Researchers in Schools

I Pick My Poison and it's Literally Everything

Key Stage 4 Programme

Pupil Name

Coursebook Designed by Dr Chris Addinsell

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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		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

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

Toxicology is a field of research that impacts upon so many diverse topics. Making sure that the chemicals we are exposed to are safe is of the utmost importance. Whether we talk about the food we eat, the medicine we take, the legal and less than legal drugs that people choose to do or the chemicals we spray on our crops; these and many others can harm us if we are exposed to too much of them. By understanding how these chemicals harm us and how much we can safely be exposed to, we are able to explore and experience the changing world around us safely.

Through this brief course, you'll come to understand that everything is poisonous, and nothing is! It's the dose that makes the poison. You'll learn about mechanisms by which chemicals can damage our cells or our DNA. You'll also learn how certain toxic chemicals can cause damage to a specific part of the body. You will learn how we test to see how safe chemicals are and evaluate the ethics of different ways of doing so.

Towards the end of the course, you'll learn how to write scientifically and how to approach problems outside of the curriculum through research. You'll develop skills in assessing the value of a source, whether it is informative, truthful, and trustworthy.

All of the above skills will be brought together by a final assignment that will consist of a set of problems applying the information that you've learnt and a short-written task that will require you to research the topic independently and to write scientifically. This work will be graded as though it were a piece of work at university.

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 and appropriate paragraphing.
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.
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.
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.

Baseline Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	William Hulme's Grammar School
Name of RIS teacher	Dr Addinsell
Title of Assignment	Chemical Spill in the Isle of Man

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	William Hulme's Grammar School
Name of RIS teacher	Dr Addinsell
Title of Assignment	Toxicity – Final 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
in vitro	Used to describe an experiment or process in biology that is done to **cells in a dish**	Adam's *in vitro* experiment involved pouring lemonade on yeast cells
in vivo	Used to describe an experiment or process in biology that is done **to laboratory animals like mice**	Laila's *in vivo* experiment involved observing if mice preferred lemonade to water
in silico	Used to describe an experiment or process in biology that is done **in a computer simulation**	Gloria's *in silico* experiment involved using computer software to predict if any chemicals in lemonade were harmful
Ethics	The guiding principles of whether something is right or wrong to do	David considered the ethics of feeding mice lemonade
Drug	A technical term for a chemical that has an effect on the body. Medicines like paracetamol are drugs, so is the caffeine in coffee.	Samir's doctor gave him a drug to stop him from feeling so sleepy
Toxin	A chemical that can cause harm to a person or another organism like a poison or a venom	The nicotine in cigarettes is a toxin
Toxic	Describing a chemical that can cause harm to a person or another organism	Nicotine is a toxic chemical
Toxicology	The study of toxins	By studying toxicology we can understand how the chemicals around us can cause harm
Neurotoxic	Able to damage your brain	Some snake venom is neurotoxic
Hepatotoxic	Able to damage your liver	Alcohol is hepatoxic

Word	Definition	In a sentence
Nephrotoxic	Able to damage your kidneys	If you take too many painkillers, they can be nephrotoxic
Genotoxic	Able to damage your DNA	The soot that chimney sweeps breathed was found to be genotoxic
Carcinogenic	Able to cause cancer	Genotoxic chemicals are often carcinogenic in the long term.
Exposure	When a chemical can enter your body	By wearing a mask, he avoided exposure to the toxic fumes
Dose	The amount of a substance that you consume or that you are exposed to	They only took the dose of 50 milligrams a day, like the doctor had ordered
Administer	To give a drug (medicine) to someone or to an animal	The doctor administered adrenalin to the patient to help with their shock
References	The sources where the information you are writing come from. Usually written at the end of a piece of scientific writing	In the references, Jamie wrote which article they had found linking lemonade to hyperactivity
Data	The results of a scientific experiment	The data from Adam's experiment were not surprising
Risk mitigation	Reducing the dangers involved in something	Sally's risk mitigation strategy was to wear goggles when opening her lemonade
PPE	Personal protective equipment, like masks, gloves and respirators worn to make the wearer safer	Frank's PPE prevented him from drinking his lemonade, maybe a face mask was a bad idea

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 – An Introduction to Toxicity

What is the Purpose of Tutorial 1?

LO1. Summarise what will be covered in this Uni Pathways course
LO2. Define 'toxic' and understand the importance of toxicology
LO3. Identify toxins from the world around them

Welcome to Uni Pathways

During the following 7 tutorials, we are going to briefly cover a wide range of topics about toxicology, the study of toxins, chemicals that can do us or other organisms harm. Before we start though, it's important that we know about each other and why we're here. Everyone will introduce themselves to the group and say why they love science.
You can write below why you love science if you'd like.

Uni Pathways format

We will have 5 tutorials including this one, covering the various topics of toxicology and then your teacher will ask you to answer some questions and write an essay about toxicology. This is the final assessment. You will give this a go and then get feedback in your 6th tutorial so you can write a final version. In the final tutorial, you will celebrate and share what you've learned as well as receive a mark and some feedback on your work.

- Tutorial 1: An Introduction to Toxicity
- Baseline Assessment – a short piece of homework to assess how you found the first tutorial
- Tutorial 2: The Dose Makes the Poison
- Tutorial 3: Targets and Mechanisms
- Tutorial 4: Assessing Toxicity
- Tutorial 5: Finding Data and Referencing
- Final Assignment – draft
- Tutorial 6: Feedback – We will go through your draft assignments and your teacher will give you feedback to improve your work
- Final Assignment – Implement feedback
- Tutorial 7: Final tutorial

Think, Pair Share

The teacher will have given a mini-lecture, introducing toxins and toxicology. You will form pairs and spend 5 minutes discussing the following:

- What is the point of toxicology?
- Why do scientists study how chemicals harm us?
- How would the world be worse if no one studied toxicology?

Writing two sentences

In the box below, write two sentences about an industry that is helped by toxicology for example: 'The farming industry is helped by toxicologists. They make sure that the chemicals that are sprayed on our crops are safer'.

What's a toxin?

We learnt that toxins are chemicals that can do us or other organisms harm. Can you think of any toxins from our homes or the world around us? The teacher will ask for some of your ideas. Below are some ideas to help you think of toxins if you are struggling.

- Think of a chemical from inside your home that is dangerous
- Think of a chemical that can harm you or the environment outside in nature
- Think of a dangerous chemical that some people choose to consume

Baseline assignment question:

Read the news article below about a chemical spill in the Isle of Man. Why is it so important that they worked to safely contain the spill? What steps would they have to take to make it safe for everyone?

https://www.bbc.co.uk/news/world-europe-isle-of-man-53767862

Details of the assignment:

The essay should be around 500 words

Your essay must be logically structured and written in clear sentences

If using external sources as examples they should be correctly referenced

Use scientific terms correctly and appropriately

Use accurate spelling, grammar, and punctuation

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

What might be the effects of the chemical spill?

What kind of precautions would the people cleaning the spill need to take for their own safety?

What organisms might be harmed?

How far might the damage spread?

How would the spill be contained?

How might scientists investigate the damage the chemical can do by studying the chemical in a laboratory?

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

What toxic means

What the dangers of toxic chemicals are

The role of scientists in evaluating toxicity

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

Think critically

Connect the concept of toxicology to the things you already know

https://www.bbc.co.uk/news/world-europe-isle-of-man-53767862

Chemical spill closes Isle of Man road for nine hours

13 August 2020

Three 1,000-litre crates were damaged

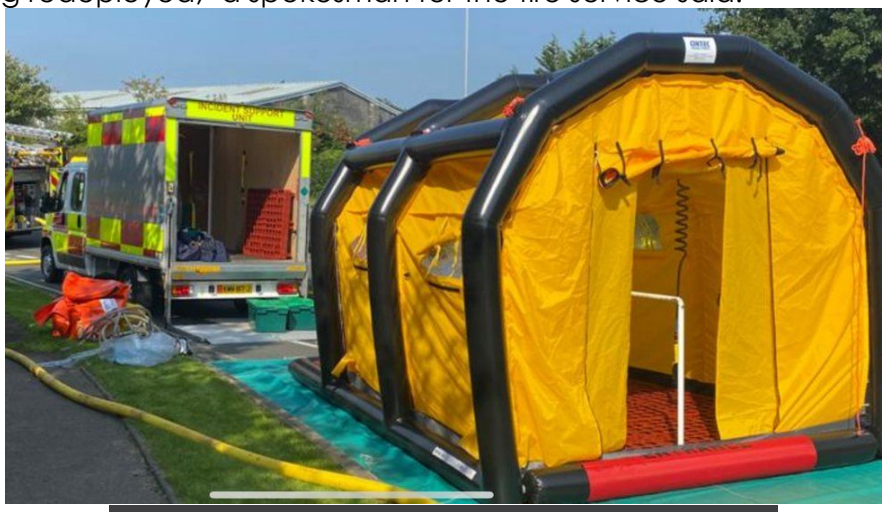
A road on the Isle of Man was closed for more than nine hours after crates containing 3,000 litres of chemicals fell from a heavy goods vehicle.

Three crates, containing potassium borate, hydrogen peroxide and sodium hydroxide (caustic soda), were damaged. The incident happened at about 13:11 BST on Ballafletcher Road in Tromode, the fire service said. Crews worked until 22:30 to decant the chemicals into undamaged containers for safe removal.

A fire service spokesman said the risk of moving the damaged crates was "too great" as they were too damaged and one was leaking. Neighbours were advised to stay inside and close all doors and windows while the chemicals were removed.

Crews from the Isle of Man Fire and Rescue Service wore fire kit, breathing apparatus and gas-tight suits during the operation, which involved using a specialist pump to transfer the liquid between containers.

Due to the sunny conditions "crews had to be rotated regularly and cooled down before being redeployed," a spokesman for the fire service said.



Fire crews were in attendance for several hours

Tutorial 2 – The Dose Makes the Poison

What is the Purpose of Tutorial 2?

LO1. Students will explain why everything is and isn't toxic
LO2. Students will calculate the safe dosage of drugs for giving to patients
LO3. Students will evaluate risk of toxins and suggest ways to mitigate that risk

Last tutorial, we talked about what toxic meant and talked about toxic chemicals from the world around us. Today we're going to consider the idea that *everything* is toxic.
Read the following statements and consider what they might mean for the field of toxicology. Do the statements sound right? Do they surprise you?

- Consuming too much water will poison you
- A spoonful of phosphoric acid could kill you; it is present in Coca Cola and is considered safe

‘Everything is a poison and nothing is, it is the dose that makes the poison’

A Swiss scientist called Paracelsus is considered the father of toxicology and above is his most famous quotation. Consider how this changes our understanding of what it means for something to be toxic. If water is technically toxic and dangerous chemicals are safe to eat and drink, what does it mean when we are warned that a chemical is safe or dangerous?
The key to that question is the word ‘dose’. In the glossary of this booklet, dose is defined as:
The amount of a chemical that is eaten or consumed
You might have heard the word dose with regards to drugs (medicines) that you get from the doctor or from the supermarket. The dose of paracetamol for an adult is 1000 mg at a time, up to 4 times a day. At this dose paracetamol is safe, at a higher dose it is dangerous and at too low a dose, it just won’t work.
How much water would we need to drink for it to be dangerous? For an adult who weighs 75 kg, drinking 7 litres of water in a short time would be likely to kill them. This is a lethal dose, lethal means *able to kill*.

Think, pair, share – toxic doses

Split into pairs and consider the following two questions:
7 kilograms is a lethal dose of water, would the lethal dose of paracetamol be higher or lower?
How might scientists work out what the lethal dose of a chemical is?
You can write notes in the box below:

Testing the toxicity of chemicals

We’ll learn about different ways to test how toxic a chemical is and how it might harm us in tutorial 4 but today we’ll focus on one method.
You can test how toxic a chemical is by feeding it to mice or rats. By doing this we can find out how much of the chemical can kill half of the animals we test. We call this the LD50 or lethal dose for 50%. This number can be used to tell us how much would be expected to kill 50% of humans and then from there how much would be considered a safe dose.
Below we’ll go through the way we can calculate this:
The dose of pibrilline that kills 50% of the mice is 4 mg. The lab mice weigh 20 g each and we want to calculate a safe dose for a 75 kg human.
The LD50 is measured in mg/kg because animals that weigh more can safely consume more.
To calculate the LD50 we need to get our numbers into the correct units:

$$\frac{4\ mg}{20\ g} = \frac{4\ mg}{0.02\ kg} = 200\ mg/kg$$

Next, we need to work out what dose we would expect to kill 50% of 75 kg humans.

$$200\ mg/kg \times 75\ kg = 15{,}000\ mg = 15\ g$$

Now we don’t want to have a 50% chance of killing our patient so we reduce this dose to a ‘safe dose’. Here we’ll use 10% of the dose that would be expected to kill 50%.

$$15\ g\ \times 10\% = 15\ g\ \times 0.1 = 1.5\ g$$

So a doctor could give a patient 1.5 grams of pibrilline.

Let's work through an example together:
A company sells pesticide that farmers spray on their crops. The lab has found that farmers are breathing in around 18 grams of the pesticide and the toxicologists have found that 6 mg kills 50% of mice. Again, the mice weigh 20 g.
First let's calculate the LD50 in mg/kg by getting the numbers into the correct units.

Then we work out what dose would be expected to kill 50% of 75 kg humans.

Finally, we want to find a safe dose by reducing the above dose to 10%.

Is the dose that the farmers are exposed to higher or lower than the safe dose?
What can we do to ensure that the farmer is safe?

Exercise

Jokey Cola are revising their recipe and they've found a chemical called popsin that really helps the flavour pop. They only expect consumers to have one can at a time but they know that their popping flavour means people won't be able to help themselves from cracking one can open after another. As such they consider the safe dose of popsin to be 0.01% of the lethal dose for 50% of their average consumers, who weigh 125 kg, in each can. 4.5 mg of popsin kills 50% of their 23 g mice. How much popsin can they 'safely' add to each can?

Assessing and mitigating risk

Assessing means working out how much of something there is, mitigating means reducing.
A: How can we work out how much risk there is?
B: How can we reduce the risk?
Which bullet points go with each question?

- Looking up how toxic the chemical is.
- Wearing gloves.
- What dose a person is exposed to.
- Using a different chemical.
- Wearing a face mask.
- Taking care when using the chemical.
- Testing how toxic the chemical is, if unknown.
- Reducing the dose a person is exposed to.

Are there any others that you can think of?

Homework

Answer these questions before the next Tutorial 3.

1) What would be the LD50 in mg/kg of a food additive that kills 50% of a batch of mice that weighed 20 grams at a dose of 0.1 mg? Show your working, provide the answer to 3 significant figures and use a suitable unit.

2) A new Alzheimer's drug was shown in tests to kill 50% of a batch of 23-gram mice at a dose of 0.3 mg. What will be the highest dose they can provide a patient if they do not wish to exceed 5% of the LD50? Show your working, provide the answer to 3 significant figures and use a suitable unit.

3) A company has developed an industrial refrigerant. In safety assessment, the chemical would be inhaled rather than eaten. Search on the internet for the measurement used to calculate the lethal dose of a breathed gas or vapour. What measurement is used? What units would be used? Where did you find the information?

4) The LD50 of Chemical X is 50 mg/kg. What dose would have been expected to kill 50% of the 30-gram rats? Show your working, provide the answer to 3 significant figures and use a suitable unit.

Success criteria:
The student will show clear reasoning and good numeracy in answering the above questions using the information learned in the tutorial and their own research.

Tutorial 3 – Targets and Mechanisms

What is the Purpose of Tutorial 3?

LO1. Students will define a target and remember examples
LO2. Students will define a mechanism and remember examples
LO3. Students will evaluate targeted risks and suggest risk mitigation strategies

Last tutorial, we talked about how a high enough dose can make any chemical dangerous and a low enough dose can make any chemical safe. We also began talking about mitigating and avoiding the risk of toxic chemicals. Today we will look at where in our bodies toxins can cause harm and how that harm can be caused. First let's talk about targets.

Target practice: where chemicals cause us harm

Consider the chemicals that we are exposed to. They may be chemicals we eat, drink or breathe; we might smear them on our skin, spray them under our armpits or inject them straight into our bloodstream. How we use these chemicals and where in our bodies they go after we are exposed can affect where in our body the chemical can harm us.

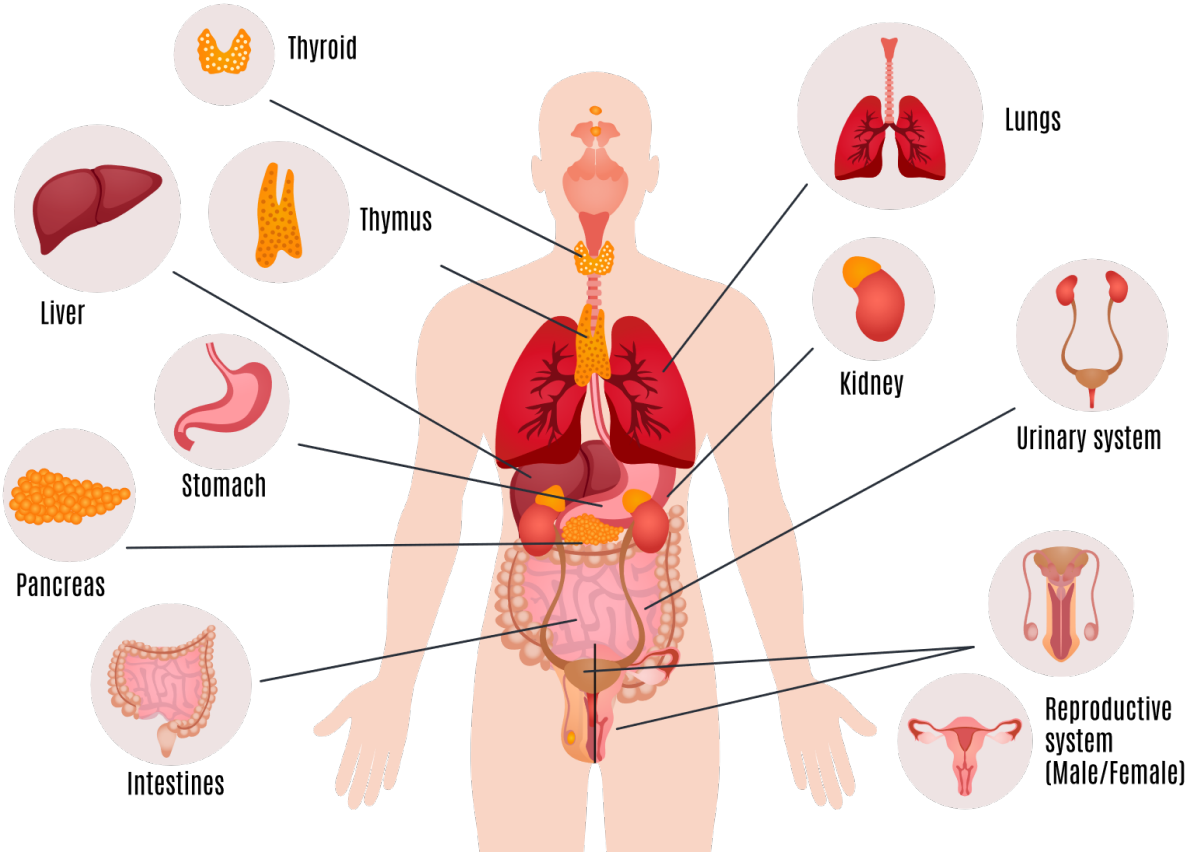
Where a chemical causes harm in an organism is called the 'target'

What is this, Latin?

A lot of scientific words are used to describe the targets and mechanisms of toxic compounds. A lot of these are scientific terms that have a much easier to understand definition. You can use either when you write as they are both correct.
Remember that a lot of these words can be changed to define:

- a harmful chemical - a toxin
- a method by which a chemical can cause harm – toxicity
- describing something that causes harm - toxic

Hepatotoxic	Toxic to the liver
Nephrotoxin	A toxin that damages the kidneys
Neurotoxicity	Harming the brain or nerves
Ototoxic	Toxic to the ears, affecting hearing and balance
Cytotoxin	A toxin that causes harm by damaging cells
Genotoxicity	Damaging the DNA
Excitotoxic	Capable of damaging nerves by overstimulation
Pulmonary toxin	A toxin that damages the lungs



Think, pair, share – toxin targets

Split into pairs and consider the following two questions:
Consuming too much paracetamol will damage your liver, eating something contaminated with methyl mercury will damage your brain. Why might two different toxins that are consumed in the same way cause harm in different places?
Name two or more parts of the body that will be damaged if someone smokes cigarettes.
You can write notes in the box below:

Mechanisms of toxicity

The way that a chemical can cause damage is often linked to where it capable of causing damage. Consider how the below examples of targets and mechanisms might be linked:

Mechanism	Target
Hydrochloric acid A potent cytotoxin Capable of damaging cells	Nephrotoxicity Damage to the kidneys
Titanium dioxide from skin creams Potentially genotoxic (research is ongoing)	Oral toxicity Damage to the mouth
Benzopyrene from cigarettes Genotoxic Damages the DNA	Pulmonary toxicity Damage to the lungs - leading to lung cancer
Paracetamol Is broken down in the body to a cytotoxic chemical	Neurotoxicity Damage to the brain and nervous system
Cyclophosphamide, a chemotherapy drug Genotoxic, damages the DNA	Skin toxicity - leading to skin cancer
Oxalic acid from Rhubarb Can deposit insoluble calcium oxalate crystals	Hepatotoxicity Damage to the liver
Domoic acid from contaminated shellfish. Excitotoxin, causes overstimulation of neurons	Toxicity in rapidly dividing cells such as hair-producing cells, skin, mouth, eyes and cancers.

Assessing and mitigating risk

Last week we learnt about assessing and mitigating the risk of exposure to toxic chemicals. How might we use our understanding of targets and mechanisms to mitigate risk. Consider the chemicals in the previous exercise. How might we reduce or eliminate the risk regarding each chemical?

Homework

Before the next tutorial,
Watch the video posted on Teams and answer the following questions.

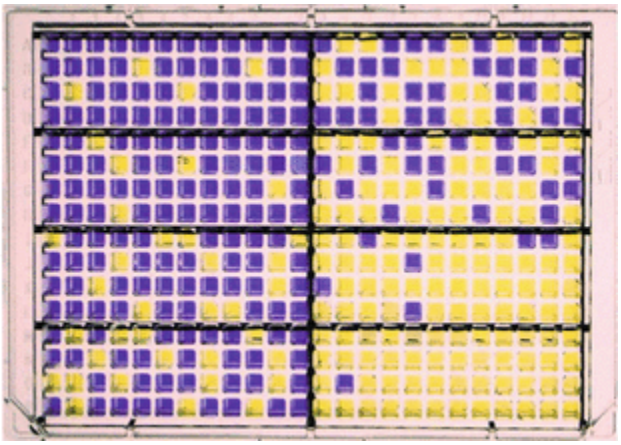
1) What built up in the blood causing toxicity to the patient's kidneys?

2) What process did that interfere with in the patient's body?

3) The overdose of antacids primarily had a _____ effect.
    a. Nephrotoxic
    b. Hepatotoxic
    c. Neurotoxic

Success criteria:
The student will show through correctly answering the above questions that they have watched and understood the video regarding a patient overdosing on antacids.

Tutorial 4 – Testing for Toxicity



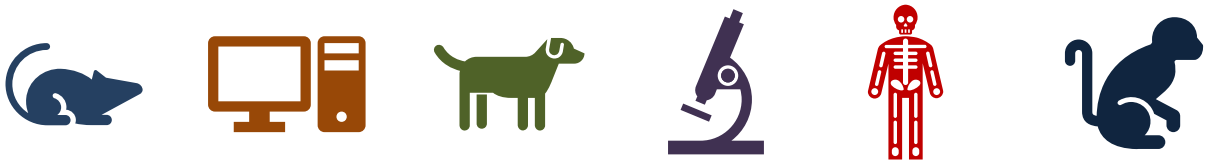
Trigger warning: This tutorial will cover animals being harmed and killed as part of developing new drugs and chemicals. If this is likely to upset you, please tell the teacher and they will try to cover the topic as sensitively as possible.

What is the Purpose of Tutorial 4?

LO1. Students will explain the role of safety assessment in chemical & drug manufacturing
LO2. Students will evaluate different models of safety assessment
LO3. Students will compare the ethics of animal testing in drug development to cosmetics

Over the course of the last three tutorials, we have learnt how at a high enough dose, any chemical can harm us, and chemicals can toxically affect different targets by differing mechanisms. We need to understand how high a dose of any given chemical is, whether it's a medicine, a pesticide sprayed on crops, a food additive or any of the other chemicals we are exposed to. In order to understand how dangerous a chemical is, we need to test it.

Toxicology Models – how do we know a chemical is toxic



In order to know which chemicals are harmful, we need to test them. Imagine that someone has developed a new medicine and they need you to test how safe it is. The above 6 pictures show different ways that we can test for whether a chemical is toxic. Can you work out what each image represents? How might each model (way of testing) allow us to test whether a chemical is toxic?
Once the teacher has defined each model, fill in the table above.

Think Pair Share

In a pair discuss the advantages and disadvantages of each model and consider when each might be used. Afterwards, share your ideas with the teacher. Write notes below.

What is this, Latin?

Some of the terms you've learnt today are Latin. When you see these written down, they are often written in *italics*. Scientists are often quite fussy about details like this. If you forget to make them italic, don't worry.

in silico – in silicon – computer chips are made of silicon

in vitro – in glass – petri dishes that living cells were examined in were historically made of glass

in vivo – in life – these models are living animals

Which model works?

Imagine you must test the safety of the following chemicals. What would be the appropriate way to test each chemical?

A new medicine to treat heart disease that is structurally similar to a group of existing drugs but expected to be more effective.

A group of 1000 chemicals that could be a possible new medicine to treat Alzheimer's. The chemical structures are very complex, and it is currently very expensive to make them.

A new chemical that is expected to reduce swelling. It is to be used in a new face cream that hides acne scars.

A pesticide developed in the 1970s has been linked to an increased incidence of thyroid cancer. It didn't have any safety tests done on it back when it was released.

A new medicine was developed to treat Weaselface syndrome. It has not produced any results suggesting toxicity during testing *in vitro* or *in* vivo. The *in vivo* tests were in rats and mice.

Cost-benefit analysis – is this worth killing mice over?

When we consider any activity, in science or otherwise, it can help to carry out a cost-benefit analysis. That is to say how much does this cost and how much benefit will I get. In the case of financial cost, this is easier to assess but when we consider the ethics of causing animal harm and death, it can be much less clear.
In the EU, Norway, UK and Switzerland it is not legal to test chemicals on animals if they are to be used in cosmetics but it is legal to test medicines. In China, cosmetics and medicines are both tested on animals. As a group, students will discuss whether you think that we should test medicines or cosmetics on animals before they are sold to humans.
Give each other time to share before responding. Remember, this is a discussion of ethics. There isn't a right or wrong answer. Try to not get upset if someone disagrees with you or thinks something that you find unacceptable. Similarly, express yourself in a way that doesn't unnecessarily upset others.

Homework

Watch the videos posted on Teams and write notes below about the reasons that bias might arise in drug testing data and its potential effects.

What reasons might cause bias in drug testing data?   What effects might this bias have?

Success criteria:
The student will show through their response that they have watched and understood the videos regarding bias in drug development.

Tutorial 5 – Salient Sources and Reputable Referencing

What is the Purpose of Tutorial 5?

LO1. Students will analyse environmental risks of different chemicals based on their targets, mechanisms, safe doses and use
LO2. Students will compare credible and dubious sources
LO3. Students will use a consistent referencing system

Over the course of the last four tutorials, we have focussed largely on how the chemicals that we produce can harm us as humans. It is of great importance that we consider how the chemicals might cause unwanted harm to organisms and ecosystems.

Environmental toxicity

Something is considered an environmental toxin if it would cause significant harm to organisms or ecosystems if it was released or incorrectly disposed of. You might have heard of some environmental toxins in school in geography or science class.
You are going to quickly research one of the following means of environmental toxicity in a pair. You will then need to present your findings to the group.

- Eutrophication from fertiliser runoff
- Bioaccumulation of heavy metals in seafood
- The effect of pesticides on bee populations
- The effect of sunscreen on coral reefs

Credible sources

How easy did you find it to quickly find credible and trustworthy sources? What is it that you look for when you search for sources online?
Would you trust the below sources?

- Daily Mail – British newspaper and news website
- The Guardian – British newspaper and news website
- Al Jazeera – Qatari government funded news website
- Wikipedia – collaborative online encyclopaedia
- Twitter – American social media platform
- TikTok – Chinese social media platform
- Breitbart News – American news website
- Nature – scientific journal
- New Scientist – popular-science magazine
- Journal of the Science of Food and Agriculture – scientific journal

Think Pair Share

Some of the above sources can almost always be trusted, some can almost never be trusted and sometimes it depends. When looking for a source, what factors should we consider? In pairs think about what would make you not trust a source. Below are some pointers to guide your conversation.
Financial concerns: Who's paying? Who's getting paid?
Political concerns: Is the political angle of the writer, funder or country impacting the credibility?

Referencing

Many referencing systems exist, and some are very specific to academic writing. To write the final assignment, you should use the following light and easy system.
Add references in line with the text as small numbers[1]. Subscript numbers can quickly be added in Word by pressing 'ctrl ='.
At the **end** of your document, keep a numbered bullet-point list that you update as you work. For news websites and journals, include the website name and link[1]. For social media or video posts, include the Author as well[2]. For books, put the book name and page[3].

1. News Website – www.newswebsite.io/article
2. Youtube – System of a Down – www.youtube.com/watch?v=iywaBOMvYLI
3. The Hermetic and Alchemical Writings of Paracelsus – p38

Final Assignment

Having learnt about toxicity, dose and toxicological assessment your final assignment consists of a series of problems and a brief dissertation.

Problems

1. GlaxoSmithKline has created a new face cream to help women reduce wrinkles under their eyes.
    a. Is it ethical to test the face cream on live animals? Why/why not?
    b. The face cream is shown to be safe and sells well in the UK. GlaxoSmithKline wants to release the cream in India as they think there is a lot of money to be made selling the cream to men, what should they consider to be sure that the face cream will be safe for men in India?
2. New research from the University of Leeds has shown that a popular pesticide that is spread on potatoes to kill beetles can cause nephrotoxicity.
    a. Should the public be concerned about how toxic the chemical is to the beetles that eat the potatoes? Why/why not?
    b. Compare the risks to the farmer and to the people who eat the potatoes.
    c. Name 2 steps that could be taken to reduce the risk to the farmer.
    d. Name 2 steps that could be taken to reduce the risk to the customers.
    e. Evaluate the risk if the pesticide gets into the environment.
3. A doctor wants to treat a patient with a drug called 4-nitroquinoline N-oxide.
    a. The doctor wishes to know how much would be safe to give to her patient. She wishes to provide a dose of 10% of the LD50 and her patient weighs 78 kg. Use your research skills to find credible sources for the LD50 of the drug and calculate the maximum dose showing your working.
    b. How would the doctor expect the drug to potentially harm the patient? Which organs would be affected and what would be the mode of action?
    c. Does 4-nitroquinoline N-oxide sound safe or unsafe? What kind of disease would it be suitable to treat if a drug is as safe or unsafe as 4-nitroquinoline N-oxide?

Final assignment questions:

Complete the problem set above and then write a dissertation on the following topic:

A pharmaceutical company has developed a new drug to treat lung cancer. The drug is taken by puffing on an inhaler, like an asthma inhaler. How will the scientists show that the drug is safe for humans to take? What will they need to consider about the kind of harm the drug could cause and the parts of the body it could harm?

Details of the assignment:

The dissertation should be around 1,000 words

Your work must be logically structured and written in clear sentences

If using external sources as examples they should be correctly referenced

Use scientific terms correctly and appropriately

Use accurate spelling, grammar, and punctuation

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

Answers to the problem set, either written or typed, clearly showing any working.

Dissertation:

How might the means of administering the drug influence its targets of toxicity?

What could be the target of any toxicity?

What could be the mechanism of any toxicity?

How can a drug be tested to show that it is safe?

What types of test would be used?

What models (organisms) would be used to run the tests?

Which order would they be run?

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

How dose influences toxicity

How toxicity affects certain targets

How various toxicity mechanisms work

How toxicity is tested

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

Think critically

Apply the understanding that you have developed through the Uni Pathways project to a piece of written work.

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

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