

PiXL Independence:

Biology – Student Booklet

KS5

Topic – Coordination and homeostasis

Contents:

- I. Level 1- Multiple Choice Quiz – 20 credits
- II. Level 2 - 5 questions, 5 sentences, 5 words – 10 credits each
- III. Level 3 - Biology in The News – 100 credits
- IV. Level 4 - Scientific Abstract – 100 credits
- V. Level 5 - Video summaries – 50 credits each

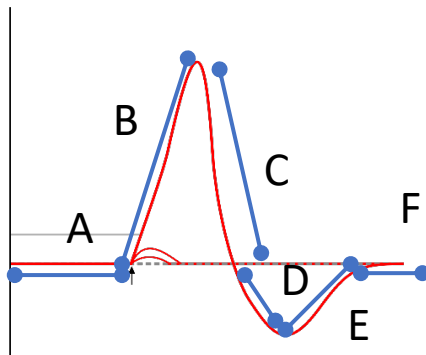
PiXL Independence – Level 1

Multiple Choice Questions

A Level Biology – Coordination and homeostasis

Part 1 – Nervous system and Muscle contraction

1. Along the axon, which ions are at higher concentrations in the extracellular space compared to the intracellular space?
 - a. Na^+ & Cl^-
 - b. Na^+ & K^+
 - c. K^+ & Cl^-
 - d. Na^+ only
2. In the following image, which letter refers to the period when the voltage gated Na^+ channels are open and the voltage gated potassium channels are closed?



- a. A
 - b. B
 - c. C
 - d. D
 - e. E
 - f. F
3. Which neurotransmitter is passed across a cholinergic synapse?
 - a. Serotonin
 - b. Acetylcholine
 - c. Acetylcholinesterase
 - d. Noradrenalin
 4. Which of the following receptors respond to pressure?
 - a. Olfactory receptor
 - b. Pacinian corpuscle
 - c. Spindle receptor
 - d. Photoreceptor

5. Which table shows the correct information for the following cell types?

a.		Motor neuron	Accelerator nerve (travels from CNS to Heart)	Vagus nerve (travels from CNS to Heart)
	Type	Autonomic	Somatic	Somatic
	Ganglions	None	Short pre-ganglionic neuron, long post ganglionic neuron	Long pre-ganglionic neuron, short post ganglionic neuron
	Neurotransmitter at synapse	Acetylcholine	Noradrenalin	Acetylcholine
	Effect	Stimulatory	Stimulatory	Inhibitory
b.		Motor neuron	Accelerator nerve (travels from CNS to Heart)	Vagus nerve (travels from CNS to Heart)
	Type	Autonomic	Somatic	Somatic
	Ganglions	None	Short pre-ganglionic neuron, long post ganglionic neuron	Long pre-ganglionic neuron, short post ganglionic neuron
	Neurotransmitter at synapse	Noradrenalin	Acetylcholine	Acetylcholine
	Effect	Stimulatory	Stimulatory	Inhibitory
c.		Motor neuron	Accelerator nerve (travels from CNS to Heart)	Vagus nerve (travels from CNS to Heart)
	Type	Somatic	Autonomic	Autonomic
	Ganglions	None	Long pre-ganglionic neuron, short post ganglionic neuron	Short pre-ganglionic neuron, long post ganglionic neuron
	Neurotransmitter at synapse	Acetylcholine	Acetylcholine	Noradrenalin
	Effect	Stimulatory	Inhibitory	Stimulatory
d.		Motor neuron	Accelerator nerve (travels from CNS to Heart)	Vagus nerve (travels from CNS to Heart)
	Type	Somatic	Autonomic	Autonomic
	Ganglions	None	Short pre-ganglionic neuron, long post ganglionic neuron	Long pre-ganglionic neuron, short post ganglionic neuron
	Neurotransmitter at synapse	Acetylcholine	Noradrenalin	Acetylcholine
	Effect	Stimulatory	Stimulatory	Inhibitory

6. The speed of transmission along an axon is dependent on both the cross-sectional area and the degree of myelination. The squid is relatively famous in scientific circles due to its extremely large axon.

The following table shows the conduction speed of 4 different organisms.

Organism	Cell type	Diameter μm	Conduction speed m/s	Myelinated
Squid	Giant Axon	1000	35	No
Earthworm	Median Giant fibre	800	30	No
Frog	Sciatic nerve	10	7	Yes
Cat	Spinal motor neuron	2	40	Yes

What is the percentage increase in conduction speed when increasing neuron diameter by 25%?

- a. 16.6%
 - b. 116.6%
 - c. 85.7%
 - d. 14.3%
7. Which of the following brain regions is responsible for controlling balance?
- a. Hypothalamus
 - b. Medulla Oblongata
 - c. Cerebellum
 - d. Temporal lobe
8. A student investigated the reaction times of his class mates with a classical experiment. She held a ruler between their thumb and forefinger and then released it. The student then recorded the point at which the ruler was caught with the fingers and the distance fallen was converted to a reaction time measured in seconds to one decimal place. She repeated the experiment 10 times for left handed students and 10 times for right handed students. Which of the following statements would be a limitation of the experiment?
- a. Boys may be more competitive than girls and try harder to catch the ruler, possibly starting to catch it before it is released.
 - b. The participant's fingers are fairly broad and will span more than a few centimeters on the ruler. No details were given on where to measure from.
 - c. There would have been natural variation in the reflexes of each student
 - d. The student only recorded reaction time to 1 decimal place.

9. The diagram below shows one sarcomere. Which table shows the correct set of labels?

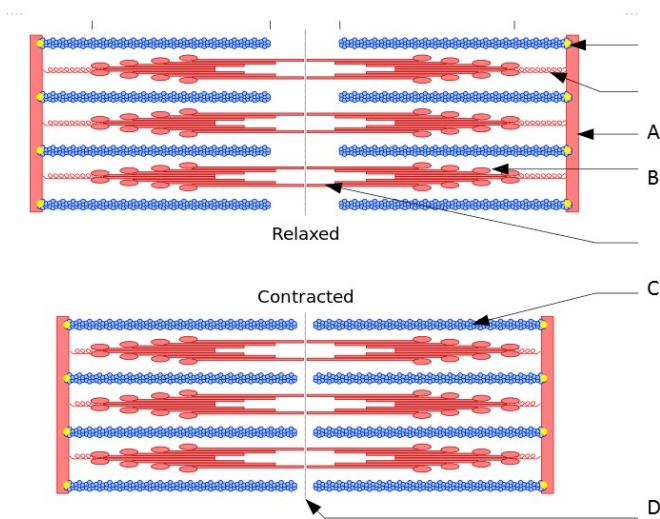


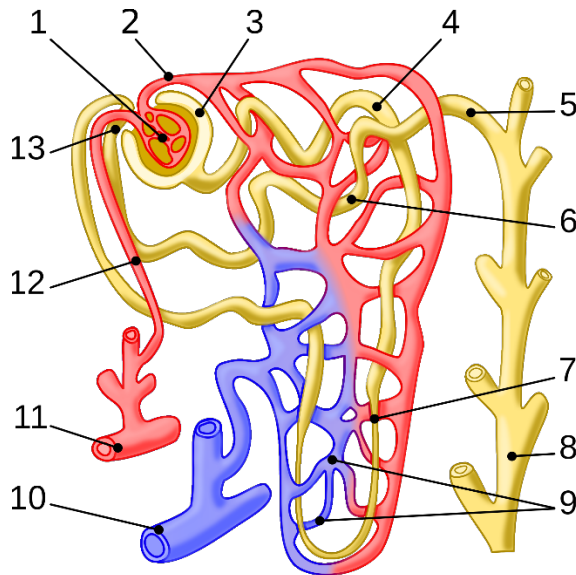
Image – Wikimedia commons – no restrictions

a.	Label	A	B	C	D
	Part	Z line	Actin	Troponin	H Zone
b.	Label	A	B	C	D
	Part	Z line	Myosin heads	Actin	M line
c.	Label	A	B	C	D
	Part	I band	Actin	Myosin heads	H Zone
d.	Label	A	B	C	D
	Part	Z line	Myosin heads	Actin	M line

10. What is the role of ATP during muscle contraction?
- To cause the myosin filaments to contract.
 - To cause the filaments to slide past each other.
 - To pull the Myosin heads back, ready for the next power stroke.
 - To cause a shape change in troponin resulting in tropomyosin exposing the myosin heads.

Part 2 – Hormones and excretion

11. What is the effect of ADH?
- To increase the permeability of the collecting ducts.
 - To increase permeability of the loop of Henle.
 - To decrease the permeability of the collecting ducts.
 - To decrease the permeability of the loop of Henle.
12. The following diagram shows a kidney nephron. Which table shows the correct set of labels?



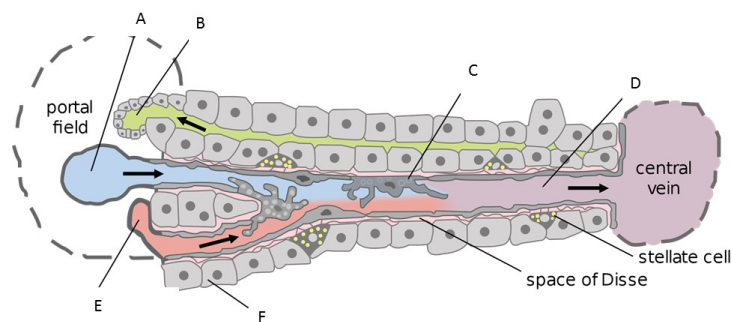
a.	Label number	1	6	8	12
	Part	Glomerulus	Distal convoluted tubule	Collecting duct	Afferent arteriole
b.	Label number	3	4	7	2
	Part	Glomerulus	Distal convoluted tubule	Loop of Henle	Afferent arteriole
c.	Label number	1	6	8	12
	Part	Bowman's capsule	Proximal convoluted tubule	Collecting duct	Efferent arteriole
d.	Label number	3	4	9	12
	Part	Bowman's capsule	Proximal convoluted tubule	Loop of Henle	Efferent arteriole

13. How do endotherms detect temperature changes in the environment?
- Hypothalamus
 - Medulla oblongata
 - Peripheral skin receptors
 - Pit organs, e.g. those found on a snake

14. Which table shows the correct response of a person that is too hot?

a.	Erector pili muscles relax	Arteriovenous shunt vessels dilate	Skeletal muscles no change	Increased evaporative cooling
b.	Erector pili muscles contract	Arteriovenous shunt vessels constrict	Skeletal muscles contract and relax rapidly	Decreased evaporative cooling
c.	Erector pili muscles contract	Arteriovenous shunt vessels dilate	Skeletal muscles contract and relax rapidly	Decreased evaporative cooling
d.	Erector pili muscles relax	Arteriovenous shunt vessels constrict	Skeletal muscles – no change	Increased evaporative cooling

15. Which row in the table shows the correct set of labels for the diagram below?



a.	Label	A	B	C	D	E	F
	Name	Hepatic arteriole	Portal venule	Hepatocyte	Bile Caniculae	Bile duct	Epithelial cell
b.	Label	A	B	C	D	E	F
	Name	Portal venule	Bile duct	Kupffer cell	Sinusoid	Hepatic arteriole	Hepatocyte
c.	Label	A	B	C	D	E	F
	Name	Bile duct	Sinusoid	Hepatocyte	Bile Caniculae	Hepatic arteriole	Epithelial cell
d.	Label	A	B	C	D	E	F
	Name	Hepatic arteriole	Bile duct	Kupffer cell	Sinusoid	Portal venule	Hepatocyte

16. What is the name of the series of reactions that remove the ammonia from excess protein and convert it to urea?

- Krebs cycle
- Urea cycle
- Deamination
- Ornithine cycle

17. Where precisely in the body is adrenalin produced?

- Adrenal glands
- Adrenal medulla
- Adrenal cortex
- Islets of Langerhans

18. In response to falling glucose levels, which cells will be most active in secreting a hormone?
 - a. Alpha cells in the Islets of Langerhans
 - b. Beta cells in the Islets of Langerhans
 - c. Pancreatic acini
 - d. Interlobular duct cells

19. A student was asked to make a low power drawing of a section through the pancreas. Which of the following statements describes the correct procedure?
 - a. Clear sharp pencil drawings of 10-20 cells. Label lines using a ruler and pencil, labels and a scale.
 - b. Clear sharp pencil drawing showing a large number of individual cells from across the field of view, using a magnification of x10-x40. Label lines using a ruler and pencil, labels and a scale.
 - c. Clear sharp pencil drawings showing each type of tissue. Shading added to define each tissue type. Label lines using a ruler and pencil, labels and a scale.
 - d. Clear sharp pencil outlines of each tissue type. Label lines using a ruler and pencil, labels and a scale.

20. Which term describes the term that refers to the synthesis of glucose from non-carbohydrate sources?
 - a. Gluconeogenesis
 - b. Glycolysis
 - c. Glycogenolysis
 - d. Glycogenesis

PiXL Independence – Level 2

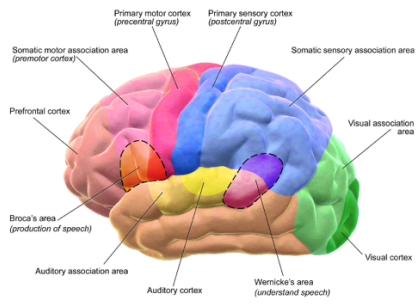
5 questions, 5 sentences, 5 words

A Level Biology – Coordination and homeostasis

INSTRUCTIONS

- For each statement, use either the suggested website or your own text book to write a 5-point summary. In examinations, answers frequently require more than 1 key word for the mark, so aim to include a few key words.
- It is important to stick to 5 sentences. It is the process of selecting the most relevant information and summarizing it, that will help you remember it.
- Write concisely and do not elaborate unnecessarily, it is harder to remember and revise facts from a big long paragraph.
- Finally, identify 5 key words that you may have difficulty remembering and include a brief definition. You might like to include a clip art style picture to help you remember it.

Example:

QUESTION:	Outline the main structures and functions of the different regions of the brain			
Sources:	Website – https://www.mayfieldclinic.com/pe-anatbrain.htm Interactive – Animation of brain regions (inside-the-brain.com)			
	<ol style="list-style-type: none"> 1. Cerebral Cortex – Involved in high level cognition, thinking. It is the outer layer of the cerebrum. Made of multiple regions, such as occipital lobe 2. Hippocampus – plays important roles in forming memories, particularly in converting short term into long term memories. 3. Cerebellum – important for producing skilled, coordinated movements. For example roller skating or dancing. Controls balance 4. Hypothalamus – involved in the hormonal control of the body, particularly temperature control (thermoregulatory centre), thirst, sleep. It also controls the pituitary gland causing release of hormones such as ADH in water regulation. 5. Medulla oblongata – involved in basic autonomic functions such as breathing, sneezing and even vomiting. Located at the base of the skull. <p>Motor and Sensory Regions of the Cerebral Cortex</p>  <p>Image- Wikimedia Commons – no restrictions</p>			
CNS – Central nervous system – brain and spinal cord	Autonomic – parts of the body controlled subconsciously, e.g. digestion	Somatic – conscious control of the	Cerebrum – not to be confused with cerebral cortex (outer layer of cerebrum) or cerebellum	Meninges – 3 layers of tissue covering the brain to protect the brain

QUESTION 1:	Compare the transmission of an action potential in a myelinated and unmyelinated neuron.			
Sources:	Website – https://www.khanacademy.org/science/health-and-medicine/nervous-system-and-sensory-infor/neuron-membrane-potentials-topic/v/effects-of-axon-diameter-and-myelination Interactive – https://www.edumedia-sciences.com/en/media/217-saltatory-conduction			

QUESTION 2:	Explain how the arrival of an action potential at a neuromuscular junction causes a muscle cell to contract.			
Sources:	Website – https://www.ptdirect.com/training-design/anatomy-and-physiology/skeletal-muscle-the-physiology-of-contraction Interactive – Action potential - Definition, Steps, Phases Kenhub			

QUESTION 3:

Explain the role of secondary messengers such as cAMP in hormonal control of the cell.

Sources:

Website – <https://opentextbc.ca/biology/chapter/18-2-how-hormones-work/>
Interactive –
http://highered.mheducation.com/sites/0072943696/student_view0/chapter10/animation_second_messenger_camp.html

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QUESTION 4:

Explain how a penguin keeps warm and why its feet do not get cold.

Sources:

Website – <https://interestingengineering.com/why-dont-penguins-feet-freeze-evolutionary-adaptation>
Website – https://www.coolantarctica.com/Antarctica%20fact%20file/science/cold_penguins.php

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QUESTION 5:

Explain how the body is able to produce hypertonic urine.

Sources:

Website – <https://www.khanacademy.org/test-prep/mcat/organ-systems/the-renal-system/a/renal-physiology-counter-current-multiplication>

Interactive – <http://www.kscience.co.uk/animations/kidney.htm>

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PiXL Independence – Level 3

Biology in The News

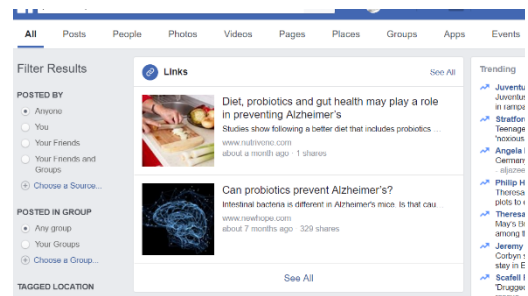
A Level Biology – Coordination and homeostasis

Fake news

Sensationalized news stories have been around for some time, but with the mass growth of social media, the problem seems to have grown in recent years.

Therefore, the ability to identify real information, track it back to the source article and make your own judgement is a very important skill. This activity will help you develop that skill.

Recently, Scientists have reported that the use of Probiotic Yoghurt can prevent Alzheimer’s. Several posts have appeared on Facebook with links to external websites. This task will help guide you to developing your ability to analyse and criticize the media. You could skip straight to the NHS Choices article which evaluates the reports, but you would miss out on some key skills development!



Probiotic Yoghurts can prevent Alzheimer’s

News article – <https://www.dailymail.co.uk/health/article-3924040/Why-having-probiotic-yoghurt-day-help-alleviate-symptoms-Alzheimer-s-disease.html>

Background – <https://www.nhs.uk/conditions/alzheimers-disease/>

Real article – <https://www.frontiersin.org/articles/10.3389/fnagi.2016.00256/full>

NHS Choices – [Alzheimer's disease - NHS \(www.nhs.uk\)](http://www.nhs.uk)

Task

You need to produce a 1 page essay on the treating Alzheimer’s with Probiotic Yoghurt

Essay section	Activity
Introduction	Read the background article and write a brief introductory paragraph about the causes and symptoms of Alzheimer’s.
Describe	Read the news article. At this point, do not look at the NHS Choices article. What are your first thoughts on the validity of the article, what is not said? What aspects of the article give it the impression of reporting reliable evidence? Write a short summary of the news article and give 2-3 evaluative points about the source reliability.
Explore	Now read the full article. Firstly, read through the experimental method and identify aspects of the method that indicate they used a valid method. Then consider and report whether you think the method is sufficient, consider control variables, relevance to the wider population of people with Alzheimer’s, replication and their conclusions.
Evaluate	Finally, read the NHS choices article which gives possible weaknesses in the study and discussed how it has been reported. Write a final paragraph which discusses the points you read from this article compared to the points you had previously considered.

PiXL Independence – Level 4

Scientific Abstracts

A Level Biology – Coordination and homeostasis

Scientific Abstracts

Once scientists have made that major breakthrough, they then need to spend their time writing a scientific paper, which hopefully will get published in a journal. An exciting result, a well written paper and a hot topic and you might find yourself in one of the most prestigious papers such as Nature or Science, but most papers end up in slightly lesser journals. Regular publishing is vital to good career progression, therefore the ability to write a scientific paper is really important. The first part (but the last to be written) of a paper is the abstract, a very concise summary of your experiment, results and conclusions. The abstract helps other scientists to quickly decide if the paper is worth reading in full. You will quickly appreciate this facet when you are sat in the university library on a Friday evening!

During your University course, you will be frequently given scientific papers with the abstract removed and asked to write your own. This task will really help you hit the ground running in your first year at Uni.

Planning and preparation

The University of Reading has an excellent resource called Engage in Research which gives you guidance on many aspects of research. You can access the section on writing abstracts at http://www.engageinresearch.ac.uk/section_a/writing_an_abstract.shtml

Here are a few of the key tips:

1. Abstracts (and the paper) have strict word limits. For this task, it will be 300 words, but is usually less for a real abstract
2. Get your message across clearly
3. Don't waffle (this is great practice for writing exam answers!)
4. You need to include an introduction, materials and methods (for this work that will be the data analysis tools you use), results and conclusion.

Examples

The following website gives a series of abstract examples: [Sample Abstracts for Writing | UNSW Current Students](#)



Figure 1 - Brachiosaurus size comparison (26-30m long)

Myelination – could the dinosaurs have survived without it?

Background

Evolution has favoured mechanisms that have led to an increase in transmission speed of neurons. Three key adaptations are relatively common, an increased diameter, electrical synapses and myelination.

Some of the largest dinosaurs were the sauropods such as the Diplodocus and Supersaurus. From tip to tail, it is estimated that some species were up to 50-60m long. This would mean that a neuron, which is a single cell, from the tail to the brain and would have been one of the longest cells in the history of life at lengths of 50-60m! Aside from the obvious problem of how the cell body transports proteins to the ends of the axon which move as slow as 1mm a day, transmission speeds of unmyelinated neurons can be as slow as 0.5ms^{-1} , therefore a pain stimulus would take a full minute to reach the brain (and at least as half as long again to send a response back to move the tail!). Therefore, the evolution of myelination was critical in the evolution of increased body size.

Source article

4 – Journal article science applications –

<https://www.sciencedirect.com/science/article/pii/S0960982216308685>

Task

You need to produce an abstract on the source article which discusses the structure and function of myelination and its evolutionary origins and advantages. **You should use no more than 300 words. This is a degree level paper and there may be some content that you do not understand. However, it is important to extract information that you can relate to prior learning and fully understand any new terminology you use.**

Describe	Explain how myelination links to your learning and what you already know about transmission of action potentials.
Compare	Compare the benefits of myelination with other methods of increasing transmission speeds.
Discuss	Discuss the evolutionary origins of myelination and the benefits to the individual.

PiXL Independence – Level 5

Video summaries

A-level Biology – Coordination and homeostasis

Cornell Notes

At A level and University, you will make large amounts of notes, but those notes are only of use if you record them in a sensible way. One system for recording notes is known as the Cornell notes system. This method encourages you to select relevant information, rather than trying to write a transcript of everything said. More importantly, it forces you to spend a few minutes reviewing what you have written, which has been scientifically proven to aid learning and memory retention.

The ideal is to write everything on one page, but some students may prefer to type and others will to handwrite their notes. Whichever option you use, remember the aim is to summarise and condense the content with a focus on the objectives that you are trying to learn and understand.

There are three main sections to the Cornell notes

- 1 **Cue/ Objectives** – This can be done before or after the lecture. You may have been provided with the objectives or you may need to decide what they were or you may want to make the link to your learning if this is an additional task or lecture you are viewing, such as this video.
- 2 **Notes** – In this space you record concisely, simply the things you are LESS likely remember - **The NEW knowledge**.
- 3 **Summary** – The most important step that is carried out after the lecture or video. This helps to reinforce learning.

Background

The following series of videos link to your learning. The first video is a documentary about the cutting edge of brain research, which explains how it is possible to transmit thoughts to computers or devices around the world. The second gives a full account of the varied roles of hormones in the human body. The final video is a Ted Talk and Sheila Nirenberg discusses how she has design the first prosthetic eye.

Source article:

Video 1 – The Greedy Brain

You Tube: <https://topdocumentaryfilms.com/greedy-brain/>

Video 2 – Fantastical World of Hormones

https://www.youtube.com/watch?v=EHnJjGzp_M

Video 3 – The Prosthetic Eye

Ted Talk –

https://www.ted.com/talks/sheila_nirenberg_a_prosthetic_eye_to_treat_blindness?language=en

Task:

You need to produce a set of Cornell notes for each one of the videos given above. Use the following objective to guide your note taking, this links to your learning.

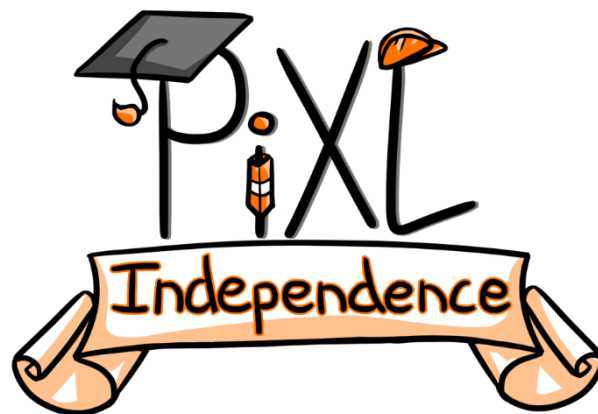
1. Discuss the advances in brain imaging technology and the potential applications of the research findings
2. Discuss the role of hormones in controlling the human body
3. Explain the challenges of creating a prosthetic eye

Cornell Notes Guide

Objectives What are the main learning outcomes that have been shared with you? This will help guide you to taking the RIGHT notes during the video.	Title Date
	Sketch down note and key words Do not write in full sentences whilst you listen, put quick sketches, single words, mind maps, short hand etc. To help train you for university, try not to pause the video because you could not pause a live lecture (However, a lecture may give more natural pauses for you to catch up).

Summary (after the video)
What are your main points of learning from this video.
This is your chance to make sense of your notes.
Make clear connections to the things you need to know

	Title Date
Objectives	
Summary	



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