UNI PATHWAYS

RESEARCHERS IN SCHOOLS

Timetable and Assignment Submission

Timetable – Tutorials

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

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Introduction to Neuroscience: What are the different brain regions and what is their importance to bodily function?	
Tutorial 2	Independent Research: Neurons and diseases.	
Tutorial 3	Critical Analysis of Research: Read sources provided and summarise the results.	
Tutorial 4	Critical Analysis of Research: Read sources provided and summarise the results.	
Tutorial 5	Draft Final Assignment: To be presented to your peers and to gather feedback from others to improve your work.	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

The Brilliant Club KS4 Programme – Pupil Feedback Report

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 GSCE
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

Name of PhD Tutor			
Title of Assignment			
Name of Pupil			
Name of School			
ORIGINAL MARK / 100		FINAL MARK / 100	
DEDUCTED MARKS		FINAL GRADE	

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

Learning Feedback Comment 1 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 2 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 3 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Resilience Comment	
How you showed learning resilience during the course *Enter feedback here*	How you could build learning resilience in the future *Enter feedback here*

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Course Rationale

What is this course about?

Traumatic Brain Injury (TBI) is a form of acquired brain injury and represents a major public health and socio-economic problem throughout the world. It manifests as two main stages: primary and secondary injury. The primary injury is the direct consequence of the trauma; this becomes secondary injury as a result of cellular and sub-cellular processes. Recent conflicts (warfare) have increased the occurrence of TBI and at present, there are no treatments that stop the spread of brain injury post-trauma.

What university-style aspects are included in this course?

There are a number of skills that pupils will learn that will give them a taste of university style learning and teaching. There will be a heavy emphasis placed upon using published research papers to understand the medical condition of TBI and the potential treatments being tested. Pupils will also learn about plagiarism and how to correctly reference these research papers in an essay. Furthermore, pupils will peer-review some work and learn how to give and take constructively criticise. Lastly, pupils will be able to analyse data and present their data as appropriate, incorporating mathematical analysis techniques.

This course is aimed to explore a topic that isn't discussed much, despite its importance and severity. This course is exciting, interesting, and will introduce pupils to the magical world of our complex brain!

Course Synopsis

The course begins with an overview of the brain and its anatomy. An introduction to TBI and its manifestation (and neuropathology) will also be taught and explained in some depth. Once students are clear about the biological background of TBI, they will be given the opportunity to learn about the current drug 'candidates' that are being researched as a potential TBI medication e.g. the noble gas xenon. Students will also learn a little about different experimental models - in vitro verses. in vivo.
By the end of the course, students should be able to explain neurotrauma research, understand the severity of TBI, develop critical analysis of data and published research papers from world-renowned scientists.

Mark Scheme Table

	Skills	1st (70-100)	2:1 (60-69)	2:2 (50-59)
Subject knowledge	Knowledge and Understanding	○ All content included is relevant to the general topic and to the specific question/title ○ Good understanding of all the relevant topics. ○ Scientific terms are defined and used accurately throughout ○ Clear justification on how the content included is related to the specific issues that are the focus of the assignment	○ Most of the content included is relevant to the general topic and to the specific question/title ○ Good understanding of most the relevant topics ○ Scientific terms are used accurately but not always clearly defined. ○ Adequate justification on how the content included is related to the specific issues that are the focus of the assignment	○ Some of the content included is relevant to the general topic and to the specific question/title ○ Good understanding on some of the relevant topics but occasional confusion on others. ○ Scientific terms are used mostly accurately with occasional confusion and often not defined. ○ Some justification on how the content included is related to the specific issues that are the focus of the assignment
Critical thinking	Research and Evidence	○ Inclusion of rich sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas ○ Use evidence/calculations to support claims/assertions/ideas, consistently clearly and convincingly ○ Evidence of further reading beyond materials provided which were used in an appropriate context ○ Data is effectively analysed and appropriate assumptions/conclusions are reached	○ Inclusion of adequate sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas ○ Use evidence/calculations to support claims/assertions/ideas, mostly clearly and convincingly ○ Evidence of further reading beyond materials provided ○ Data is analysed and the assumptions/conclusions that are reached are mostly appropriate	○ Inclusion of some sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas ○ Use evidence/calculations to support claims/assertions/ideas, at times clearly and convincingly ○ Limited evidence of further reading beyond materials provided ○ There is an attempt to analyse data is and draw assumptions/conclusions
	Developing an Argument	○ A point of view or position in relation to the title or question is consistently clear ○ Argument/proof exceptionally well-developed and well-justified ○ A position is clearly established in relation to the question, and is developed effectively and consistently	○ A point of view or position in relation to the title or question is adequately clear ○ Argument/proof clear and well-developed and position justified ○ A position is established in relation to the question, and is well-developed in most of the essay ○ Some evidence of linking subjects that have not previously	○ A point of view or position in relation to the title or question is somewhat clear ○ Argument/proof clear but not well-developed ○ A position is established in relation to the question, and is well-developed in parts of the essay ○ Limited evidence of linking subjects that have not previously been associated

		throughout the essay ○ Makes links effectively between subjects that have not previously been associated ○ Uses concepts from the tutorials in an unfamiliar context, and does so accurately and confidently. ○ Content is analysed effectively to support the argument	been associated ○ Use some concepts from the tutorials in an unfamiliar context, but not always accurate ○ Analysis of content to support the argument	○ Limited use of concepts from the tutorials in other contexts ○ Some analysis of content to support the argument
	Critical Evaluation	○ Moved beyond description to an assessment of the value or significance of what is described ○ Evaluative points are consistently explicit/systematic/reasoned/justified ○ Effective critiques on the reliability of sources provided	○ Mostly description but some assessment of the value or significance of what is described ○ Evaluative points are mostly explicit/systematic/reasoned/justified ○ Some evidence of critiques on the reliability of sources provided	○ Only description with minimal assessment of the value or significance of what is described ○ Evaluative points are at times explicit/systematic/reasoned/justified ○ Limited evidence of critiques on the reliability of sources provided
Written communication	Structure and Presentation	○ Ideas are presented in paragraphs and arranged in a logical structure that is appropriate for the assignment ○ The introduction clearly outlines how the essay/report will deal with the issues ○ The conclusion summarises all the main points clearly and concisely ○ All calculations, formulas and methods are clearly structured, clear to follow and correct ○ Tables and graphs are effectively constructed including appropriate headings, units and scales. ○ All sources are referenced correctly in an agreed format	○ Ideas are presented in paragraphs and arranged in a structure that is mostly appropriate for the assignment ○ The introduction adequately describes how the essay/report will deal with the issues ○ The conclusion summarises most of the main points clearly ○ Calculations, formulas and methods are mostly structured, clear to follow and correct ○ Most tables and graphs are well constructed ○ Most sources are referenced correctly in an agreed format	○ Ideas are presented in paragraphs and arranged in a structure ○ The introduction mentions how the essay/report will deal with the issues ○ The conclusion summarises some of the main points clearly ○ Calculations, formulas and methods are not always structured, clear to follow and correct. ○ Some tables and graphs are well constructed but contains some errors ○ Some sources are referenced correctly in the agreed format with occasional errors

	Language and Style	○ No spelling, grammar or punctuation errors ○ Units and significant figures are presented accurately throughout ○ Writing style consistently clear, appropriate for scientific documents and easy to follow ○ Accurate and consistent use of technical language and vocabulary	○ Minimal spelling, grammar or punctuation errors ○ Units and significant figures are presented accurately throughout ○ Writing style mostly clear, appropriate for scientific documents and easy to follow ○ Some attempts of using technical language and vocab alary, but not always accurate	○ Some spelling, grammar or punctuation errors ○ Units and significant figures are presented accurately throughout with occasional errors ○ Writing style moderately clear, appropriate for scientific documents and easy to follow ○ Use of simple language and vocabulary effectively but struggles to use technical language

Glossary of Keywords

Word	Definition
Neuroscience	Study of the brain
Traumatic Brain Injury (TBI)	Injury to the brain caused by a trauma to the head caused by e.g. motor-vehicle incidents, falls, assaults.
Cerebrum	The largest part of the brain. In humans, the cerebrum is the most developed of the major divisions of the brain – cerebrum, cerebellum and brainstem.
Pathology	Branch of medical science primarily concerning the examination of organs, tissues, and bodily fluids in order to make a diagnosis of disease.
Therapeutic	Treatment of disease
Nerve Cells	Cells of the nervous system that are specialised to carry messages through the body. The human brain has approximately 100 billion neurons.
Neurotransmitter	The chemical in our brain that allows the nerve cells to communicate and transmit messages.
Excitotoxicity	The ability of excitatory amino acids to cause the death of neurons after an incidence of TBI
Mitochondria	An organelle found in large numbers in most cells. Mitochondria allow the process of respiration and energy production to occur.
Neuroprotective	Preservation of neuronal structure/ function.
Clinical Trials	The process of trialling medicines before new medicines are released for use.
Anaesthetic	A drug that causes a reversible loss of sensation – usually used to facilitate surgery.
In Vitro	Studies performed with microorganisms, cells or biological molecules - 'within the glass'.
In Vivo	Studies performed on whole living organisms – 'within the living'.

Tutorial 1: The Basics of Our Brain

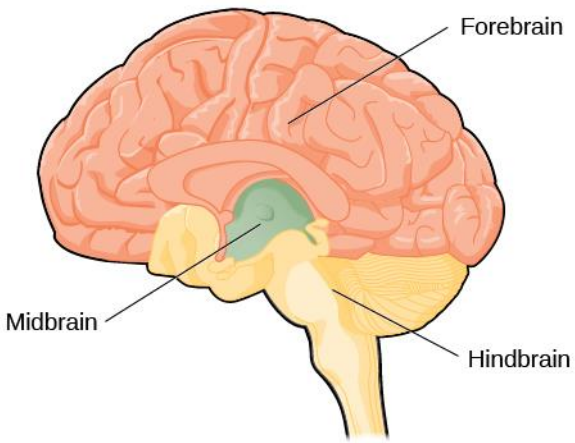
What is the Purpose of Tutorial 1?

- Introduction to the brain anatomy and its many functions
- Appreciate the importance of the full functioning of the brain
- Introduction to traumatic brain injury (TBI)

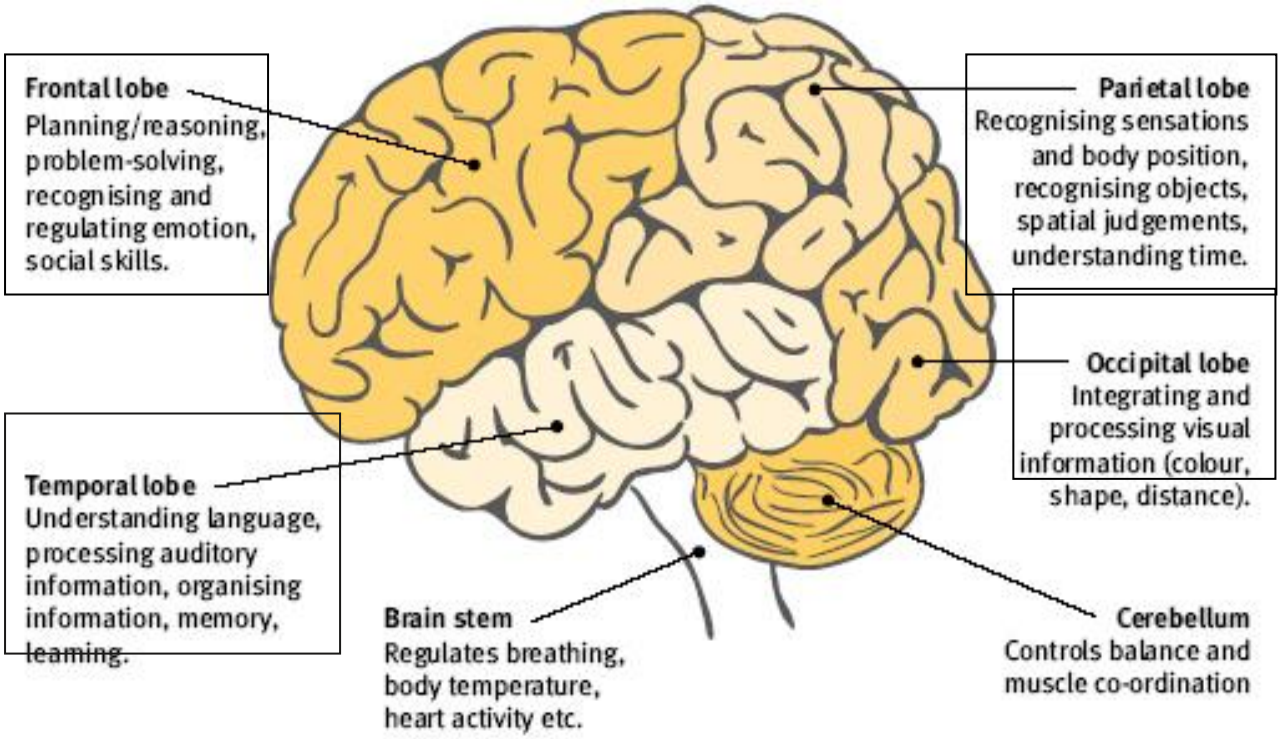
The Brain

Our brain is an organ that serves with the spinal cord, to comprise the body's central nervous centre. The brain is a VERY complex and magnificent structure that acts as the control centre for the body. It allows us to move, have intellectual capacity and gives us self-awareness.

The brain is comprised of three basic units: the forebrain, the midbrain and the hindbrain. The forebrain consists of the cerebrum (also called cortex).

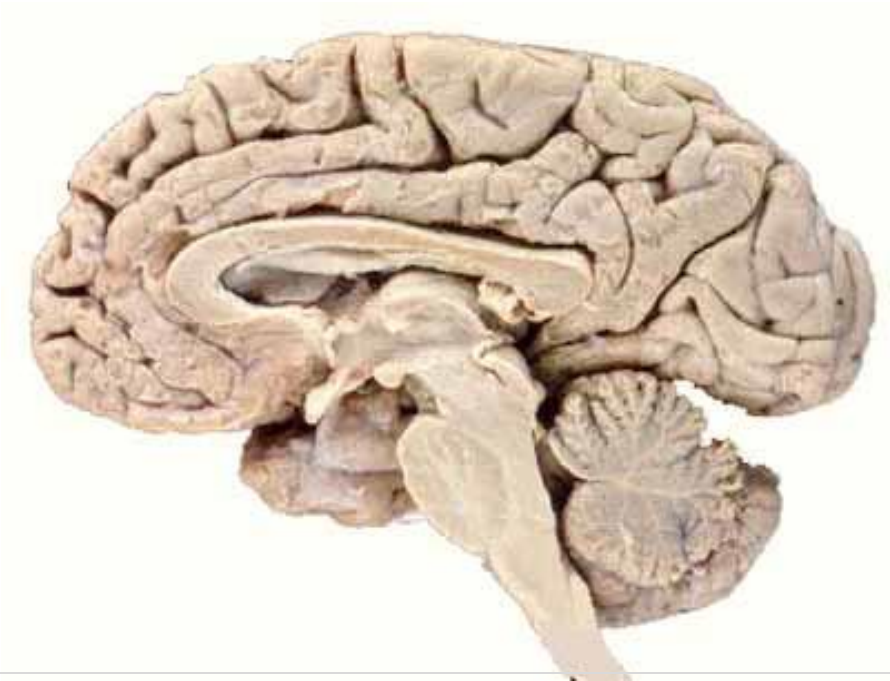


The cerebrum is divided into four sections called 'lobes': the frontal lobe, parietal love, occipital lobe, and temporal lobe.



Q:

Why do you think the brain is 'wrinkled' and features these cortical folds (also called gyrencephalisation)?



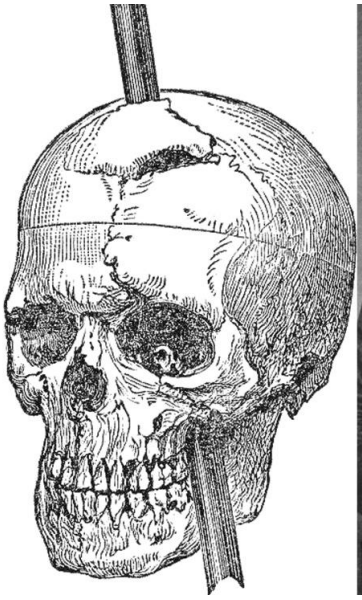
Label the image of a real dissected brain above.

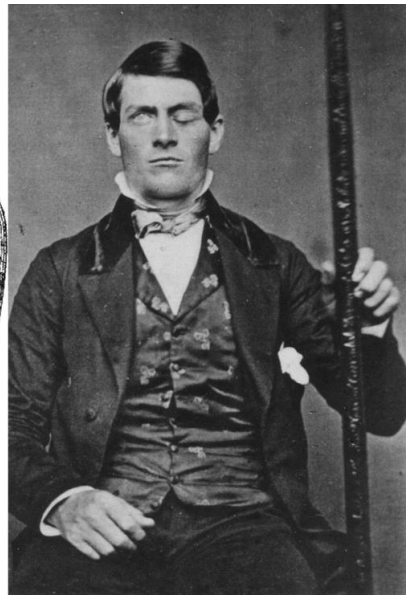
As we have learnt, the brain is extremely important for everything we do, from breathing to talking. What happens when a region of the brain is damaged?

Case study: Phineas Gage (1823-1860)

Phineas Gage is neuroscience's most famous patient. When he was 25 years old, he sustained a terrible injury to his brain. The effects of the injury upon his character made Gage a curiosity to the public and an important case study for scientists hoping to understand more about the brain. Whilst working in railway construction, a tamping iron (long hollow cylinder of iron of approx. 6kg) was propelled through Gage's skull – entering through his left cheekbone and exiting through the top of his head. The accident destroyed a large section of his brain

Other fascinating





cases of brain injury

Q: Looking at the image above, what behavioural changes do you think this injury had to Gage?

Foreign accent syndrome: speech disorder that causes a sudden change to speech so that a native speaker is perceived to speak with a "foreign" accent. Most often caused by damage to the brain by a stroke or traumatic brain injury (20 known cases worldwide).

e.g. Woman from Plymouth had stroke and woke up with a Chinese accent

Traumatic Brain Injury (TBI)

TBI is an injury to the brain caused by a trauma to the head (head injury). There are many possible causes, including road traffic accidents, assaults, falls, blasts and accidents at home or work. The effects of TBI are varied (heterogeneous), depending on a number of factors such as type, location and severity. Symptoms can be wide-ranging from physical effects, to emotional and behavioural effects.

Write two new things you learnt today:

Homework 1 – Baseline Test

The homework assignment for the first tutorial is a baseline test to see your initial level of attainment in this subject area. The assignment will test for some or all of the subject specific skills that are required later in the final assignment. However, it is shorter than the final assignment and is will be an introduction to the subject as well as a challenge! Do not worry too much about doing 'well' or 'badly' on the baseline test, it takes into account the fact that you may not be familiar with the subject area. It is designed to help you and your PhD tutor identify where you are at the start of the programme and to help you measure your progress along the way.

1. Briefly describe the anatomy of the brain

2. Why is the brain important?

3. Based on your knowledge of the brain regions and its functions, is there a region that could be the 'most important'? Give your reason why.

4. Based on the story of Phineas Gage, what can you say about how the brain works?

5. Can you find another famous case of brain trauma causing an impact on brain function?

6. Read the abstracts below and summarise the paper in your own words. Try to identify the methods that the authors have used during the experiment and explain why they used that particular technique. When was the paper published? What journal is this paper published in? Don't worry if you cannot fully understand the abstracts, they are very challenging! We will go through them in more detail next week.

Soc Sci Med. 2015 Dec;147:309-16. doi: 10.1016/j.socscimed.2015.11.015. Epub 2015 Nov 17.

Injury careers after blast exposure among combat veterans deployed to Iraq or Afghanistan.

Chase RP[1], McMahon SA[2], Winch PJ[3].

⊕ **Author information**

Abstract

During the Iraq and Afghanistan wars, blasts were the most common cause of combat injuries, including traumatic brain injury (TBI). Prior to 2007, service members were not systematically screened for TBI, and estimates suggest that tens of thousands of mild TBIs went undiagnosed. This study sought to understand post-acute "injury careers," documenting the life- and health-related narratives of veterans who were at high risk of undocumented TBI due to being blast-exposed before 2007. Researchers conducted 38 in-depth interviews between May 2013 and August 2014 with Army veterans who served in combat-intense settings (n = 16) and their family members (n = 10). Respondents detailed a series of experiences in the months and years following blast exposure. We present this series as a model that draws upon the vernacular of participants who described veterans "downplaying" their injuries and later "detaching" themselves from friends, family, and communities, and "denying" or being "oblivious" to their circumstances until a "wake-up call" pushed them to "get help." Looking to the future, veterans grapple with uncertainties related to personal identity and professional or social expectations. This model is presented within a member-checked metaphor of an individual being hurled into - and emerging from - a canyon. Policies and programs addressing veteran health, particularly among those exposed to multiple blasts prior to systematic TBI documentation, must consider the personal, social, and health system challenges faced by veterans and their families throughout their injury careers.

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J Neurosci Nurs. 2016 Feb;48(1):15-27. doi: 10.1097/JNN.0000000000000176.

Pathophysiology and Treatment of Severe Traumatic Brain Injuries in Children.

Allen KA[1].

Author information

Abstract

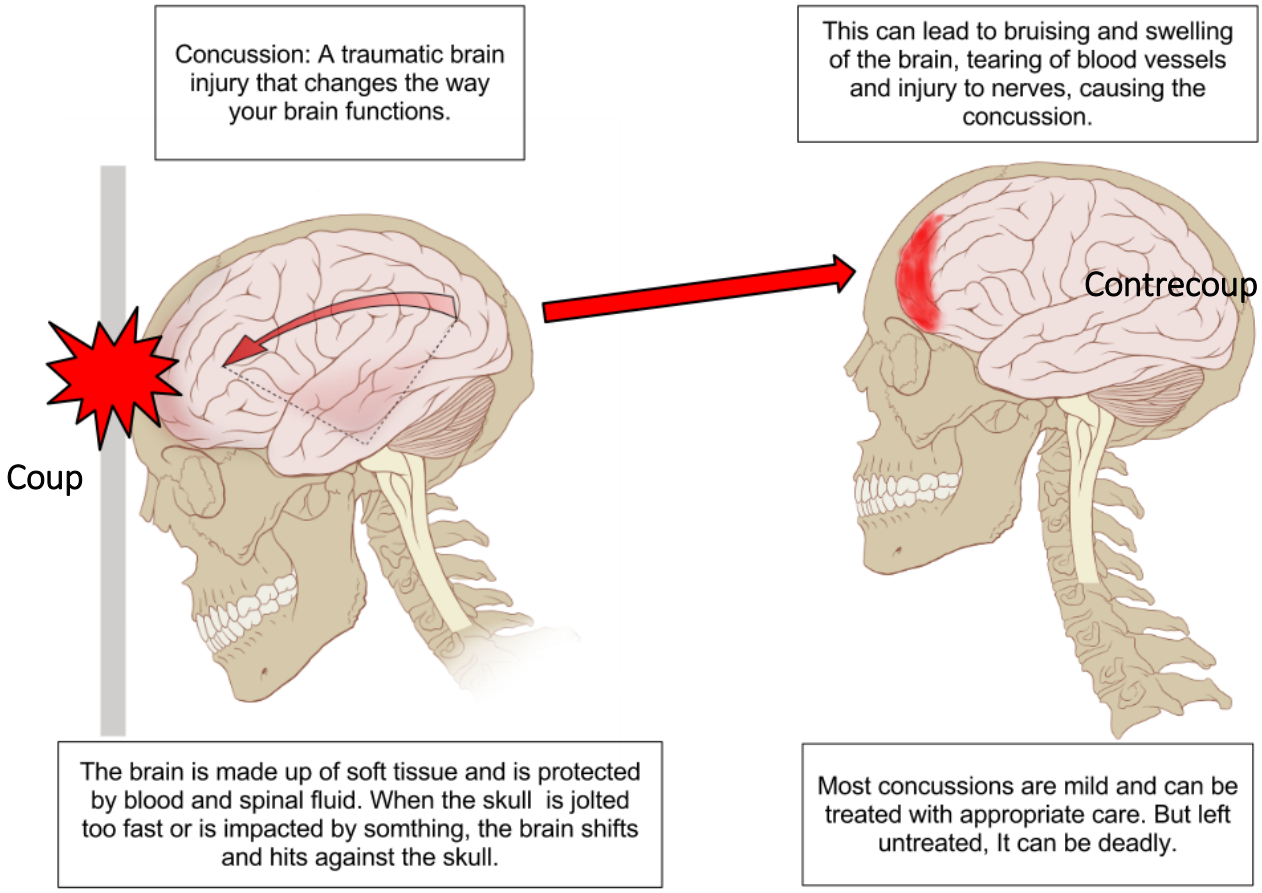
Traumatic brain injuries (TBIs) in children are a major cause of morbidity and mortality worldwide. Severe TBIs account for 15,000 admissions annually and a mortality rate of 24% in children in the United States. The purpose of this article is to explore pathophysiologic events, examine monitoring techniques, and explain current treatment modalities and nursing care related to caring for children with severe TBI. The primary injury of a TBI is because of direct trauma from an external force, a penetrating object, blast waves, or a jolt to the head. Secondary injury occurs because of alterations in cerebral blood flow, and the development of cerebral edema leads to necrotic and apoptotic cellular death after TBI. Monitoring focuses on intracranial pressure, cerebral oxygenation, cerebral edema, and cerebrovascular injuries. If abnormalities are identified, treatments are available to manage the negative effects caused to the cerebral tissue. The mainstay treatments are hyperosmolar therapy; temperature control; cerebrospinal fluid drainage; barbiturate therapy; decompressive craniectomy; analgesia, sedation, and neuromuscular blockade; and antiseizure prophylaxis.

Tutorial 2: Traumatic Brain Injury – Cause, Type, Manifestation

What is the Purpose of Tutorial 2?

- Understanding TBI further
- Identifying the types of TBI injury and how they are manifested
- What is secondary trauma and what are the cellular processes that cause it

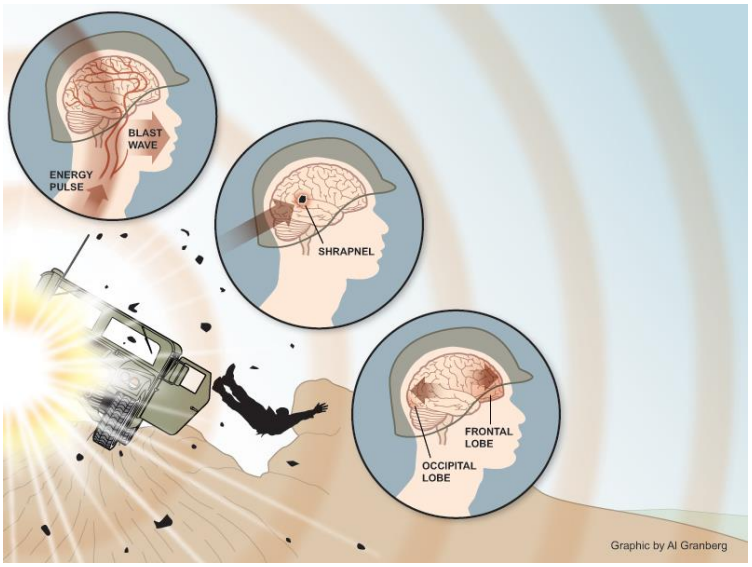
Open head injury – there is penetration to the skull
Closed head injury – there is NO penetration to the skull e.g. coup-contrecoup injury



An explosion causes two types of TBI. Can you think of what the two may be?

1.

2.



A common misconception is that TBI can be seen after injury through bleeding, bruising or other physical injury. This is NOT true. Often, TBI can be manifested without direct impact to the brain – diffuse brain injury – and is clinically challenging to diagnose. It is often referred to as the 'silent epidemic'.

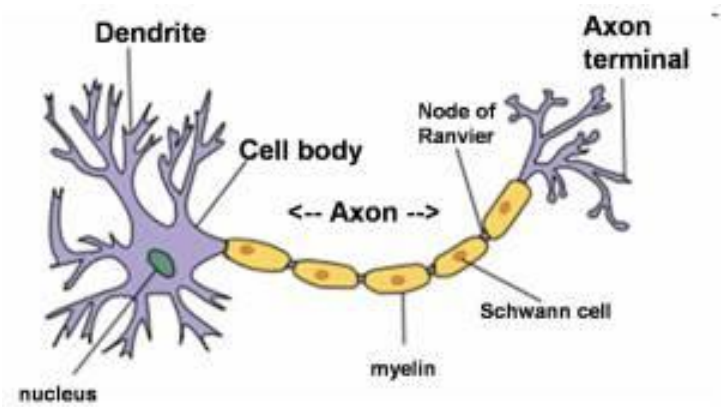
Sequence of TBI events:

1. Primary insult: occurs at the moment of impact – mechanical damage to nerve cells and blood vessels

2. Secondary insult: evolution of pathological processes from the time of injury – continual damage over hours and days after

What are Nerve Cells?

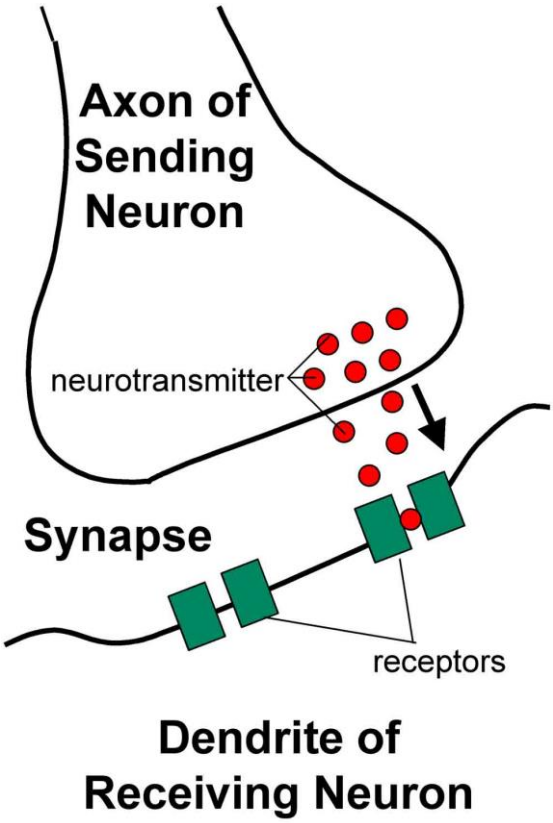
Nerve cells are the cells of the nervous system (the brain and spinal cord) that are specialised to transmit messages from one part of the body to another. The messenger cells are called neurons. They carry electrical signals that are used for cell-to-cell communication. Neurons release neurotransmitters, chemicals that excite neighbouring neurons and allow messages to pass through the body. Essentially, neurons work as a team. The initial insult of TBI can cause shearing, tearing and or stretching of the brain tissue.



Complete the table below with the function of the neurone regions:

Name	Function
Nucleus	
Cell body	
Dendrite	
Myelin	
Node of Ranvier	

Neurotransmitters and Excitotoxicity



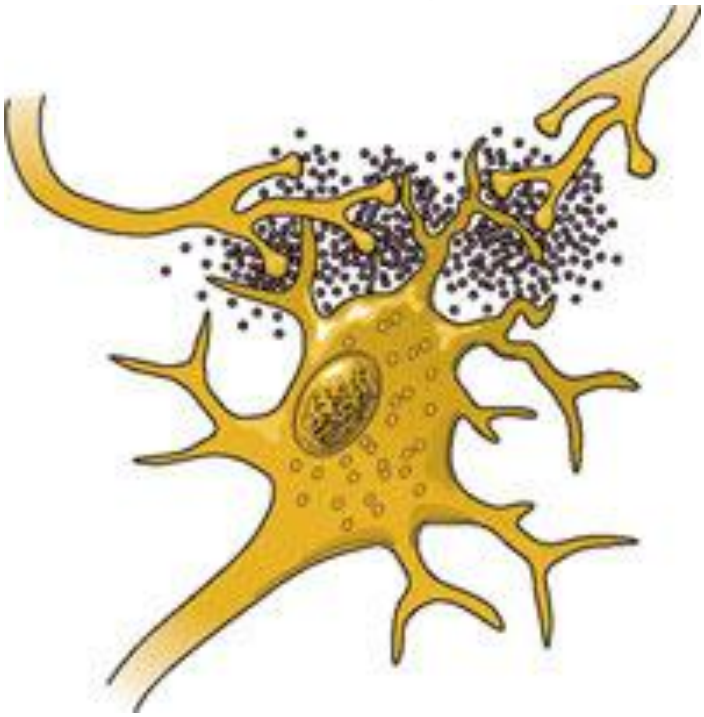
Neurotransmitters are a class of chemicals that carry messages between neurons. A sending **neuron** releases neurotransmitter, which activates the receiving neuron. The receiving neuron becomes active and sends the message along.

There are a number of **neurotransmitters** that have been identified; e.g. acetylcholine, dopamine and serotonin. An imbalance of neurotransmitter can be seen in the implication of several diseases such as Alzheimer's disease and Parkinson's disease.

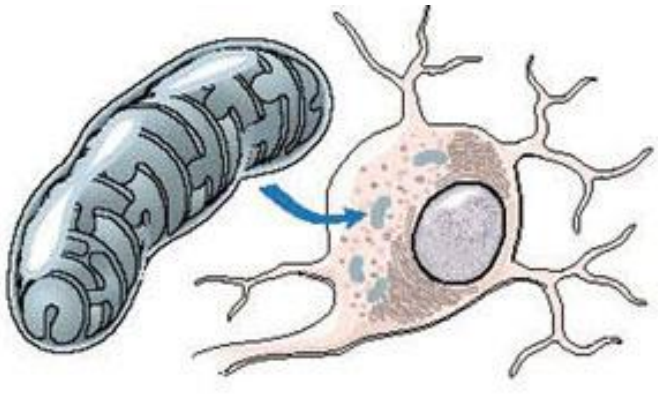
BUT too much neurotransmitter is TOXIC!

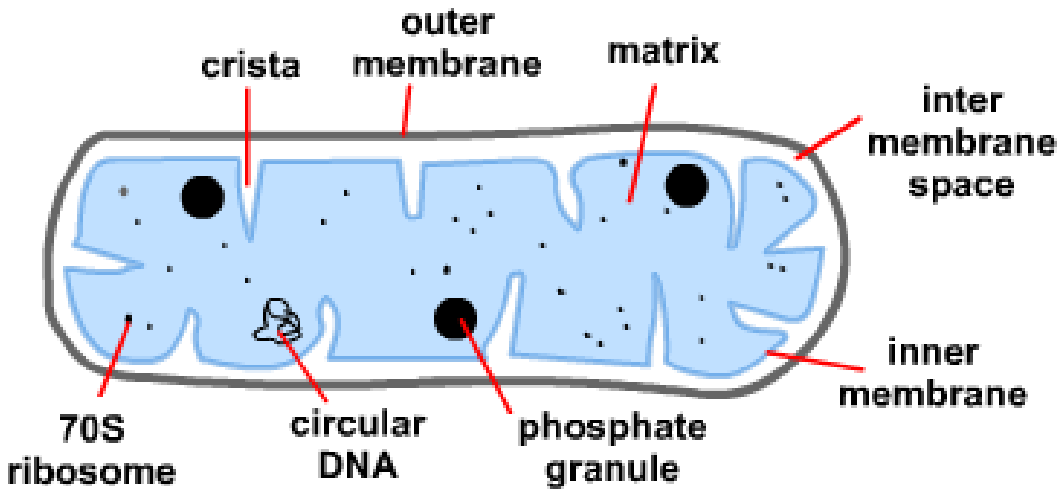
Neurons become damaged when nearby cells release excess levels of the chemical signal (neurotransmitter) glutamate. This excitotoxicity causes levels of other molecules (ions) to become disrupted and affects other important organelles of the cell, such as the mitochondria. There has been some research that have recognised an excess release of neurotransmitter as a result of TBI.

Label the diagram below with the appropriate regions:



What are mitochondria and why are the mitochondria important players in TBI?





Q: What is an organelle?

Q: What is the function of mitochondria in a cell?

Homework 2

1. There are three classes of neurons. Can you find out what the differences between them are?

a) Sensory Neurons

b) Motor Neurons

c) Association Neurons

2. What is a synapse?

3. We touched upon the topic of mitochondrial malfunction due to the imbalance of neurotransmitters during excitotoxicity. What are the specialised functions of the different components of the mitochondria?

Ribosomes

DNA

Folded inner membrane

4. We learnt a little about neurotransmitters and their function in communication between nerve cells. An imbalance of neurotransmitter can be found in a number of diseases such as

Alzheimer's disease and Parkinson's disease. Can you do some research and find out why an imbalance of neurotransmitter has been associated with such diseases (you can choose one disease of the two to describe). Be sure to reference any sources used.

Tutorial 3: Treatments and Scientific Research – Part 1

What is the Purpose of Tutorial 3?

- Discuss the current treatments that are available for the treatment of blast TBI
- To be able to evaluate the treatments in their efficiency
- To explore scientific research and how theories are designed and experiments carried out – in vitro Vs. in vivo
- Learn how to reference correctly

Let's Review – Write three NEW points that you have learnt about TBI.

1.

2.

3.

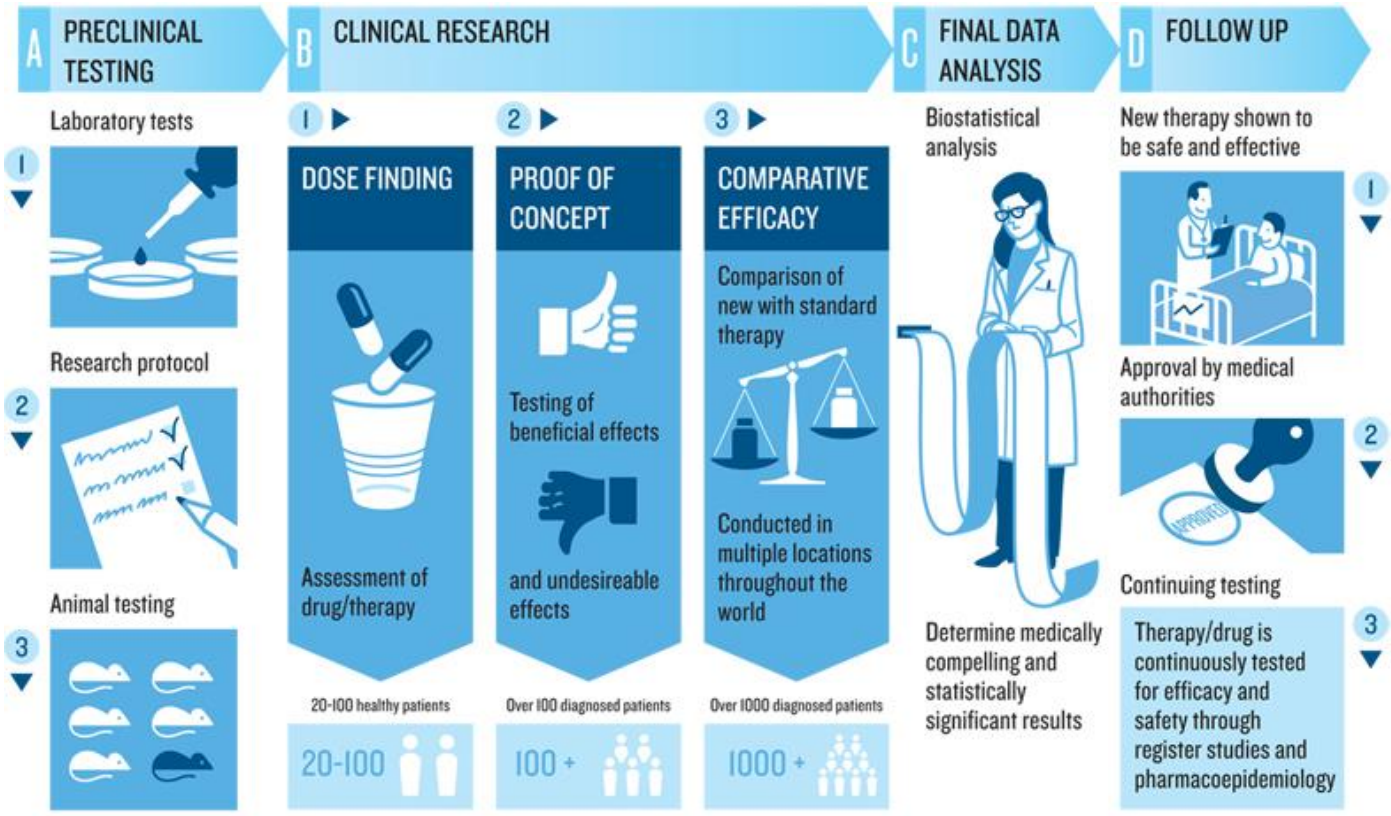
What is neuroprotection?

Neuroprotective treatments are interventions that aim to reduce the incidence of TBI – thus, potentially improving the outcome after injury. It is known that after the initial damage of nerve cells, there is a short window before the following excitotoxic damage. This gap in time could suggest that the opportunity exists to arrest or minimise progressive damage.

At present, TBI management options are disappointing and many drugs do not pass clinical trials.

Q: What kind of drug/ treatment do you think would be useful for TBI?

Q: What are clinical trials and how long do you think they take?

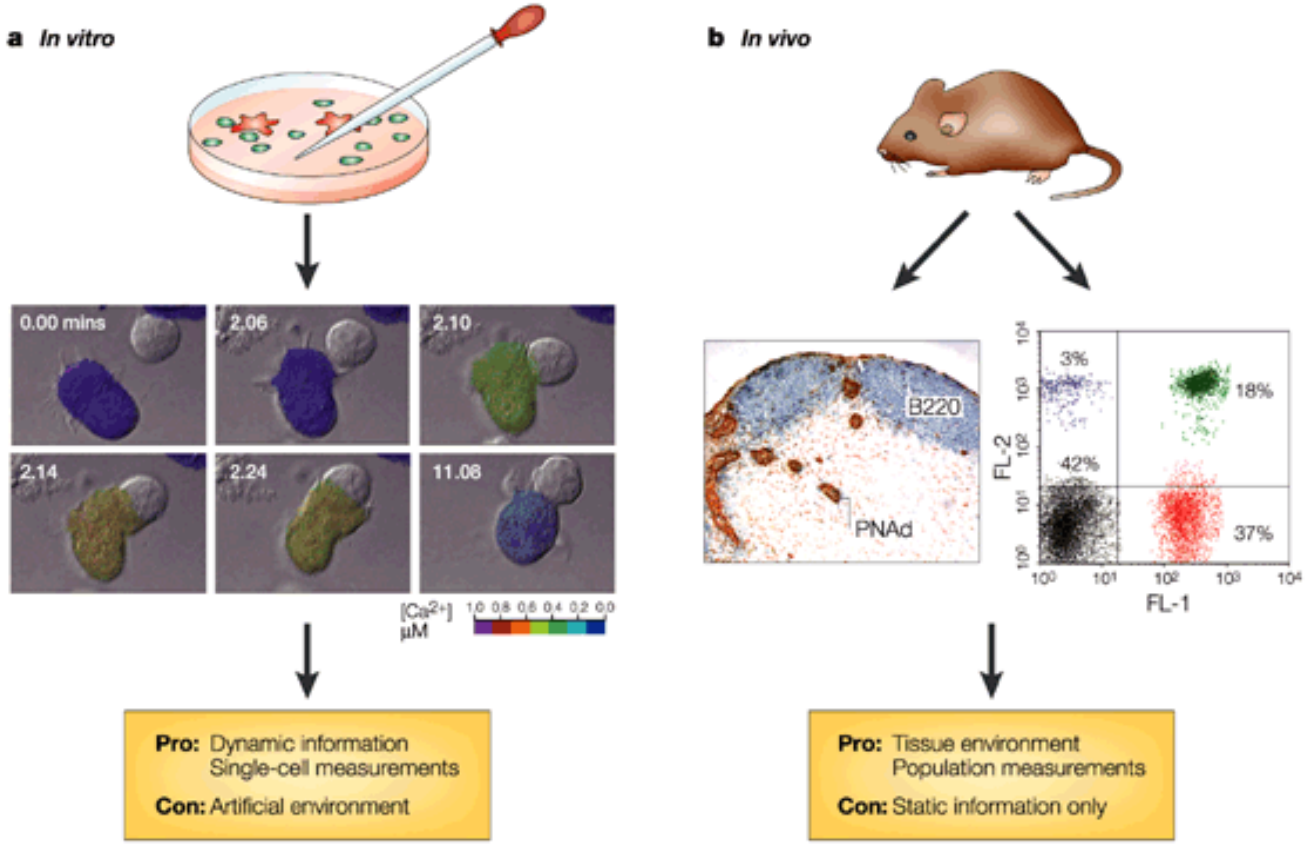


Q: Can you think of any ethical issues that may arise during preclinical testing?

Q: Can you think of any ethical issues that may arise during clinical testing?

Scientific Laboratory Research: Different Research Models – *In Vitro* Vs. *In Vivo*

There isn't ONE way to conduct scientific research. In fact, there are hundreds of ways to study a particular topic and every researcher has their method and reasoning behind it.



Which technique would you carry out first? Do you think the results from '*in vivo*' research can be translated into humans?

_____

_____

_____

_____

_____

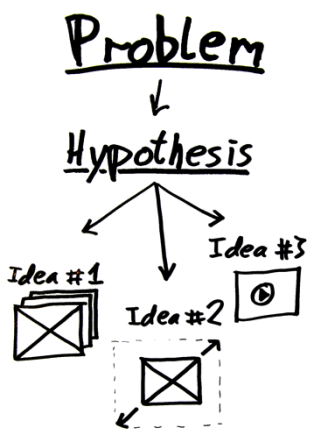
_____

<u>Hypothesis</u>

A hypothesis is a proposed explanation made on the basis of limited evidence as a starting point further investigation.

e.g. If _____(I do this)_____, then _____(this)_____ will happen.

Scientists base their work from a hypothesis that branches into many smaller ideas. These ideas form the experiments that they do in order to answer the question.



Homework 3 – Analysing and discussing research findings

1. The blood brain barrier can also be damaged as a result of blast TBI. What is the blood brain barrier and why is it important?

2. Read the following review paper and answer the questions below. Tip: Highlight the important points as you read!

Nowrangi *et al. Medical Gas Research* 2014, **4**:3
http://www.medicalgasresearch.com/content/4/1/3

MEDICAL GAS RESEARCH

REVIEW Open Access

Argon gas: a potential neuroprotectant and promising medical therapy

Derek S Nowrangi[1], Jiping Tang[1*] and John H Zhang[1,2*]

Introduction

Argon gas is considered a small noble gas element that has been applied in a number of fields. It has been generally classified as a nonreactive or inert gas providing a view that it does not contain any biologically active characteristics. In fact, argon has demonstrated characteristics such as narcosis at hyperbaric pressures and more recently neuroprotective and organoprotective behaviors. Pharmaceutical drugs and surgical interventions have been widely accepted and commonly used methods of clinical treatments for a variety of applications such as the neuroprotection [1-4]. However, the high cost and development of new drugs and surgical techniques have exposed a need for new and easy to administer treatments. The application of argon as a medical gas presents a possible relief to this search and provides distinct advantages.

This review seeks to show the development of argon in the medical field with an emphasis on its ability as a neuroprotectant. In order to provide a foundation of argons role in the medical field, a summary of its discovery and characteristics will be first provided. We will then discuss the evidence suggesting the affirmative ability of argon as a neuroprotectant and highlight some evidence suggesting otherwise. In order to better understand how argon provides its biological actions, a review and discussion of the possible mechanisms of receptor interactions and apoptotic cellular pathways will be provided. Finally, we will consider the future of argon as a clinical therapy and other potential applications in the medical field.

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a) What is the point of this paper? What message is it trying to get across?

b) Why do we need to look for new way to treat TBI patients?

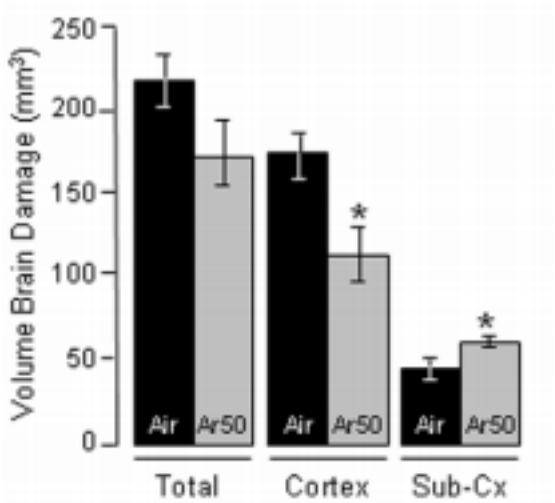
3. Authors from the paper below treated brain-damaged rats with Argon (Ar50 – 50% volume) as a neuroprotectant. They also used plain air as a way of comparing with Argon. They then studied the volume of brain damage in different brain regions – the cortex and sub-cortex (Sub-Cx).

(If you wish to read more about this experiment, you can search for this paper at www.pubmed.com).

PLoS One. 2012;7(2):e30934. doi: 10.1371/journal.pone.0030934. Epub 2012 Feb 22.

Ex vivo and in vivo neuroprotection induced by argon when given after an excitotoxic or ischemic insult.

David HN[1], Haelewyn B, Degoulet M, Colomb DG Jr, Risso JJ, Abraini JH.



Q: What does this graph tell you about the effect of argon on the brain-damaged rats? Did it work? Use the graph to support your answer.

Tutorial 4: Treatments and Scientific Research – Part 2

What is the Purpose of Tutorial 4?

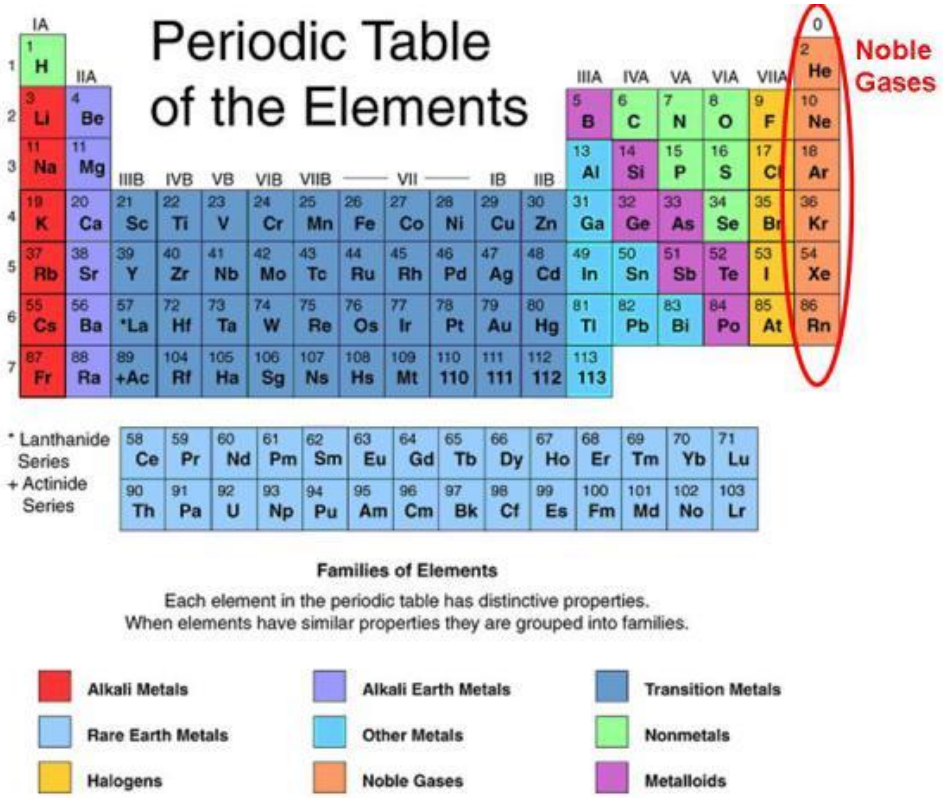
- To be able to understand and discuss primary research from published papers
- Understand the relevance of xenon and argon in TBI therapy
- Suggest an experimental design and possible method for trying to find a treatment for TBI

What are Xenon and Argon? Why are they important in TBI treatment?

Xenon and Argon are important elements part of the family of six Noble Gases. They are chemically inert – meaning that they do not react with other elements as they contain the full eight electrons in their outermost energy level. They are quite rare but also have anaesthetic properties, meaning that they are used clinically. Xenon as a neuroprotective agent has been explored.

Xenon is known to prevent overstimulation of neurons, preventing excitotoxicity and the cascade of events that damage the mitochondria and other organelles in the nerve cell.

Although not certain, there is some emerging research surrounding this treatment and its potential as an effective neuroprotective.



Xenon is already used clinically as an anaesthetic. Why is this a good thing if it is found as a good treatment for TBI? Think about the drug development process.

Crit Care Med. 2015 Jan;43(1):149-58. doi: 10.1097/CCM.0000000000000624.

Xenon improves neurologic outcome and reduces secondary injury following trauma in an in vivo model of traumatic brain injury.

Campos-Pires R[1], Armstrong SP, Sebastiani A, Luh C, Gruss M, Radyushkin K, Hirnet T, Werner C, Engelhard K, Franks NP, Thal SC, Dickinson R.

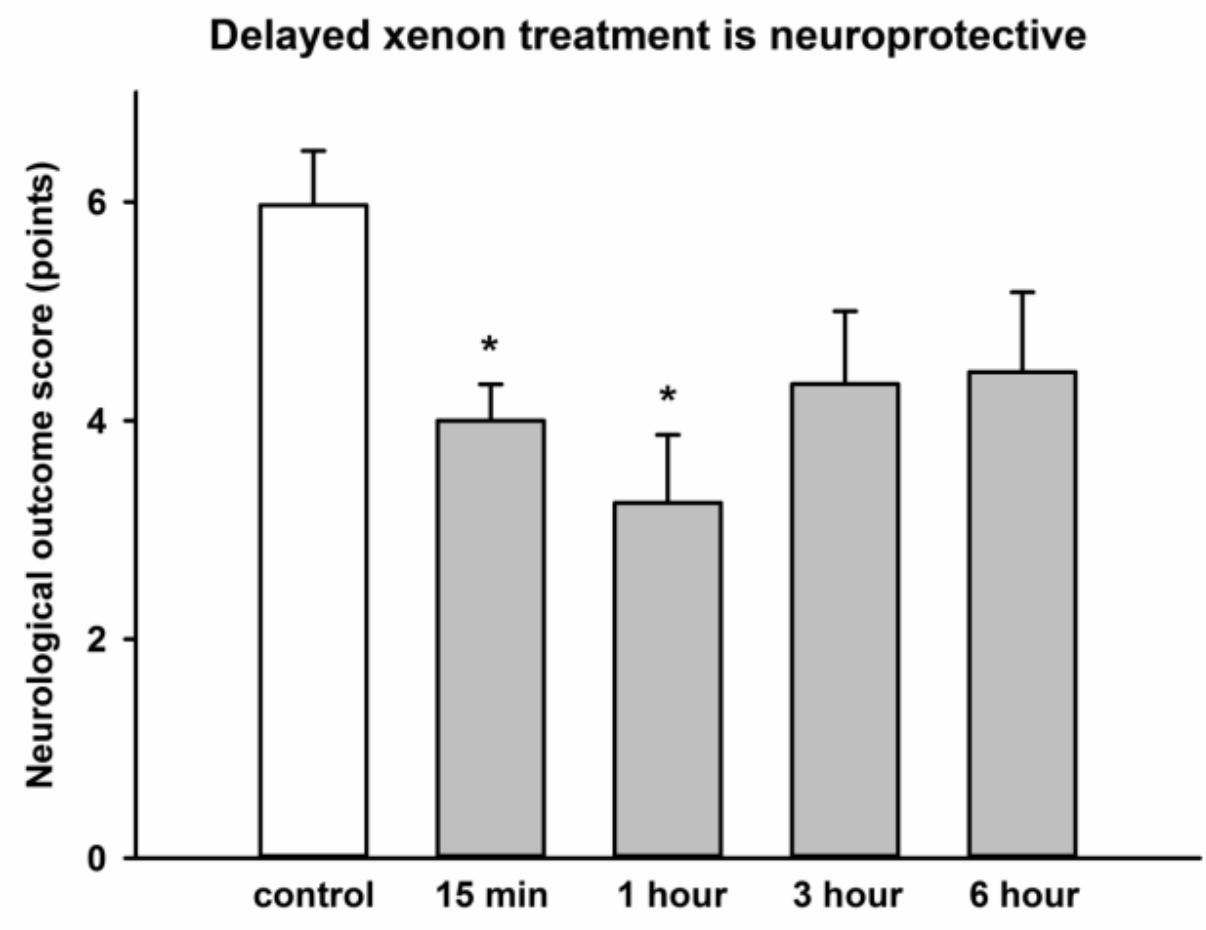


Figure 3.
Delayed xenon treatment following trauma improves neurological outcome 24 hours after trauma. Xenon-treated animals (grey bars) received 75% xenon : 25% oxygen for 3 hours duration, starting at 15 minutes, 1 hour, 3 hours or 6 hours after trauma. Control animals (white bar) received 75% nitrogen : 25% oxygen. Neurological outcome was measured 24 hours after trauma. Bars represent mean values and error bars are standard errors (n=34, control; n=21, xenon 15 min; n=8, xenon 1 hr; n=9, xenon 3 hr; n=9, xenon 6 hr) * = $p<0.05$ compared to control.

Q: What does the asterisk above some of the bars mean?

Other methods of data analysis: images of brain slices after injury.

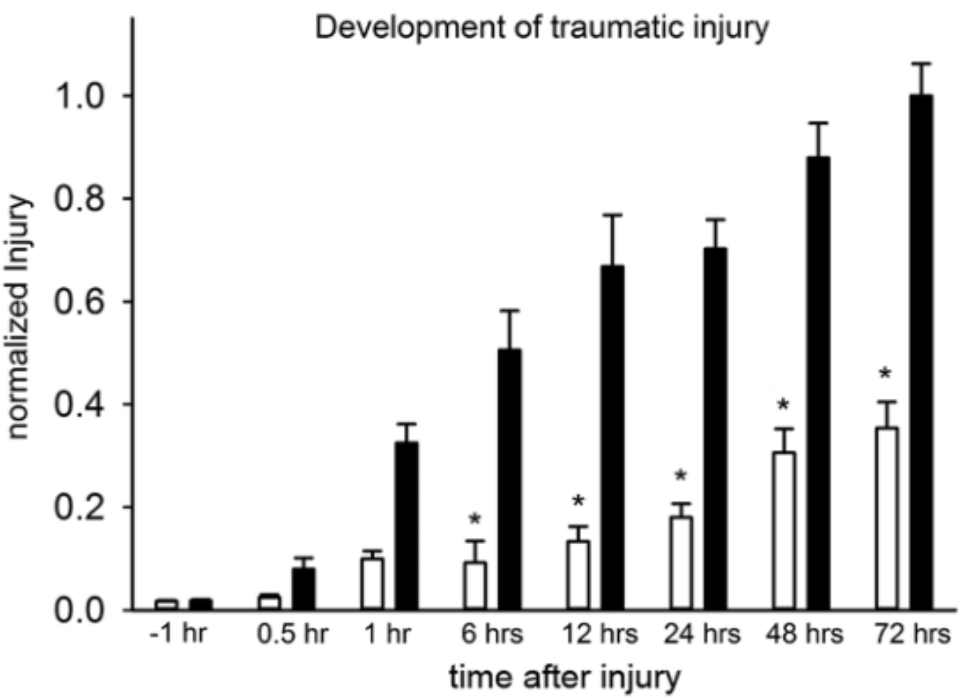
t = -1 hr | 0.5 hr | 24 hr | 48 hr | 72 hr

The white area shows the growth of damage using propidium iodide (PI) fluorescence. PI only enters cells that have a damaged cell membrane. The white that can be seen in the microscope represents the growth of brain damage.

Describe and analyse what the images above show:

As we have previously seen, data can also be represented graphically. White bars are xenon treated injured cells and the black bars are cells with injury and no treatment.

Describe and analyse what the graph below shows:



Homework 4 –

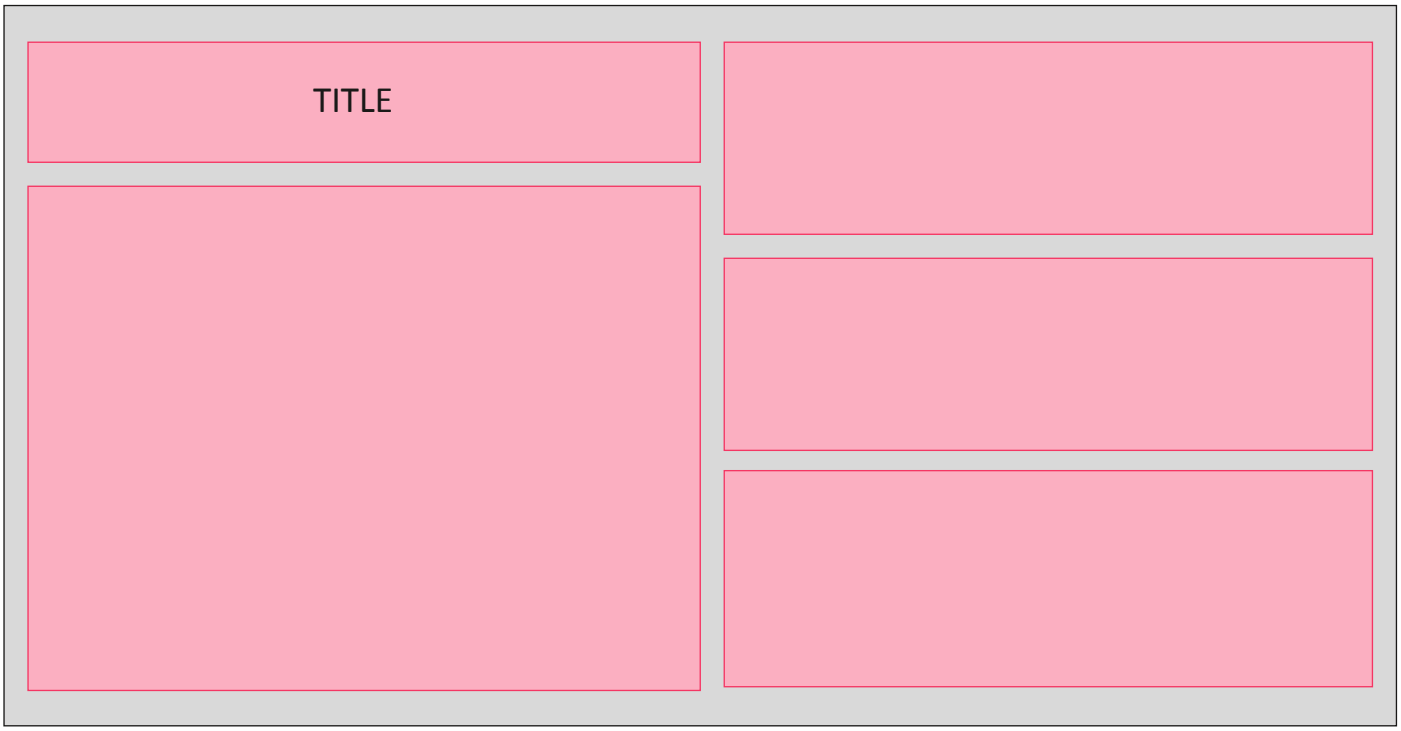
Presenting scientific research data

Design an informational poster on an A4 sheet of paper showing what you know about TBI so far and show some examples of the current research.

Extra research/reading is strongly encouraged! The poster must be engaging and fun to read. Ask yourself if you would want to read it.

Make sure you include the following:

- Anatomy of the brain
- What is TBI?
- How does TBI manifest itself?
- What neuroprotectants are being researched at present?



Tutorial 5: Treatments and Scientific Research – Part 3

What is the Purpose of Tutorial 5?

- To understand how scientific data is analysed statistically
- To be able to plot data effectively, in a way that is reader-friendly
- To be able to interpret a different types of graphs that present data from research

The table below shows some data taken from an experiment where brain slices were treated with different neuroprotectants (xenon, argon, krypton and neon). There were also control experiments carried out where brain slices were not damaged and not treated, and also damaged but not treated.

Percent (%)	24 hours	48 hours	72 hours
Control : No trauma, no treatment	18	23	27
Control : Trauma, no treatment	62	83	100
Xenon treatment	29	38	60
Argon treatment	40	45	70
Krypton treatment	48	62	100
Neon treatment	64	80	94

There are different ways of plotting data.

Let's discuss the different ways this data can be plot on the graph paper below.

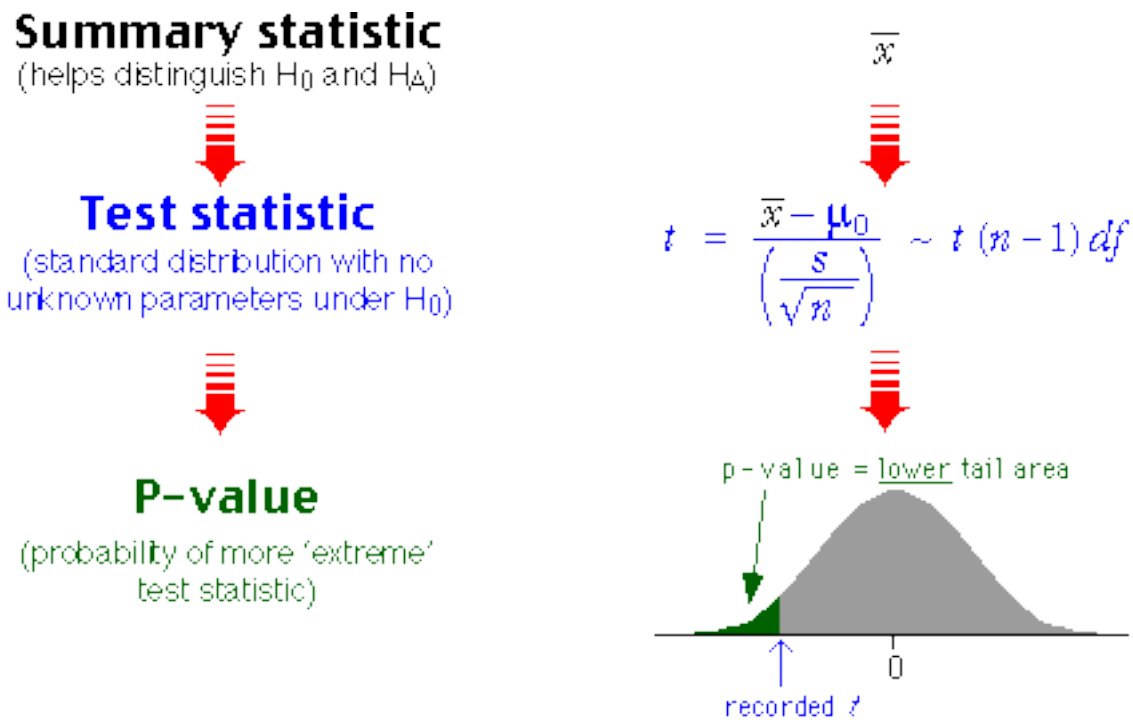
How can we analyse this data using statistics?

It is really important to know how to analyse data statistically, as this will give us the quantitative numbers that will allow for future work, and that can be used in published papers.

Let's discuss how we can analyse data such as the one given below.

Percent (%)	24 hours	72 hours
Control : No trauma, no treatment	18	27
Control : Trauma, no treatment	62	100
Xenon treatment	29	60

There are a number of different statistical tests. The most popular is called a 't-test'.



Homework 5 – Draft Assignment: Literature Review and Presenting Findings

For your final assignment, you will need to write a literature review. This is a type of university style essay where you analyse a number of sources in order to form a discussion and argument regarding to a certain topic/ question. Gather information and plan your essay. Include all the relevant information regarding TBI and its manifestation. Also include information about current research that is being carried out.

<u>Final assignment:</u>

Part 1:

What do we know about traumatic brain injury (TBI)? Evaluate the effectiveness of current TBI treatment and discuss potential treatments being studied by researchers today? Use research papers and figures to support your essay.

Write an essay of 1200 words with a bibliography. Use at least two research papers to support your writing. Use all the information that we have learnt about TBI and how it progresses in severity. Discuss the different research methods that have been used to try to find a therapy for TBI, and suggest your own method is possible. Be critical and show original thought as and when possible.

There are three research papers at the back of this handbook. You are free to use these (and reference as necessary), or you can find relevant ones yourself. Use these sources to support your answer and to form a strong argument. You don't need to write full sentences, a draft is more of a space for brainstorming and organising your ideas into sections that can later be expanded when writing the essay.

1. Introduction

- Background information about TBI
- Summary of the topic that you will be discussing

2. Main Body

- Talk about the information you have found
- Critically analyse your sources
- Compare your sources with another
- Start to form an argument/ generate a few points that will answer your question

3. Conclusion

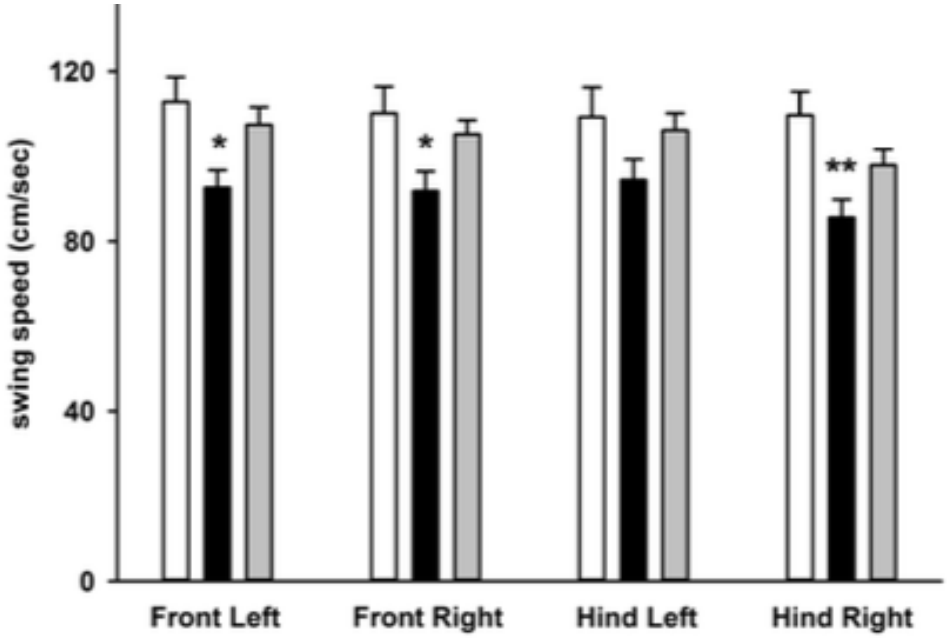
- Summarise your review
- Give a final statement based on your research

Part 2:

To determine whether there were specific locomotor deficits in particular limbs we examined the swing speed for each limb. Swing speed is calculated from stride-length and time between paw placements for each limb.

Analyse the graph below and write a small paragraph (approximately 300 words) summarising the data that is presented here. Think about including the following things:

- Why is swing speed interesting?
- What do the results show (be exact and give numbers).
- What do the asterisk mean?
- Give details about the statistics.
- Did xenon have a neuroprotective effect on swing speed?



Legend: Analysis of individual limb speed shows a significant reduction in TBI-injured animals in front left, front right and right hind limb speed compared to sham-operated animals. Xenon-treated TBI-injured animals are not significantly different to sham-operated controls. Bars represent mean values of sham (white), TBI-injury (black) and xenon-treated TBI injury groups (grey). The error bars are standard errors (*n*=9 sham, *n*=19, TBI, *n*=19 TBI + xenon). * = $p<0.05$, ** = $p<0.01$ compared to sham-operated control.

Tutorial 6: Feedback Tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on final assignments.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

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?
• • •	• • •

Examples of excellent essays

Essay 1

Another major problem with in vivo testing are the surrounding ethical issues. The animals used in the experiments have to be given TBI in most cases and this has drawn widespread criticism including anti-animal cruelty charities that have a loud voice when it comes to their campaign. This could prove to be another obstacle before the treatment is distributed.

I personally believe that in vitro testing is the most useful as the effects are clearly displayed at a cellular level, allowing researchers to iron out any flaws that they have noticed. Despite this, it is quite logical that in vivo testing is done as well so there can be an accurate representation of the effects of the treatment on living organism. This should only be done *after* various in vitro tests to reduce potential risk of an animal being left with TBI which would likely lead to death.

What went well with Essay 1?

Essay 2

NMDAR may be involved in the way argon acts as a neuroprotectant. Overstimulation of NMDAR results in an increase of the levels of calcium inside the cell. This increase causes a rise in the levels of a protein called Bax which is known to cause cells to self-destruct. It competes with the proteins Bcl-2 and Bcl-xL which keep the cell from dying because of Bax. Zhuang and colleagues found that, when treated with argon, levels of Bcl-2 in nerve cells increased but there was no change in the levels of Bax or Bcl-xL. This would potentially stop the cell from dying because of the Bax protein. This is similar to how xenon acts as an anaesthetic and a neuroprotectant. Xenon inhibits the activity of NMDAR which lowers levels of calcium in the neurones.[8]
However a study by Harris and colleagues showed that NMDAR may not be involved in argon's neuroprotective abilities.

What went well with Essay 2?

Essay 3

Overall, it is alarming the increase of TBI cases in the UK and in the world. In fact, TBI can cause numerous types of complications. It can lead to speech impairment, locomotive deterioration, loss of memory or in more extreme cases death. Now it is understood how important noble gases like argon and xenon are to prevent secondary and third injuries. Their abilities as neuroprotective can be really beneficial to the humankind saving millions of life. After researching and analysing different experiments, I came to the conclusion that xenon even though it is expensive is the best neuroprotective agent. So the use of xenon and argon is a possible way to combat TBI and hopefully in future there will be more efficient treatments against TBI.

What went well with Essay 3?

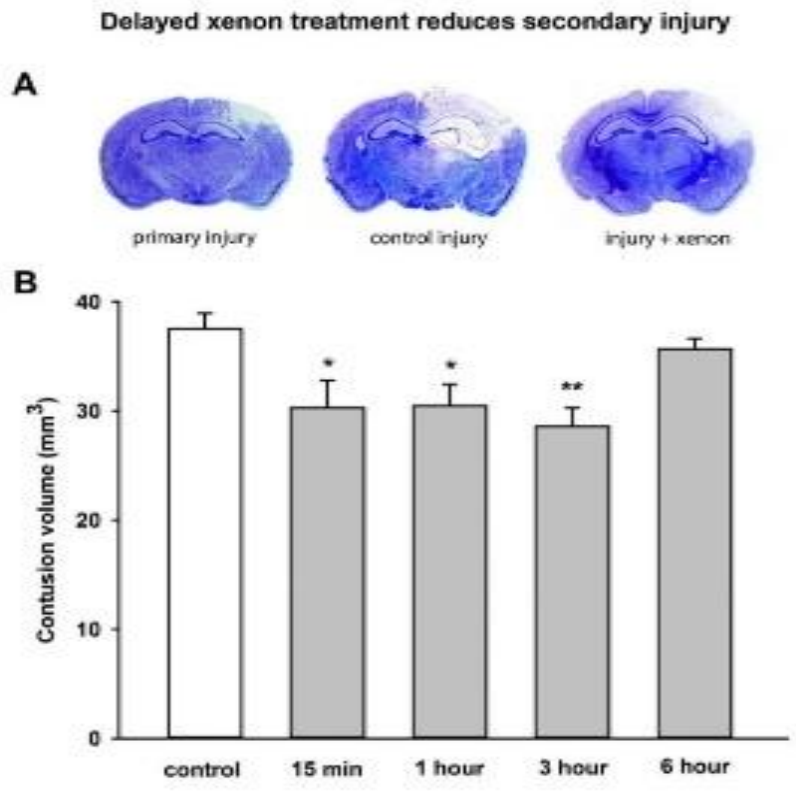
Essay 4

A Chinese study sought to monitor the clinical efficacy of acupuncture and cognitive training after a cognitive impairment due to TBI. There were 28 cases in the observation group and 27 cases in the control group. The control group were given cognitive and conventional training; the observation group were applied acupuncture in 4 regions, once a day for 4 weeks. To assess their progress they implemented the mini-mental assessment and the Montreal cognitive assessment. The observation group's results in both assessments were significantly more than the control group's results and had vastly increased scores compared to the first assessments they had completed.
This paper presents an alternative and safe approach to improve mechanical functions, which does not require complex treatment to administer. Acupuncture naturally stimulates nerves to release endorphins and reduces pain as the equivalent to morphine. In contrast, it may not be as an effective neuroprotectant as xenon or argon but is a cheap and unique method that has already proven to be effectual with humans, whereas xenon and argon has not yet gone to clinical trials to be applied on people and would be inconvenient to travel with in combat settings [7].

What went well with Essay 4?

Essay 5

One research paper[1] suggests that delayed xenon treatment reduces secondary injury as shown in figure 1. We can see that there is a significant difference between the control and the secondary injury treated by xenon (as shown by the asterisks which indicate a significant difference). Looking at figure 2 from the same research paper we can see that xenon treatment (given 15 minutes after injury) appears to significantly reduce the primary injury[1]. The paper then goes on to say "These findings support the idea that xenon may be of benefit as a neuro-protective treatment in brain trauma patients" It also says how xenon appears to most beneficial up to 3 hours.



What went well with Essay 5?

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 I 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.

Referencing Sources - Practice

Important for:

- Successful research
- Helps the reader find the original source if they wish
- Improves writing skills
- Adds authenticity to the argument
- Shows wider reading

What is plagiarism?

Plagiarism is deliberately presenting someone else's ideas as your own – basically cheating! In university, plagiarism is treated seriously and usually results in disciplinary action. Be sure to always write passages in your own words and note down sources as you plan/write your essay.

Author(s) – (Year) – Title – Journal Name – Volume Number: Page Numbers

E.g.

Soc Sci Med. 2015 Dec;147:309-16. doi: 10.1016/j.socscimed.2015.11.015. Epub 2015 Nov 17.

Injury careers after blast exposure among combat veterans deployed to Iraq or Afghanistan.

Chase RP[1], McMahon SA[2], Winch PJ[3].

Chase RP, McMahon SA, Winch PJ (2015). Injury careers after blast exposure among combat veterans deployed to Iraq or Afghanistan. *Soc. Sci. Med.* 147: 309-16

Write the source below in proper format as demonstrated above:

J Neurosci Nurs. 2016 Feb;48(1):15-27. doi: 10.1097/JNN.0000000000000176.

Pathophysiology and Treatment of Severe Traumatic Brain Injuries in Children.

Allen KA[1].

Appendix 2 – Using the VLE

VLE username	
VLE password	

Please remember the following key details…

- You are able log into the VLE either through the link on our website (www.thebrilliantclub.org) or going directly to the VLE site at (https://portal.thebrilliantclub.org/sign-in).
- Please update your profile with your full name and email address- this will allow you to retrieve forgotten passwords or usernames
- If you forget your log-in details you can request them to be emailed to you by clicking the link on the VLE home page. (If you are still having problems you can email: schools@thebrilliantclub.org)

What is the VLE?

The VLE is a virtual learning environment for all pupils on Uni Pathways it is used for:

- messaging your tutor
- submitting homework
- submitting your final assignment
- accessing resources for your tutorials
- finding out more information about university and careers

How should I use the VLE?

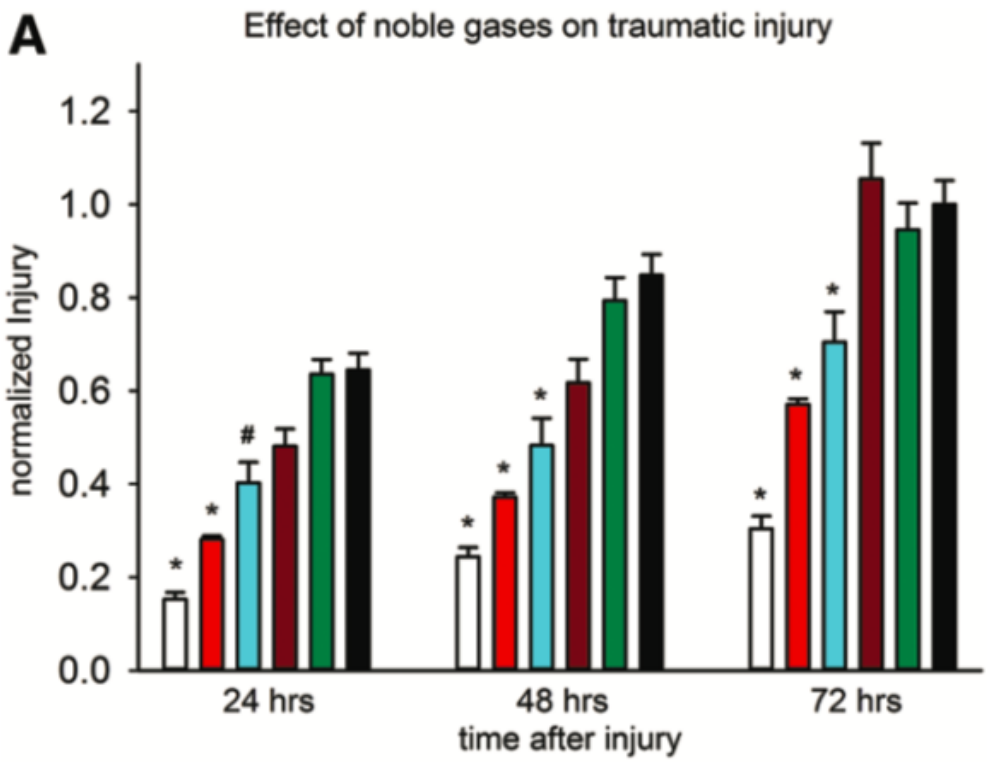
The VLE is a professional academic environment in which pupils are able to message their PhD Tutor. Here are a few things to consider:

- Ensure you keep a professional tone in the messages you send to your tutors.
- Ensure you always reply to your tutors in a timely manner.
- Thank your tutor for the effort they are putting in to give you your feedback etc.
- Submit all homework to your tutor on time.

IMPORTANT: Final assignment

- When you submit your final assignment, please remember that you need to do so through the 'My Activities' tab and not as an attachment to a message.

Notes



(A) Effect of 50% atmosphere of the inert gases xenon (*red bars*), argon (*cyan bars*), krypton (*brown bars*), and neon (*green bars*) on control traumatic injury (*black bars*) at 24, 48, and 72h after injury. Sham-treated slices (*white bars*) were not subject to trauma. Xenon and argon provided significant neuroprotection at all time points. Xenon was more effective than argon, with xenon-treated slices being 57±1% of control injury compared with 70 ± 6% of control injury for argon-treated slices, 72h after injury. None of the other inert gases provided significant protection against injury at any of the time points. The *error bars* are standard errors. The data have been normalised to the control injury at 72 h after injury. *Indicates value significantly different ($P < 0.001$) from control injury at each time point. #Indicates value significantly different ($P < 0.01$) from control injury (N = 141 control traumatic injury; N = 105 sham; N = 104 xenon; N = 44 argon; N = 45 krypton; N = 22 neon).

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