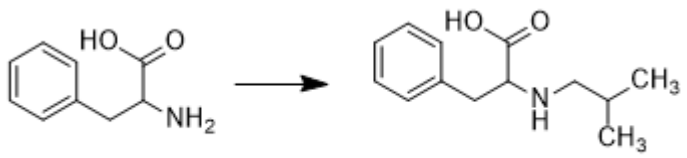


Target product

3.)

Target product

4.)



Target product

Tutorial 4 – Green chemistry in organic synthesis

What is the Purpose of Tutorial 4?

This tutorial will introduce you to the basics of green chemistry in organic synthesis. We will discuss atom economy and how to calculate it. We will also discuss hazards and the importance of risk assessments.

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

- define what green chemistry is.
- calculate the atom economy of a reaction.
- use risk assessments to check the safety of a reaction.

Tutorial 4 Notes

Activity 1 – Green chemistry in organic synthesis

Fill in the gap, using any of the words shown in the box below. You have 5 minutes.

Green chemistry is the design of chemical processes that reduce or _____ the use or generation of _____ substances. Green chemistry in organic synthesis includes but is not limited to carrying out reactions at _____ _____ where possible; using _____ solvents or reagents; _____ the amount of waste generated in chemical _____; reducing the number of _____ _____; reducing the quantity of reagents used and minimising the potential for _____.

hazardous				reactions
eliminate	safe		reaction steps	
		reducing		
accidents				room temperature

Activity 2 – Atom economy calculations. You have 10 minutes.

CALCULATION OF ATOM ECONOMY

$$\text{atom economy} = \frac{\text{mass of atoms in desired products}}{\text{mass of atoms in reactants}} \times 100\%$$

1.) Hydrogen can be manufactured by reacting methane with steam:

	CH_4	+	H_2O	→	$3H_2$	+	CO
	methane		steam		**hydrogen**		carbon monoxide
M_r =	(16.04)		(18.02)		(2.02)		(28.01)

Calculate the atom economy for the manufacture of hydrogen.

_____

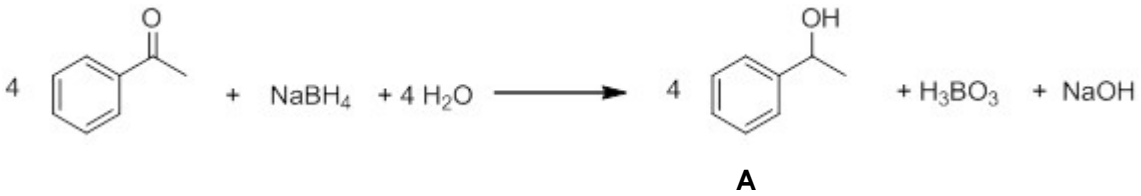
_____

_____

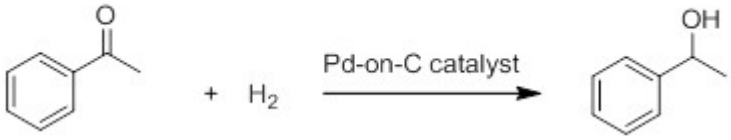
_____

_____

2.) The reactions below are used to synthesise **A**.



M_r = (120.15) (37.83) (18.02) (122.17) (61.83) (40.00)



M_r = (120.15) (2.02) (122.17)

a) Calculate the atom economy for synthesising **A** in each of the reactions

b) Which of the reactions is greener: the first or second?

c) Calculate the atom economy for the synthesis of aspirin in the reaction below:

$$C_6H_4(OH)COOH + (CH_3CO)_2O \rightarrow C_6H_4COOHOCOCH_3 + CH_3COOH$$

Aspirin

M_r = (138.12) (102.09) (180.16) (60.05)

Activity 3 – Hazards (Think-Pair-Share)

You want to design a synthesis. Previous research showed that synthesis such as the type you intend to design have been successfully carried out in all the solvents below.

Solvent	Hazard
Benzene	1.) May cause genetic defects 2.) May cause cancer 3.) Harmful to aquatic life with long lasting effects. 4.) Causes serious eye irritation.
Ethyl lactate	1.) Causes serious eye damage. 2.) May cause respiratory irritation.
Ethanol	1.) Causes serious eye irritation 2.) May cause damage to organs.
Ethyl ethanoate	1.) Causes serious eye irritation 2.) May cause drowsiness or dizziness.

Considering the hazards listed above,

1.) Which solvent would you proceed with?

_____

_____

2.) Pair up and discuss with your partner:

a) Your reason for choosing the solvent.

b) What safety precautions you will take while carrying out the synthesis.

Write down your thoughts below:

_____

_____

_____

_____

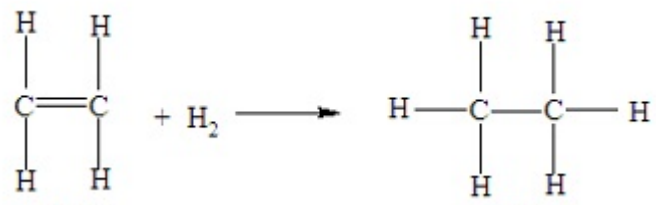
_____

_____

Homework 4 – Atom economy

Calculate the atom economy of the labelled product in the following reactions (**make sure you show your calculations in each case**):

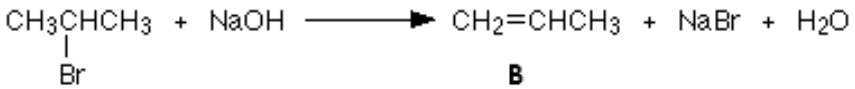
1.)



A

M_r = (28.05) (2.02) (30.07)

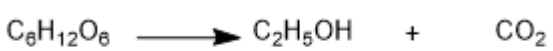
2.)



B

M_r = (122.99) (40.00) (42.08) (102.89) (18.02)

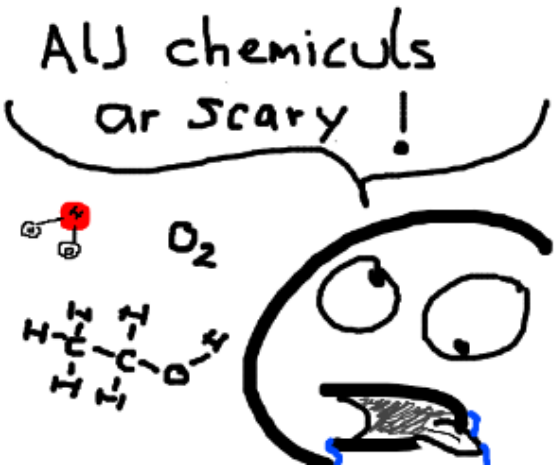
3.)



C

For number 3, calculate the relative formula masses yourself before working out the atom economy of **C**.

Tutorial 5 – Chemophobia



What is the Purpose of Tutorial 5?

By now you understand the importance of designing green organic synthesis. In today's tutorial you will learn that we can't always make a reaction green, but there are steps we can take to handle hazardous chemicals safely and responsibly. You will also learn that the hazards of chemicals are sometimes exaggerated by people with little or no scientific knowledge leading to what we call chemophobia.

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

- know that chemicals are not to be feared but handled with care.
- explain the importance of chemical literacy in preventing chemophobia.

Tutorial 5 Notes

Activity 1 – Bursting chemical myths

INGREDIENTS: WATER (75%), **SUGARS (12%)** (GLUCOSE (48%), FRUCTOSE (40%), SUCROSE (2%), MALTOSE (<1%)), STARCH (5%), **FIBRE (3%)** (E460, E461, E462, E464, E466, E467) **AMINO ACIDS** (GLUTAMIC ACID (19%), ASPARTIC ACID (16%), HISTIDINE (11%), LEUCINE (7%), LYSINE (5%), PHENYLALANINE (4%), ARGININE (4%), VALINE (4%), ALANINE (4%), SERINE (4%), GLYCINE (3%), THREONINE (3%), ISOLEUCINE (3%), PROLINE (3%), TRYPTOPHAN (1%), CYSTINE (1%), TYROSINE (1%), METHIONINE (1%)), **FATTY ACIDS (1%)** (PALMITIC ACID (30%), OMEGA-6 FATTY ACID: LINOLEIC ACID (14%), OMEGA-3 FATTY ACID: LINOLENIC ACID (8%), OLEIC ACID (7%), PALMITOLEIC ACID (3%), STEARIC ACID (2%), LAURIC ACID (1%), MYRISTIC ACID (1%), CAPRIC ACID (<1%)), ASH (<1%), PHYTOSTEROLS, E515, OXALIC ACID, E300, E306 (TOCOPHEROL), PHYLLOQUINONE, THIAMIN, **COLOURS** (YELLOW-ORANGE E101 (RIBOFLAVIN), YELLOW-BROWN E160a), **FLAVOURS** (ETHYL HEXANOATE, ETHYL BUTANOATE, 3-METHYLBUT-1-YL ETHANOATE, PENTYL ACETATE), E1510, NATURAL RIPENING AGENT (ETHENE GAS).

You have 5 minutes to put a tick on any one you agree is a myth.

1) You can lead a chemical-free life.
2) Man-made chemicals are dangerous.
3) Synthetic chemicals cause cancer.
4) You should not eat or drink in a laboratory.
5) Natural chemicals are safer than man-made chemicals.

Activity 2 – Whole class discussion (15 minutes)

After reading and discussing the article below, we will take a vote on whether the said chemical should be banned or not.

Dihydrogen Monoxide – To ban or not to ban??

The Invisible Killer

Dihydrogen monoxide is colourless, odourless, tasteless, and kills uncounted thousands of people every year. Most of these deaths are caused by accidental inhalation of DHMO, but the dangers of dihydrogen monoxide do not end there. Prolonged exposure to its solid form causes severe tissue damage. Symptoms of DHMO ingestion can include excessive sweating and urination, and possibly a bloated feeling, nausea, vomiting and body electrolyte imbalance. For those who have become dependent, DHMO withdrawal means certain death.

Dihydrogen monoxide:

- is also known as hydroxyl acid and is the major component of acid rain.
- contributes to the "greenhouse effect."
- may cause severe burns.
- contributes to the erosion of our natural landscape.
- accelerates corrosion and rusting of many metals.
- has been found in excised tumours of terminal cancer patients.

Contamination Is Reaching Epidemic Proportions!

Quantities of dihydrogen monoxide have been found in almost every stream, lake, and reservoir in the UK today. But the pollution is global, and the contaminant has even been found in Antarctic ice. DHMO has caused millions of dollars of property damage.
Despite the danger, dihydrogen monoxide is often used:

- as an industrial solvent and coolant.
- in nuclear power plants.
- in the production of styrofoam.
- as a fire retardant.
- in many forms of cruel animal research.
- in the distribution of pesticides. Even after washing, produce remains contaminated by this chemical.
- as an additive in certain "junk-foods" and other food products.

Companies dump waste DHMO into rivers and the ocean, and nothing can be done to stop them because this practice is still legal. The impact on wildlife is extreme, and we cannot afford to ignore it any longer!

Reference: https://www.lockhaven.edu/~dsimanek/dhmo.htm

Homework 5 – Final Assignment

A) Write a 1000-word essay on "How has organic synthesis changed the world"?

Success criteria – how to structure your assignment and what to include

1.) Include an introduction to organic synthesis.
2.) Include the impact of organic synthesis on:
    a) The pharmaceutical industry (include examples of natural and synthetically designed (non-natural) drugs).
    b) The dye industry (include examples of dyes).
    c) The environment.
    d) Other areas of impact you have researched on.
3.) Include a definition of green chemistry.
4.) Include your suggestions on how organic synthesis could be made green.
5.) Include details on how to handle hazardous (non-green) chemicals responsibly.
6.) Finally, include a conclusion.
7.) Refer to the mark scheme on **page 6** for other success criteria.

It is essential that you produce a structure for all examples given in (a) and (b) and a reaction scheme for making at least one example in each case. Ensure that all structures and reaction schemes are labelled and referred to in the essay.

In your essay, show me that you **understand**:

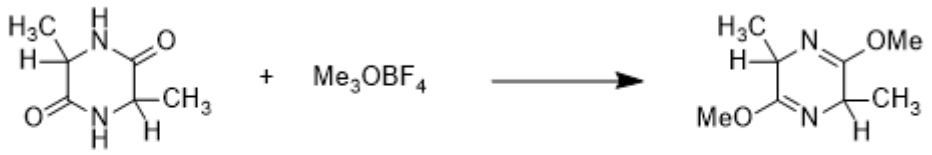
1.) What organic synthesis is.
2.) What natural products are.
3.) What green chemistry entails.

Show me that you **are able to**:

1.) Apply your knowledge of organic synthesis and green chemistry to make your own suggestions on how organic synthesis can be made green.
2.) Do your own research on more areas of impact.

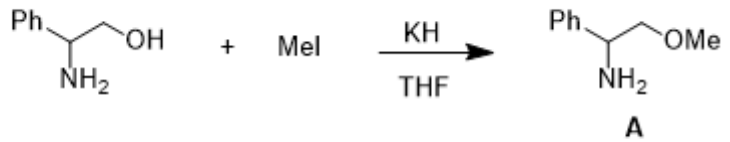
B.) Calculate the atom economy of product **A** in the following reactions (**make sure you show your calculations in each case**):

1.)



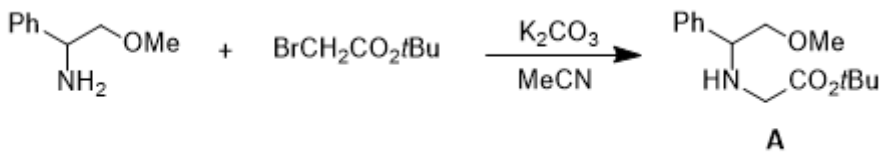
M_r = (142.16) (147.91) (170.21)

2.)



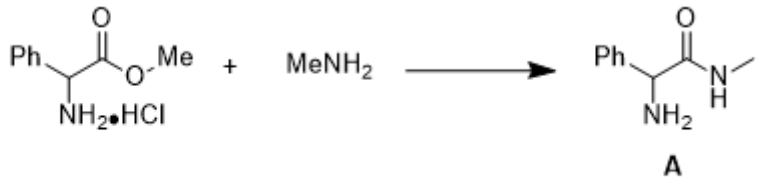
M_r = (137.18) (141.94) (151.12)

3.)



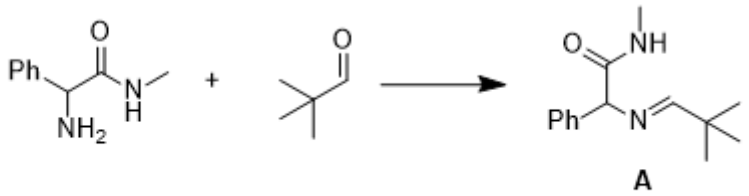
M_r = (151.21) (195.06) (265.35)

4.)



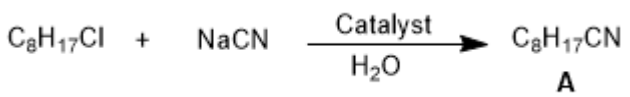
M_r = (201.65) (31.06) (164.21)

5.)



M_r = (164.21) (86.13) (232.33)

6.)



For number 6, calculate the relative formula masses yourself before working out the atom economy of **A**.

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.

Notes

UNI PATHWAYS

UNI PATHWAYS

thebrilliantclub.org