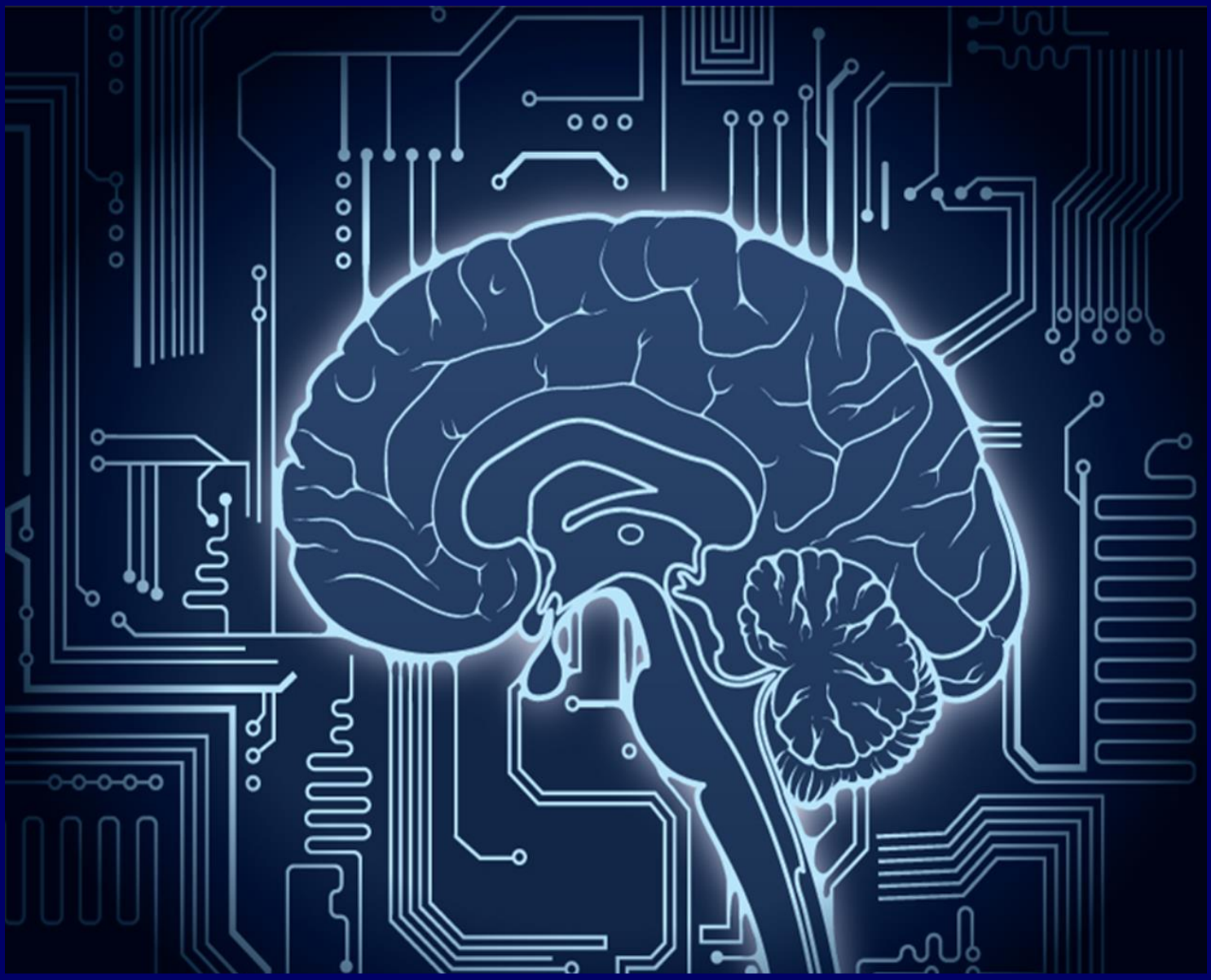
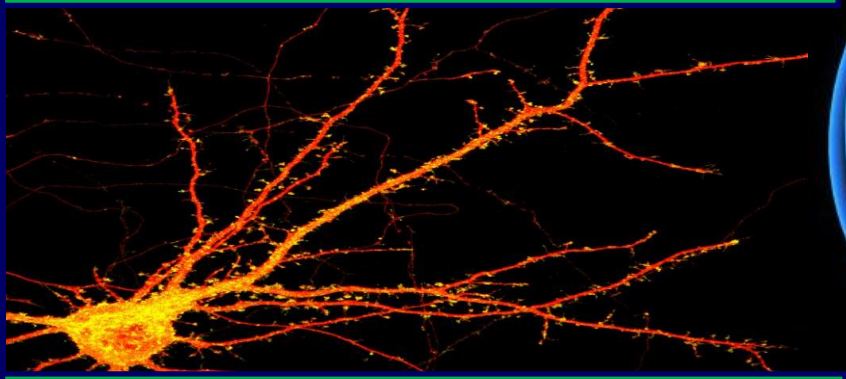


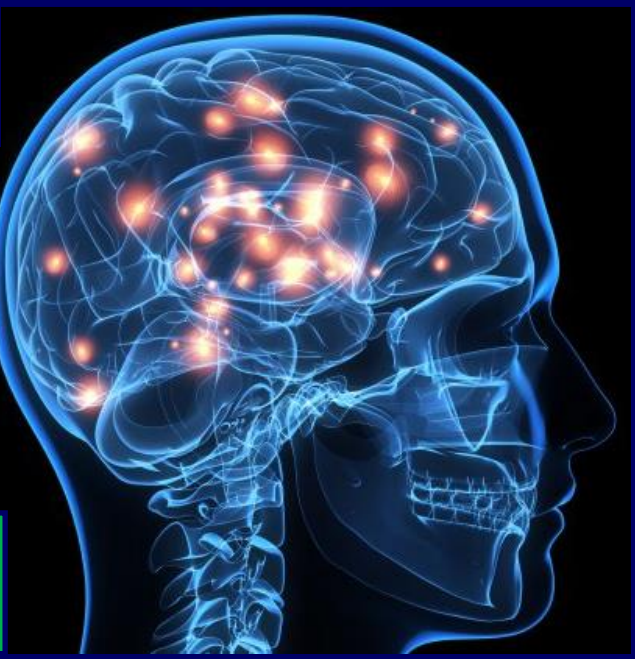
THE SCIENCE OF THE BRAIN

Advances, techniques and research

Key Stage 4 Programme: 2016-2017

Teacher's Name: Dr Bammann





Pupil's Name:

Timetable and Assignment Submission

Fill this in with your teacher.

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6			
7			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 5		
Tutorial 6		

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after 4.00pm on	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

KS4 Programme 2016-17 – 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 current key stage
3rd	40-49	Performing to a good standard at current key stage
Working towards a pass	0-39	Performing below a good standard at current key stage
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 RIS Teacher			
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 teacher 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*

Example

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Course Rationale

In recent years there has been an increasing trend for young people from all backgrounds to access higher education (HE). However, a significant gap remains between the rich and poor when it comes to attending high tariff universities[1]. One of the most crucial indicators of a student's likely progression to HE, particularly for progress to higher tariff universities, is their subject attainment.

The RiS Uni Pathways (UP) course aims to uplift students' subject attainment first and foremost. This is in line with both the science department and the School's wider focus on A/A* pupils as well as the RiS core aims of championing university access and increasing subject expertise. Providing subject-specific tailored mentoring will support students to reach their target grades at GCSE.

In addition, the university focus of the course is expected to increase students' aspirations towards HE progression, providing them additional focus, confidence and resilience in their studies. The UP Course is modelled on the Brilliant Club's (thebrilliantclub.org) Scholar's Programme, which has proven to be a successful way of achieving this[2].

About the course:

Neurons are specialised cells in our body, responsible for coding, interpreting and responding to environmental information. The olfactory bulb is a part of the brain responsible for transforming odours into useful information for the brain. For a long time it was believed that when we reach adulthood neurons are no longer being born in the brain. However, recent research has shown otherwise. We know that these adult-born new cells can travel to the olfactory bulb, but what is their role in this system? How do neurons modulate and pass information to other neurons in a network? What methods can be used to study these processes? Understanding the principles of neuronal activity and neurogenesis, and improving the tools necessary for this research, could lead to new treatments for different mental diseases such as Alzheimer's, Parkinson's and Huntington's disease, and mood disorders such as depression and anxiety.

This course is aimed at pupils who are interested in the functions of the brain and methods of studying them. This course will provide an understanding of the main principles of neuroscience research.

The initial tutorials will present to the pupils the basic concepts of neurogenesis, neuronal activity, neuronal network and neuronal imaging. These concepts are based on general cell biology (semi-permeable membranes, proteins, ion channels), electricity (currents, parallel circuits), and optics (frequency range of the spectrum, interactions of electromagnetic radiation with matter, lenses). Once the pupils are familiar with these concepts, they will be presented with the methods for studying neuronal activity and neuronal network activity, such as electrophysiology, calcium imaging and optogenetics, and will discuss information from academic articles. Finally, with some data obtained during my postdoctoral research the pupils will present a reduced version of an academic article.

Tutorial 1: Do we smell with only our noses?

Tutorial 2: Classical methods of neuroscience research.

Tutorial 3: Neuronal network – how does it work?

Tutorial 4: Computational practical on neuronal network.

Tutorial 5: Advanced methods of neuroscience research.

Tutorial 6: Wrapping up!

Tutorial 7: The role of granule cells.

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[1] UCAS End of Cycle Report 2015, UCAS, December 2015

[2] http://www.thebrilliantclub.org/wp-content/uploads/2015/07/TBC-Annual-Report-web_VF.pdf

Course Map

What is the function of the brain? How does it decode environmental information?
Anatomy of a neuron. Electrical properties of the neuron.
Measuring the activity of a neuron.
How can we see neurons? What are a microscope and its parts?
Inhibitory and excitatory neurons in a neuronal network.
Different ways of analysing neuronal activity.
Do adult-born new neurons modulate the neuronal network?

Mark Scheme:

Key Skill	1st	2.2
Language	☐ Uses appropriate new and scientific vocabulary correctly and effectively. ☐ Use of new scientific vocabulary shows a detailed understanding of the concepts covered.	☐ Uses simple new vocabulary effectively but struggles with new vocabulary that is more challenging. ☐ Scientific vocabulary may be used incorrectly at times.
Communication	☐ Writing is coherent and organised following a logical sequence. ☐ Almost faultless spelling, punctuation and grammar. ☐ Writing is of an appropriate style for the scientific document and follows stylistic techniques.	☐ As times the writing is poorly organised with a lack of coherent structure. ☐ The spelling, punctuation and grammar are weak in places. ☐ Inconsistent use of style throughout resulting in lack of clarity.
Critical thinking and evaluation	Critical thinking ☐ Validity of all data is discussed without the need to be prompted to do so. ☐ Critical evaluation of the data is systematic and logical – the limitations of the data are explained clearly and most of the main points have been covered. ☐ Evaluation is consistent across the different data sets being used. ☐ Not too critical of the data they are using (e.g. does not refuse to use it because of a minor flaw in the experimental design). ☐ Appropriate suggestions are made for improvement of the experimental design to increase the reliability of the results. Evaluation ☐ Shows a good understanding of what a hypothesis is and how the data presented supports or refutes it. ☐ Generalisation of the argument (if appropriate) has been performed correctly and succinctly with no superfluous steps or irrelevant reasoning. ☐ Conclusions are well-reasoned and clearly supported by the data, but the limitations of the data are also recognised and discussed. ☐ Data from a range of sources is used for comparison with their results and any differences are discussed	Critical thinking ☐ Validity of some of the data they are using is discussed. ☐ Critical evaluation of the data covers some of the main points but at times the reasoning is not clear or lacks a logical progression. ☐ Can be inconsistent in the evaluation of different data sets (e.g. where two data sets were collected using the same methodology, the reliability of only one set is discussed). ☐ Can be too critical of the data (e.g. refuse to use it because of a minor flaw in the experimental design). ☐ Suggestions are made for improvement of the experimental design, but these can be unrealistic or would not have the desired effect. Evaluation ☐ Some understanding of what a hypothesis is, but this might be confused with a theory. ☐ Discusses how the data presented supports the hypothesis, but some steps in the reasoning may be missing and/or irrelevant points have been included. ☐ Generalisation of the argument has been attempted but not accurately. ☐ Results have not been compared to literature.
Research skills	☐ All the outside sources are correctly referenced in the agreed format. ☐ Uses a purposeful but imaginative range of sources; reliable, relevant, and balanced in their choice. ☐ Comprehensive research is evidenced; sources of information go beyond the obvious choices.	☐ Sources are not always referenced correctly. ☐ A limited range of sources has been used. ☐ Sources that have been found outside of the course reading may be unreliable; inappropriate for the subject; or heavily biased; limited attempt made to balance these with other sources.
Analysis	☐ Uses all sources of data and evidence to support a conclusion. ☐ A quantitative form of analysis is used to infer a relationship (e.g. stating proportionality due to doubling of quantities). ☐ Stages of analysis covered in tutorials (numeric or written) are correctly implemented and easy to follow; these are effective applied to unseen problems. ☐ Has considered the limitations of data/evidence sources where appropriate. Using this to support their conclusion. ☐ The argument towards the conclusion is well developed and logical.	☐ Uses some but not all sources of data/evidence to support a conclusion. ☐ Uses qualitative analysis effectively, quantitative analysis may be incorrect at times. ☐ Stages of analysis covered in tutorials are correctly use, there may be difficulty in applying these to unknown problems. ☐ There is some consideration into the limitations of the evidence sources. ☐ The argument towards the conclusion is less well developed and difficult to follow.

Glossary of Keywords

Word	Definition	In a sentence…
Neuron	A specialized, impulse-conducting cell that is the functional unit of the nervous system, consisting of the cell body and its processes, the axon and dendrites.	A neuron is the unit of the nervous system that passes information throughout the body.
Action potential	The change in electrical potential that occurs between the inside and outside of a nerve or muscle fibre when it is stimulated, serving to transmit nerve signals.	When a neuron is active, information is passed in the form of an action potential.
Ion channels	Pore forming membrane proteins that control action potentials through the flow of ions across the membrane.	Sodium and potassium ion channels are responsible for the shape of an action potential in neurons.
Excitatory	An excitatory neuron increases the probability of an action potential occurring in another cell.	An excitatory neuron makes the next neuron fire more action potentials.
Inhibitory	An inhibitory neuron decreases the probability of an action potential occurring in another cell.	An inhibitory neuron makes the next neuron fire less action potentials.
Microscope	An optical instrument having a magnifying lens or a combination of lenses for inspecting objects too small to be seen or too small to be seen distinctly and in detail by the unaided eye	Microscopes are used to observe cells that cannot be seen with the naked eye, such as neurons.
Fluorochromes	Fluorescent chemical compounds that can re-emit light upon light excitation. They can be used as tracers, dyes, substrates of enzymes or indicators.	One way to detect an action potential is to fill up neurons with the fluorochrome GBP-1, which shows levels of calcium inside a cell.
Calcium imaging	Scientific technique that shows the levels of calcium ions, providing further information on action potentials.	We can measure an action potential indirectly with calcium imaging techniques – an action potential increases calcium levels inside a cell.
Calcium indicator	Molecules that bind to calcium. In doing so, they can provide information on levels of calcium ions in a region.	When an action potential occurs, calcium is released inside the cell, and calcium indicators show this increase.
Optogenetics	A scientific technique that allows the researcher to control an action potential through the use of light.	Optogenetics enables us to control the activity of a neuron by manipulating the opening of ion channels.
Neurogenesis	Formation of new neurons.	There are two main neurogeneses. One happens before birth, the other during adulthood. The latter occurs in fewer regions of the brain.
Olfactory bulb	A neural structure of the vertebrate forebrain involved in olfaction, or the sense of smell.	The olfactory bulb receives thousands of neurons every day through a process called neurogenesis.

Tutorial 1 – Do we smell with only our noses?

Today's Key Questions:

- What is the function of the brain?
- How is a neuron adapted to respond to the environment?
- How can you represent a neuron in a circuit diagram?

What is the Purpose of Tutorial 1?

- Introduction of myself and the course;
- Explanation of brain function and its ability to decode information from the environment;
- Anatomy of a neuron and its circuit diagram representation based on Hodgkin and Huxley model.

This tutorial will allow the pupil to understand the following topics and to be able to answer the questions bellow:

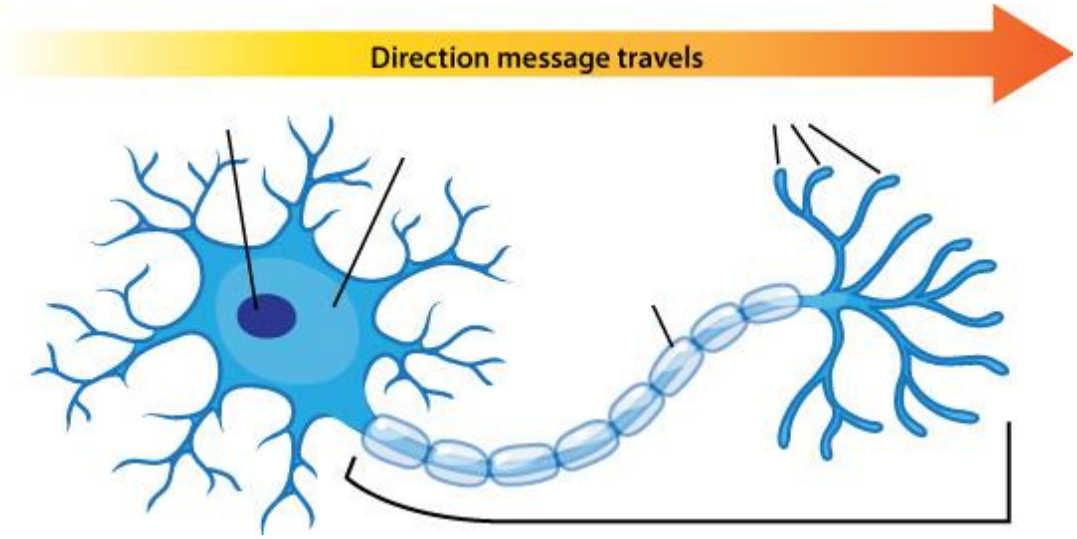
The five senses.	
Labels: - Smell - Sight - Touch - Taste - Hearing	

Notes:

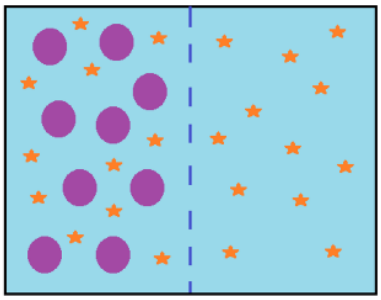
Name the parts of a neuron:

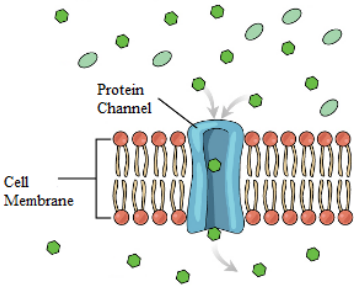
Labels:

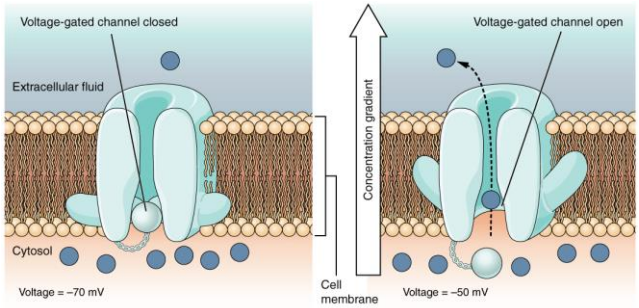
- Soma (cell body)
- Axon
- Nucleus
- Myelin sheath
- Dendrites
- Propagation of information
- Axon terminals



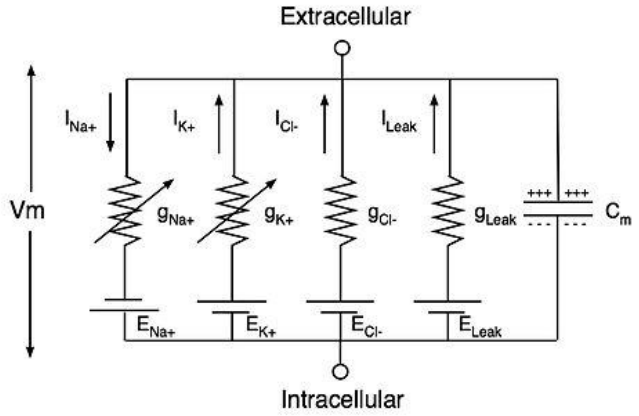
Describe the function of the semi-permeable membrane in cells. Use the images as guidance. Define the function of voltage-activated ion channels in a neuron.







Explain in your own words the arrows and the various symbols of the circuit diagram of a neuron below:



Notes:

Today's Homework is:

- Baseline Assessment

Relevant reading:

- Fundamentals of Neuroscience, Wikiversity (here). Lessons 1 to 4, 13, A, B and C. The others can be read for stretch.
- Neuroscience: Science of the brain, an introduction for young students. British Neuroscience Association, European Dana Alliance for the Brain (here). Chapters 1, 2 and 16. The others can be read for stretch.
- Introduction to Neurons and Neuronal Networks (here). Introduction, chapters 1, 2 and 3.
- MindCreators.com (here), neuron model.

Baseline Assessment

The homework assignment for the first tutorial is a baseline test to show 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 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 tutor identify where you are at the start of the programme and to help you measure your progress along the way.

Task:

Write in your own words a brief introduction to neuroscience (approximately 200 words), referring to the topics covered in the previous lesson. Include a definition of a neuron and its function in the nervous system (focusing especially on the central nervous system); the parts of a neuron; and how the neuron passes information. As a stretch, describe an action potential and how the membrane is responsible for the action potential. Please add references to support your ideas (reference rules are described in Appendix 1).

Tutorial 2 – Classical methods of neuroscience research.

Today's Key Questions:

- How can we measure the activity of a neuron?
- How can we see a neuron?
- What are the main components of a microscope?

What is the Purpose of Tutorial 2?

- Explanation of electrophysiology methods for research;
- Explanation of electronic microscope, imaging and optics methods for research.

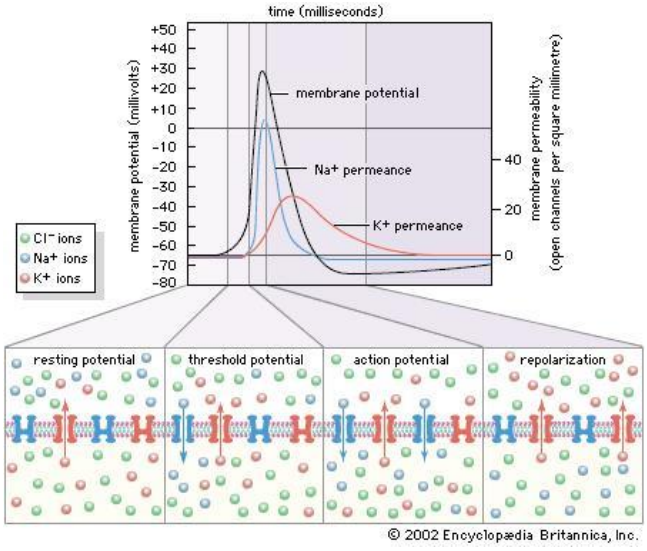
This tutorial will allow the pupil to understand the following topics and to be able to answer the questions bellow:

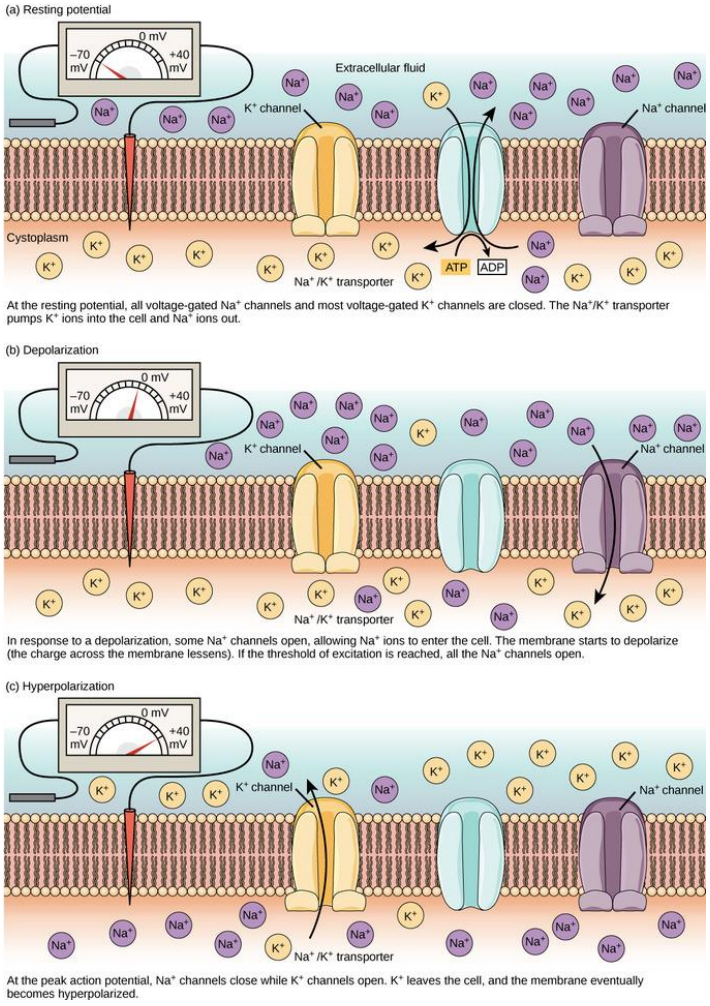
What magnitude is the potential difference of a neuron? Why does it have a value of around -85?

Ion	Concentration (mM)		Calculated Nernst potential
	Inside Cell	Outside Cell	
Na+	20	120	+45mV
K+	139	2.5	-101mV
Cl^-	3.8	120	-87mV
measured resting potential = -88mV			

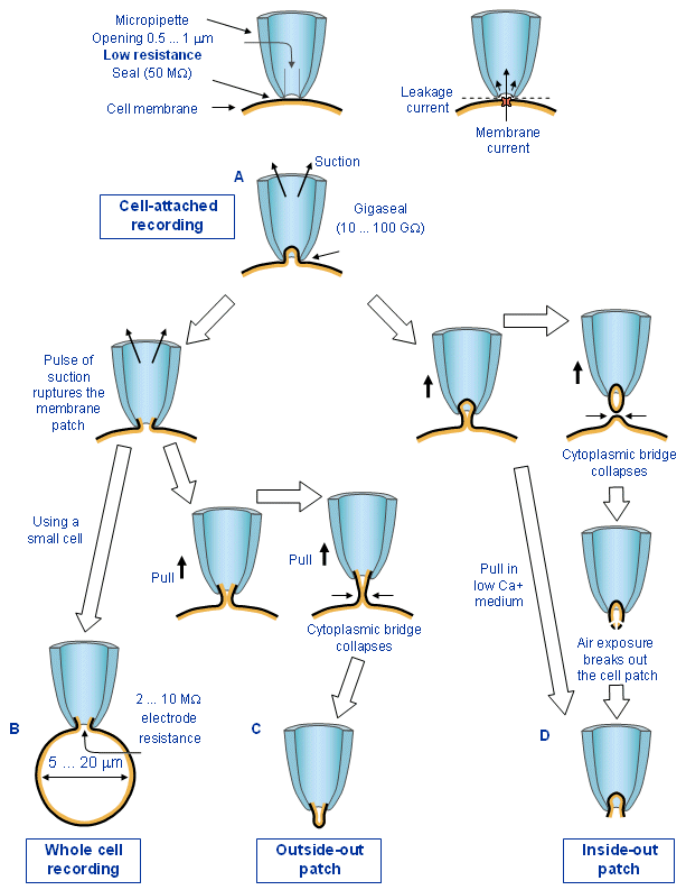
Notes:

What are the phases of an Action Potential? How do they happen?

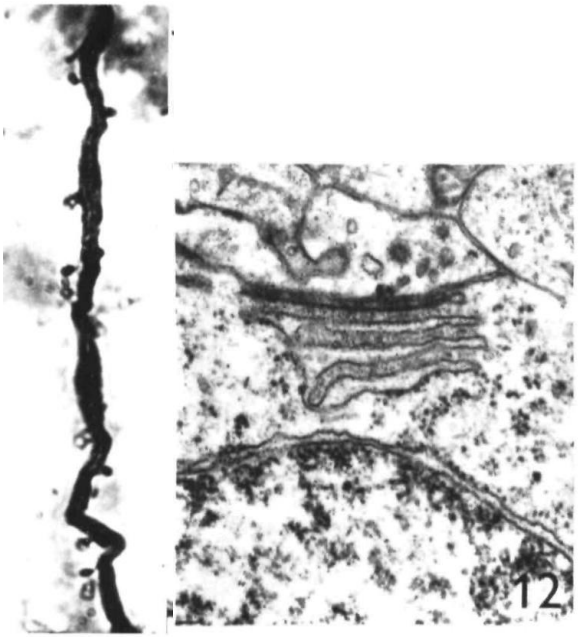




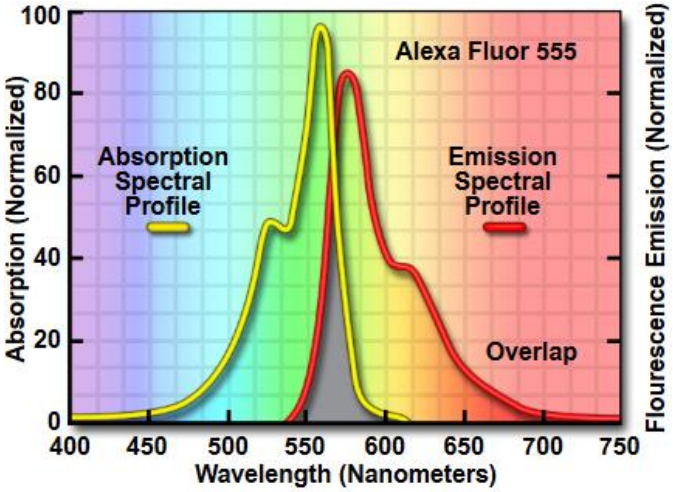
What are the types of slice/cell electrophysiology and their benefits?



What are the benefits of electronic microscopes in Neuroscience?



Describe in your own words how excitation and emission of fluorophores work.



Notes:

Today's Homework is:

Draw a figure showing the shape of a generic neuronal action potential, with time on X axis and voltage on Y axis. List the necessary equipment to analyse the activity and to obtain the morphology of the neuron in a live brain slice, connecting to the technique that you would be using for them. As a stretch, how would you identify adult-born new neurons arriving at the olfactory bulb?

Relevant reading:

- Electrophysiology Patch-clamp equipment (here). Youtube video.
- Electrophysiology for Dummies (here). Getting started and how to build a rig.
- Introduction on Brain Imaging (here), The Dana Foundation. Introduction, Brain imaging technologies and their applications in neuroscience, Cellular and molecular imaging, Optical imaging probes and Optical imaging microscopes.
- Price, J. L. and Powel, T. P. S. (1970). The morphology of the granule cells of the olfactory bulb. J. Cell Sci., 7, 91-123 (here).
- Introduction to fluorescence microscopy. Especially Introduction and Fundamentals of Excitation and Emission (here).

Tutorial 3 – Neuronal network – how does it work?

Today's Key Questions:

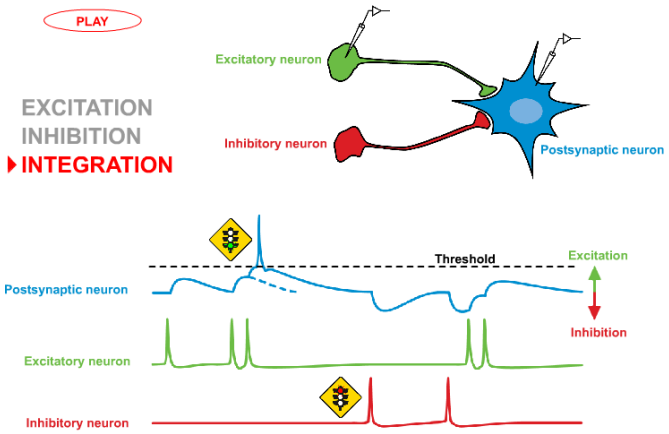
- How would the unity (neuron) work in a system (network)?
- How does the olfactory bulb work?
- How can different neurons modulate the activity of the network?

What is the Purpose of Tutorial 3?

- Explanation of neuronal network activity;
- Explanation of inhibitory and excitatory neurons;
- Explanation of granule cells in the olfactory bulb (inhibitory) and its specialisations.

This tutorial will allow the pupil to understand the following topics and to be able to answer the questions bellow:

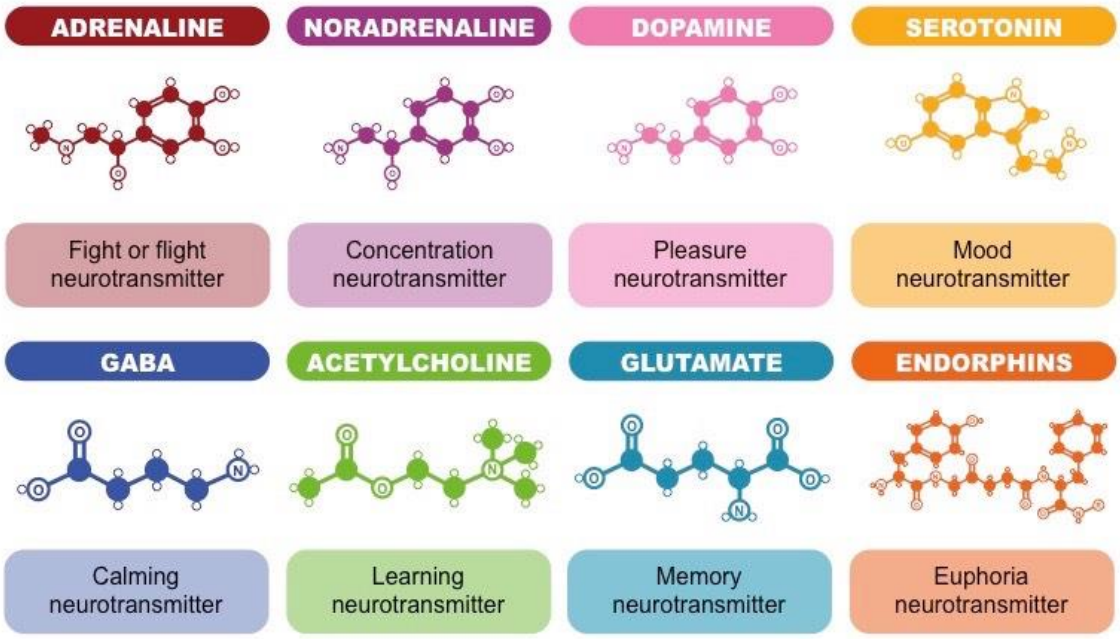
What does EPSP stand for? And IPSP?



Notes:

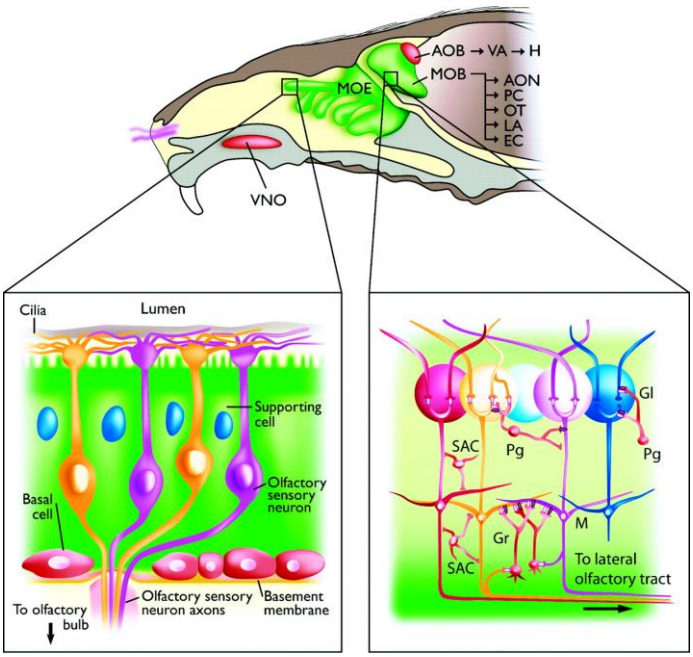
Describe in your own words the all-or-nothing rule of action potentials. Use the word "threshold" in your description.

Classify the following neurotransmitters into excitatory and inhibitory.



How would an excitatory neuron influence the activity of a postsynaptic neuron? And an inhibitory neuron?

How would a granule cell in the granule cell layer of the olfactory bulb modulate the sensorial information received?



Today's Homework is:

Describe the neurogenesis process that occurs in the olfactory bulb during adulthood. How do new neurons influence the activity of the established network? How could this affect an animal's odour sense?

Relevant reading:

- Balu, R. R., Pressler, T. and Stowbridge, B. W (2007). Multiple models of synaptic excitation of olfactory bulb granule cells. J. of Neurosci., 27(21), 5621-5632 (here).
- Introduction to Neurons and Neuronal Networks (here). Introduction and chapter 6.
- First glimpse of brain circuit that helps experience to shape perception (here).
- Adult neurogenesis in Wikipedia (here).

Tutorial 4 – Computational practical on neuronal network.

Today's Key Questions:

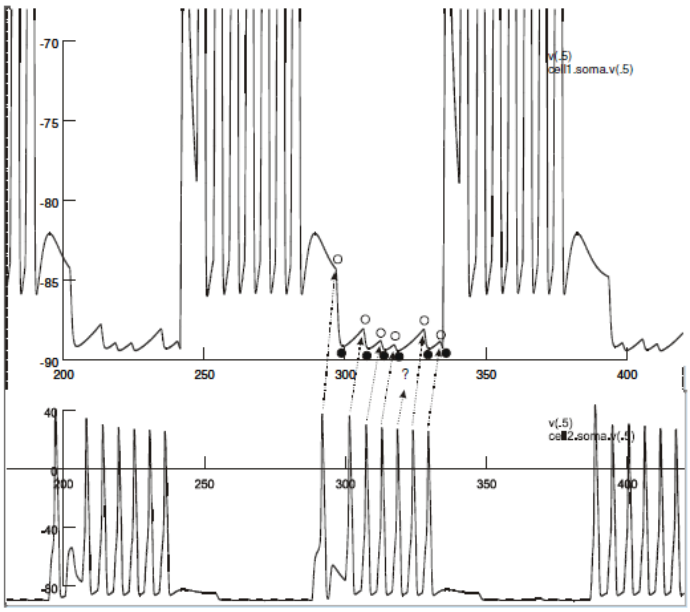
- How does an excitatory neuron behave in a network?
- How does an inhibitory neuron behave in a network?
- How do they influence the movement of a zebra fish?

What is the Purpose of Tutorial 4?

- Practical lesson with a simulated neuronal network.

This tutorial will allow the pupil to understand the following topics and to be able to answer the questions bellow:

Describe the activity of the two cells in the figure below.



Draw a hypothetical network of the previous figure.

Notes:

Relevant reading:

- Swimmy at MDCUNE, UCLA (here).
- Grisham, W., Schottler, N. A. and Krasne, F. B. (2008). SWIMMY: Free software for teaching neurophysiology of neuronal circuits. J. Undergrad. Neurosci. Educ., 7(1), A1-A8 (here).

Tutorial 5 – Advanced methods of neuroscience research.

Today's Key Questions:

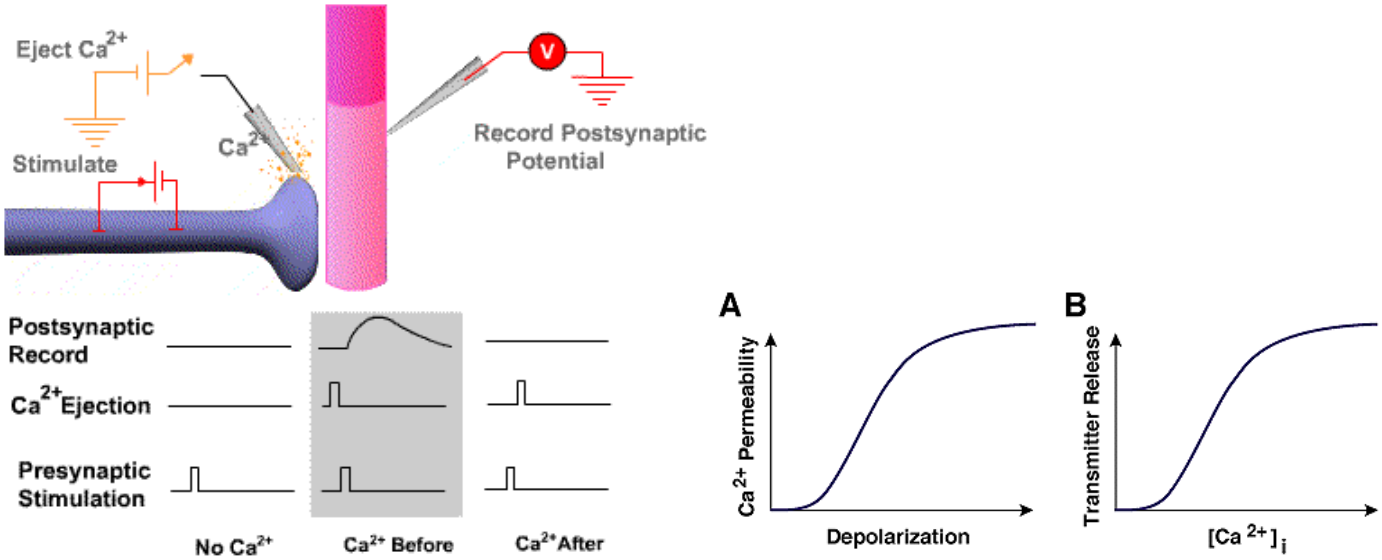
- How does the transmission of information from one neuron to another work?
- How can we measure this in a non-invasive way?
- How can we manipulate the neurons' activity in a non-invasive way?

What is the Purpose of Tutorial 5?

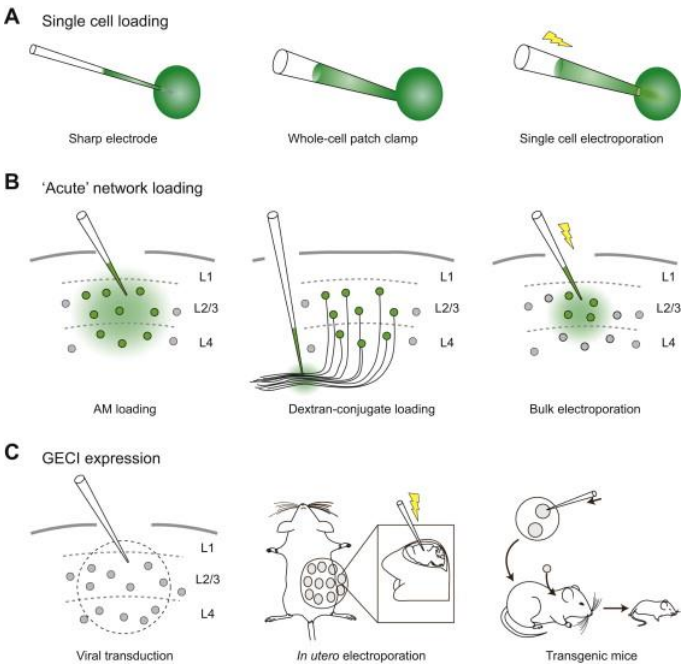
- Understanding the principle of calcium imaging;
- Understanding the principle of optogenetics.

This tutorial will allow the pupil to understand the following topics and to be able to answer the questions bellow:

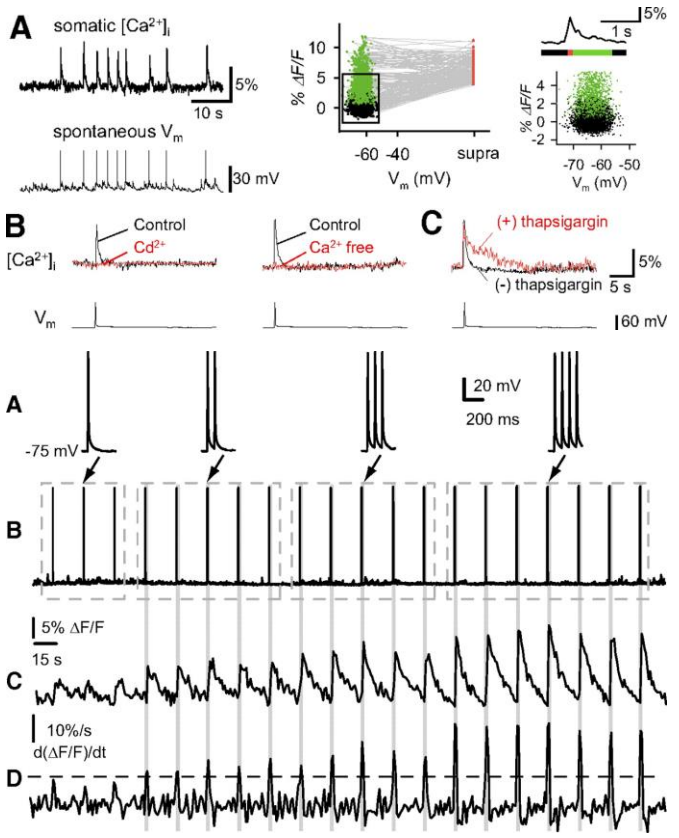
Using the figures below, describe what is happening on a presynaptic terminal during action potential.



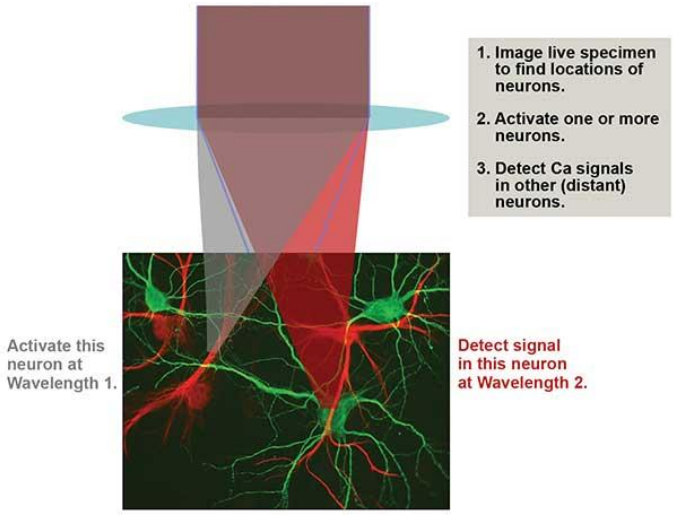
List one benefit and one disadvantage of each loading method.



Explain in your own words the time difference between an action potential and the levels of calcium inside a cell.



Describe the type of experiment in the picture below and give one reason this would be beneficial.



Notes:

Today's Homework is:

- Draft of Final Assignment (described in the next session). Not necessary to write the Methods and Results sections; however, a good Introduction, parts of the Abstract and parts of the Discussion will help you for the next tutorial. You can use the relevant readings for each tutorial to support your text. You can also use parts of previous assignments and questions in your write-up.

Relevant reading:

- Photonics handbook at edu.photonics.com. Especially Lasers for microscopy: major trends (here).
- Introduction to Neurons and Neuronal Networks (here). Chapter 5.
- Grienberger, C. and Konnerth, A. (2012). Imaging calcium in neurons. Neuron, 73(5), 862-885 (here).
- Optogenetics: Controlling the brain with light (here, youtube video. Beware: flashing lights).

Tutorial 6 – Wrapping up!

Today's Key Questions:

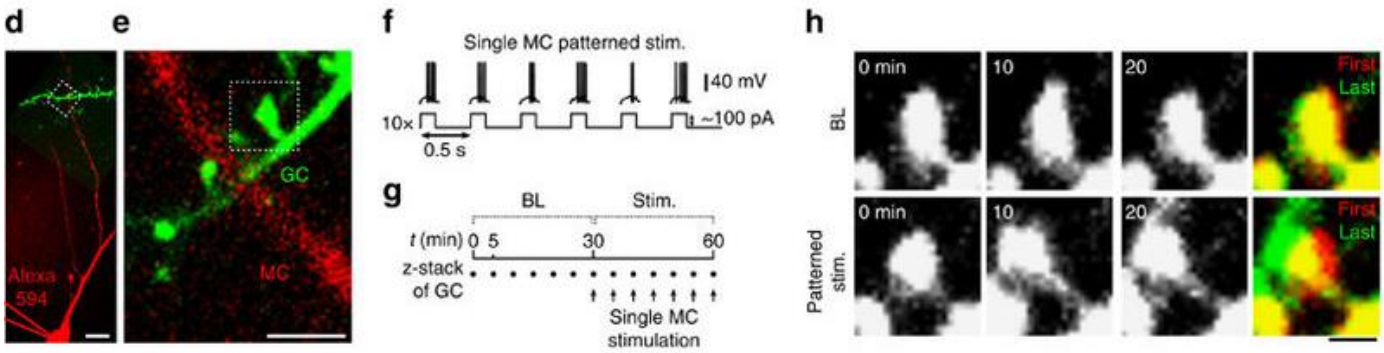
- Is there a way to control network communication within the olfactory bulb?
- Asking the main points of the whole course.
- Asking if the pupils understood the assignment.

What is the Purpose of Tutorial 6?

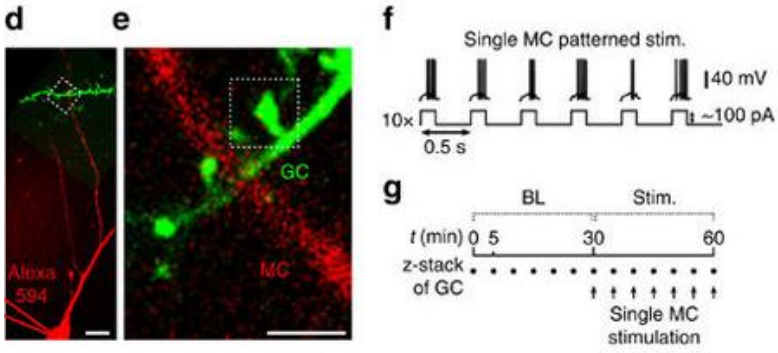
- Discussion of the various topics of the course.
- Demonstration of the movement and search abilities that granule cells have, in order to modulate the neuronal network.
- Presentation of data and discussion of the final assignment.

The pupils will be using for their final assignment the following data:

Electrophysiology and imaging.

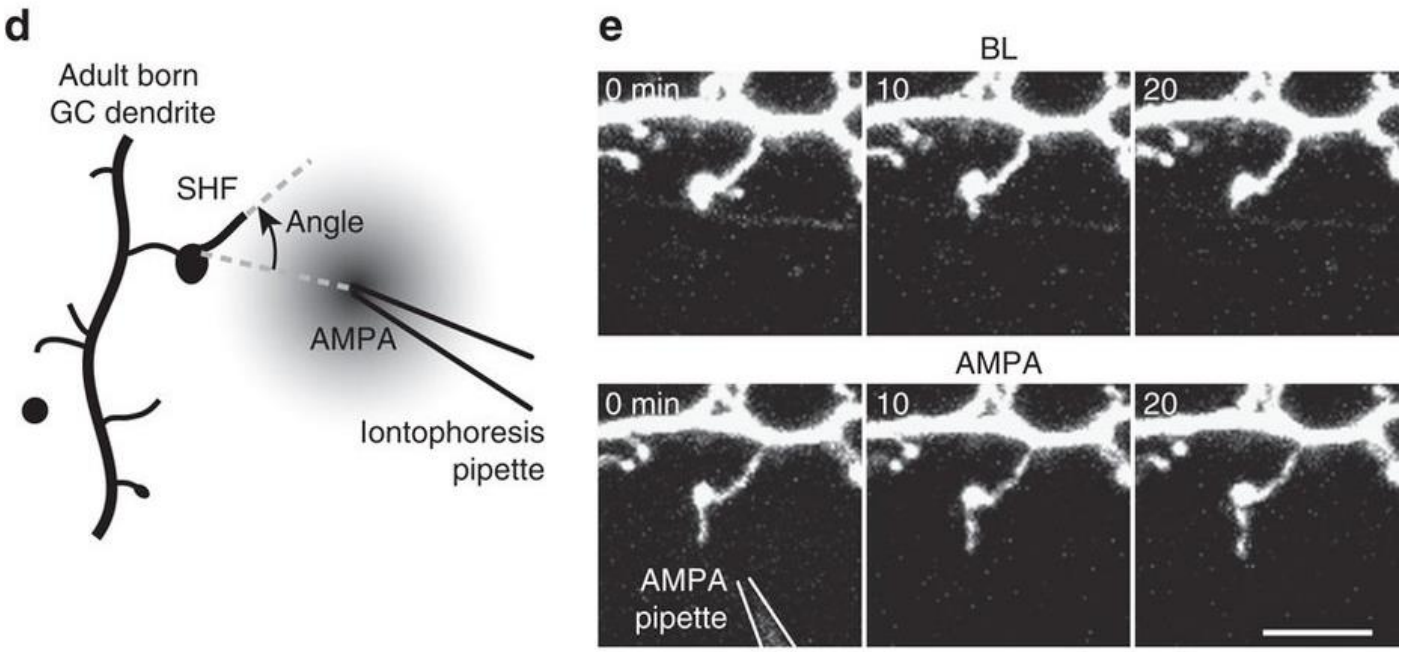


Displacement difference between first time point and last.			
Nearby spines		Distant spines	
Control	During stimulation	Control	During stimulation
0.5	2.2	0.5	0.5
0.4	2.1	0.2	0.4
0.1	2.0	0.2	0.6
0.2	1.8	0.4	0.7
0.7	1.9	0.3	0.4
0.4	2.2	0.3	0.5
0.1	1.6	0.1	0.3
0.7	2.4	0.5	0.6
0.4	2.3	0.7	0.4
0.0	1.7	0.3	0.2
0.3	1.5	0.6	0.1
0.5	2.0	0.4	0.1



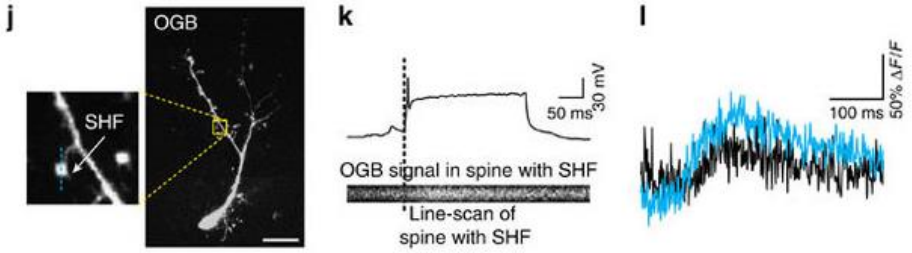
Number of APs elicited per stimuli.			
With spinehead displacement		Without spinehead displacement	
Before GC	After GC	Before GC	After GC
3	0	5	4
4	2	7	4
5	1	5	7
6	1	4	6
3	1	6	4
4	2	3	4
7	0	6	3
4	1	7	5
7	2	7	4
3	2	3	3
3	2	5	7
3	0	6	6

Pharmacology and imaging.



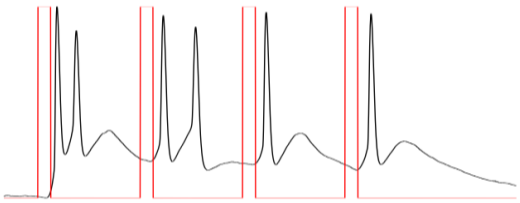
Angle difference between first time point and last.					
Nearby spines			Distant spines		
Control	Glutamate application	Glutamate antagonist	Control	Glutamate application	Glutamate antagonist
6	63	17	12	7	11
5	41	4	3	7	18
10	86	13	11	8	15
17	59	6	6	19	7
13	51	12	19	7	14
11	64	15	0	1	9
15	76	15	4	4	19
14	69	0	8	2	2
9	76	13	8	20	15
13	43	8	13	18	1
13	55	20	1	19	13
7	87	20	15	20	2

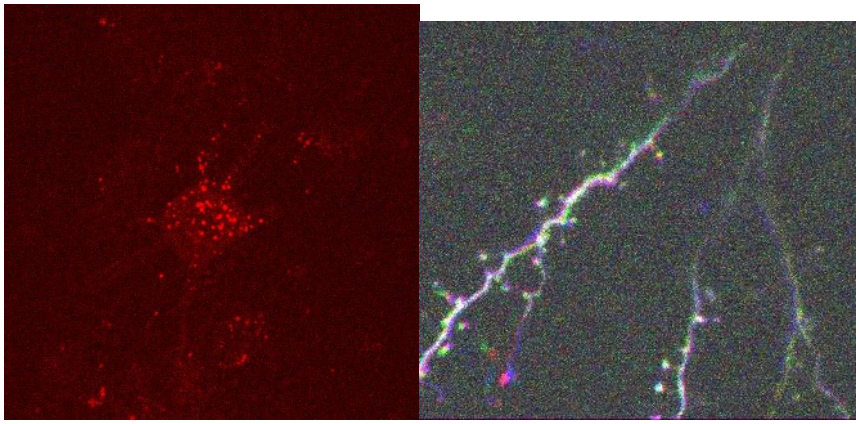
Calcium imaging.



DF/F of calcium levels per stimuli.			
With spinehead displacement		Without spinehead displacement	
Before GC	After GC	Before GC	After GC
158	104	138	117
127	105	124	111
123	113	122	143
147	118	126	128
127	118	122	152
126	109	114	119
130	105	110	155
150	104	118	154
142	120	138	118
121	109	153	145
110	105	131	149
122	113	135	118

Optogenetics and calcium imaging.





Displacement difference between first time point and last.			
Nearby spines		Distant spines	
Control	During stimulation	Control	During stimulation
0.1	1.3	0.6	0.6
0.6	1.7	0.7	0.6
0.3	1	0.6	0.2
0.6	2	0.2	0.3
0	1.9	0.6	0.6
0.7	2	0.3	0
0.5	1.5	0.3	0.4
0.1	1.8	0.5	0.6
0	1	0.2	0.6
0.4	1.5	0.4	0.1
0.5	1.9	0.4	0.7
0.3	1.4	0	0.5

DF/F of calcium levels per stimuli.			
With spinehead displacement		Without spinehead displacement	
Before GC	After GC	Before GC	After GC
152	101	160	130
117	110	122	113
117	107	117	147
145	115	152	147
115	111	112	134
110	100	159	146
141	100	148	125
140	104	160	154
158	107	140	139
116	106	147	132
140	119	111	116
155	107	124	118

Today's Homework is:

- Final Assignment

Do adult-born new neurons modulate the neuronal network?

This assignment consists of a smaller, simpler version of an academic article. It should contain the sections: Title (as above), Abstract, Introduction, Methods, Results, Conclusion and Reference. The Abstract has a limit of 300 words, whereas for the rest of the article (not counting the References) there should be a limit of 2000 words.

The Abstract is a summary of the article itself, which should have a small introduction, the aims of the article, a quick overall result, and conclusion.

The Introduction should contain information about the olfactory bulb, neurogenesis, function of neurons and the modulation of neuronal activity. These should reference to other articles.

For the Methods and Results, you will be presented with a series of data obtained from various experiments on previously infected adult-born new neurons (above). These will be from electrophysiology and imaging; pharmacology and imaging; calcium imaging; and optogenetics. You should choose at least two of the experiments. You have to describe the experiment, the theory and reason behind it, prepare the data in form of graphs and interpret the results.

In the Conclusion you need to describe the overall aim of the article, and its importance. This should be backed up by a short version of the results, and the implications of the results. The Reference is described on Appendix 1.

Relevant reading:

- Breton-Provencher, V. et al (2016). Principal cell activity induces spine relocation of adult-born interneurons in the olfactory bulb. Nature Communications, 7, article number 12659 (here).

The Deadline is:

Notes:

Tutorial 7 – The role of granule cells.

What is the Purpose of Tutorial 7?

- Reflect on skills learned on the programme with a view to encouraging resilience
- Receive feedback on final assignment

What are the key questions?

- What strengths have I demonstrated in my work and what areas of development are there left for me to address?
- What steps do I need to take to improve my academic output?

Activity 1 – Marking your own

Using the mark scheme, identify three things you did well and three things you could improve.

What went well?

1.

2.

3.

What could be improved?

1.

2.

3.

Activity 2 – Responding to feedback

Read through your feedback sheet and highlight on your assignment where you received positive feedback (one colour) and areas for improvement (different colour). You might find it helpful to annotate this with a brief comment or two.

Activity 3 – Looking Forward: Think, Pair Share

1. Think about how you can use this feedback in your future school work.
2. Talk to your partner about how you both plan to make changes to your school work in the future as result of this feedback
3. Share your ideas as a group.

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 Uni Pathways 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 thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. In our assignment, the Reference should be following the reference settings of the journal Cell. Examples:

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 in your own words) you should write between brackets the author's surname and the year. If there are more than three authors, you should write "et al."; otherwise, list the authors' names. Example: "Neuronal nitric oxide is present in granule cells (Baader et al., 1997)."

References: This is just a list of the references you have used in your assignment, in alphabetic order. It should include as much information as you have about the reference.

Articles – Authors (year). Title of the article. *Where the article comes from* (newspaper, journal etc.) *issue number*, *pages*. Example: "Baader, S.L., Bucher, S., and Schilling Karl (1997). The developmental expression of neuronal nitric oxide synthase in cerebellar granule cells is sensitive to GABA and neurotrophins. Dev. Neurosci. *19*, 283–290."

Websites – Author (if possible). Title of the web page, website address [date you accessed it, in square brackets]. Example: Dan Snow. 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

Books – Author (date published). *Title of book* (in italics), pages where the information came from. Example: S. Dubner and S. Levitt, (2006). *Freakonomics*, 7-9.

Appendix 2 – University Applications Guidance

For course choices and careers information:	www.brightknowledge.org.uk
For information and statistics on universities and course:	www.unistats.direct.gov.uk
For comprehensive information on universities, including rankings:	www.thecompleteuniversityguide.co.uk

PLEASE NOTE – The Researchers in Schools programme is designed to support the university applications process at your school. The work you complete for the programme should add to your schoolwork rather than detract from it. Please be aware of deadlines and try to manage your workload appropriately. If you are worried about the programme interfering with your schoolwork then please speak to your teacher.

Top Tips for Strengthening an application to Neuroscience.

Besides good marks, you should have a personal statement that makes you stand out from other applicants. Some universities advise on how to prepare them (as in here and here), but general advice would be as follows:

- Show interest and engagement in your subjects: this can be done by visiting and volunteering in a lab, participating in Science fairs, mentioning that you follow science blog and twitter accounts.
- Highlight skills that can be transferable to the subjects you are applying. Especially mention how you could use your various different skills within science. Some examples are decision-making, problem-solving, and flexibility.
- Work experience can be useful to your chosen subject.
- Join or start a club or society related to your chosen subject to demonstrate commitment.
- Read or subscribe to subject specific journals or publications.
- Discuss or comment on current hot topics or issues in your chosen field.
- Make the most of public lectures and attend university events.

Neuroscience is a growing field and you don't need to be a biologist to start working in it. There are plenty of pathways into this exciting and modern field. Pharmacology and biology are the most common ones. However, you can find engineers, mathematicians, computer scientists, physicians, physicists, chemists, psychologists, linguistics, all of them and more being part of the community developing neuroscience. The development of methods and materials to help the neuroscience research is a very promising field, as well as neuroprosthetics, robotics and computational neuroscience. The A levels that would help you most are Science related, but if you go to university through a different course, there is still plenty of ways to study neuroscience.