

PiXL Independence:

Biology – Student Booklet

KS5

Topic - Biological molecules

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 Poster – 100 credits
- V. Level 5 - Video summaries – 50 credits each

PiXL Independence – Level 1
Multiple Choice Questions
A Level Biology – Biological molecules

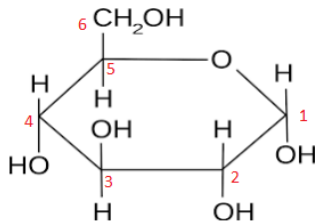
INSTRUCTIONS

Score: /20

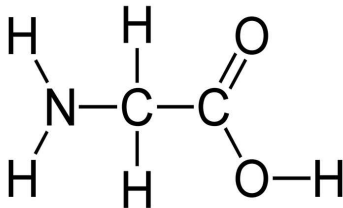
- Read the question carefully.
- Circle the correct letter.
- Answer all questions

Part 1 – Carbohydrates, Lipids & Nucleotides

1. What is the specific name of the following image?



- a. Alpha Glucose
b. Beta Glucose
c. Fructose
d. Sucrose
2. What type of molecule is shown below?



- a. Carbohydrate
b. Amino acid
c. Fatty acid
d. Nucleotide
3. What type of reaction occurs when glucose joins with galactose to make lactose?
- a. Hydrolysis
b. Redox
c. Synthesis
d. Condensation
4. Which of the following terms best describes water?
- a. It is polar
b. It is adhesive
c. It is cohesive
d. A & B
e. A, B & C

5. In a tri-glyceride, what type of bond connects the glycerol molecule to the fatty acid tails?
 - a. Glycosidic
 - b. Phosphodiester
 - c. Peptide
 - d. Ester

6. How would you test for Sucrose?
 - a. Heat with Benedicts solution
 - b. Biuret solution
 - c. Heat with dilute H_2SO_4 , neutralize and then heat with Benedicts solution
 - d. Mix with ethanol, then mix with water and shake.

7. What is the structure shown by Haemoglobin?
 - a. Primary
 - b. Secondary
 - c. Tertiary
 - d. Quaternary

8. In thin layer chromatography, which term best describes Silica Gel?
 - a. Running solvent
 - b. Extraction solvent
 - c. Mobile phase
 - d. Stationary phase

9. A cofactor is referred to as a prosthetic group if it is tightly bound to the enzyme. What is the cofactor for Amylase?
 - a. Fe^{2+}
 - b. Zn^{2+}
 - c. Cl^-
 - d. Fe

10. Which of the following pairs of nucleotides are Purines?
 - a. Adenine & Thymine
 - b. Guanine & Cytosine
 - c. Guanine & Adenine
 - d. Thymine & Cytosine

Part 2 – Enzymes & DNA replication

11. Which statement describes the correct order of events during protein synthesis?
- Transcription → Translation → Modification and Packaging → Excretion
 - Translation → Excretion → Transcription → Modification and Packaging → Excretion
 - Transcription → Excretion → Translation → Modification and Packaging → Excretion
 - Transcription → Translation → Modification and Packaging → Secretion
12. In an experiment investigating the rate of H_2O_2 breakdown into O_2 and H_2O with catalase, the following data was obtained.

Temperature $^{\circ}\text{C}$	Volume of gas collected cm^3
10	7.0
20	12.6
30	22.6
40	40.8
50	35.2

Calculate the Q_{10} for the rate of reaction.

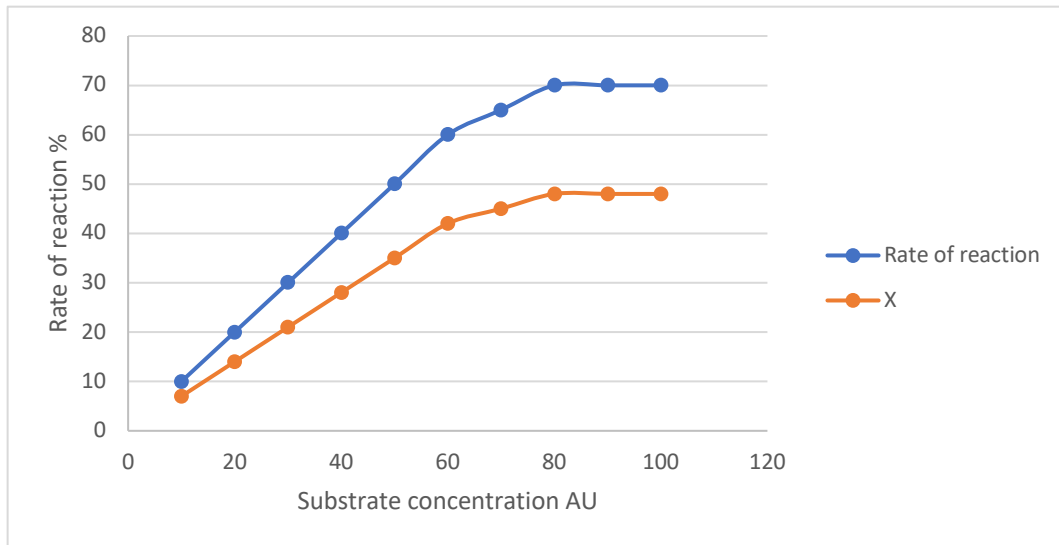
- 7.0
 - 5.6
 - 1.8
 - 33.8
13. A criticism of the student's work in the experiment above was that they did not repeat their work. Which term best describes their weaknesses?
- The data is not accurate
 - The data is not reliable
 - The data is not precise
 - The experiment is not valid
14. In preparation for an experiment, a student carried out a series of serial dilutions of a stock solution of a protease enzyme. The original stock solution had a concentration of 0.7mol dm^{-3}

The student removed 2cm^3 of the solution and added it to 8cm^3 of distilled water. They repeated this dilution three more times.

What is the final concentration of the solution?

- 0.175 mol dm^{-3}
- $2.8 \times 10^{-2}\text{ mol dm}^{-3}$
- $0.0112\text{ mol dm}^{-3}$
- $1.12 \times 10^{-3}\text{ mol dm}^{-3}$
- $7.0 \times 10^{-5}\text{ mol dm}^{-3}$

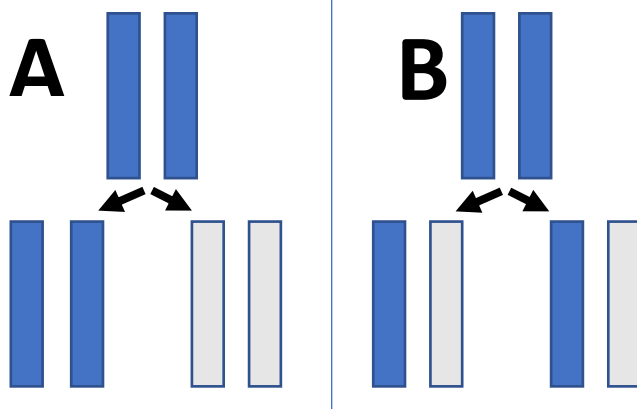
15. In an experiment involving the rate of breakdown of a substrate by an enzyme, the following data were collected.



The experiment was repeated with the addition of X. What is X?

- Co-enzyme
 - Allosteric activator
 - Competitive inhibitor
 - Non-competitive inhibitor
16. Meselson and Stahl investigated the replication of DNA. Several models at the time were put forward for the method of DNA replication. Meselson and Stahl used cells grown in different environments with isotopes of either ^{14}N or ^{15}N . This led to DNA that could be separated by centrifuge.

In the image below, what type of replication is indicated by Diagram A?



- Dispersive replication
- Semi-conservative replication
- Conservative replication
- Semi-dispersive replication

17. Which of the following provides the correct nucleotide sequence for the following small protein?
Methionine – Leucine – Aspartic acid – Serine

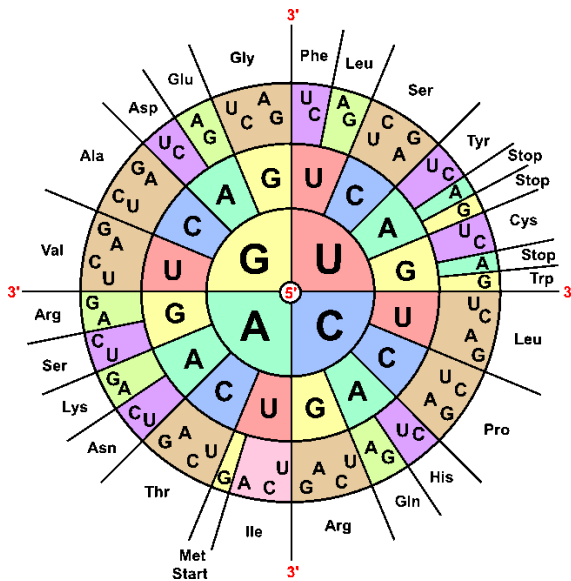


Image courtesy of Wikimedia commons – no restrictions.

- a. AAUCCUCAGAUUGUA
 b. AUGAUUCAGUCCUAA
 c. AUGCUUGACGAUUAA
 d. AUGUUAGACUCCUAA
18. A DNA sequence reads:
AGT
- Which is the correct sequence on the anticodon of the tRNA?
- a. UGT
 b. UCA
 c. TCU
 d. AGU
19. Which of the following enzymes will show the highest rate of reaction at pH2?
- a. Carbonic anhydrase
 b. Amylase
 c. Pepsin
 d. Trypsin
20. Vitamin B3 is used to synthesize NAD (nicotinamide adenine dinucleotide) which plays an essential role in respiration. Which term best describes NAD?
- a. Enzyme
 b. Co-enzyme
 c. Co-factor
 d. Prosthetic group

PiXL Independence – Level 2
5 questions, 5 sentences, 5 words
A Level Biology – Biological Molecules

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:	Explain how a protein is synthesized.			
Sources:	<p>Website – https://www.bbc.co.uk/bitesize/guides/z3mbqhv/revision/6 Interactive – https://sciencemusicvideos.com/ap-biology/module-14-from-gene-to-protein/translationprotein-synthesis-tutorial/ Transcription – https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription Translation – https://www.khanacademy.org/science/biology/gene-expression-central-dogma/translation-polypeptides/a/translation-overview</p>			
	<ol style="list-style-type: none"> 1. Section of DNA containing gene to be expressed is unzipped 2. mRNA is formed by adding complimentary base pairs to each DNA strand by RNA polymerase 3. mRNA is exported to ribosome on rough ER through nuclear pore 4. tRNA transfer amino acids to the ribosome. Each tRNA has a complimentary sequence of three nucleotides (anticodon) to those on the mRNA (codon). This sequence of codons determines the order of amino acids. 5. Ribosome joins amino acids together with a peptide bond. Protein is released and transferred to the golgi apparatus for further processing and packaging. 			
Anticodon – 3 nucleotides on the tRNA that are complimentary to the codon on the mRNA	Transcription – process of converting DNA into mRNA (like transcribing a book)	Translation – process of converting mRNA into a polypeptide (like translating to a different language)	RNA Polymerase – makes RNA (not DNA)	Promotor – a protein that binds to the DNA so the RNA polymerase knows where the gene starts

QUESTION 1:

Compare the structure and formation of proteins, lipids and polysaccharides.

Sources:

Website – [IB Biology Notes - 3.2 Carbohydrates, lipids and proteins \(ibguides.com\)](https://www.ibguides.com/notes/3-2-carbohydrates-lipids-and-proteins/)

Interactive – <https://www.youtube.com/watch?v=YO244P1e9QM>

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QUESTION 2:

Explain how the properties of water are essential for the existence of life.

Sources:

Website – <https://alevelbiology.co.uk/notes/the-biological-importance-of-water/>
Interactive – [Water - Liquid Awesome: Crash Course Biology #2 - YouTube](#)

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QUESTION 3:

Explain the evidence for theory of semi-conservative replication.

Sources:

Website – <https://www.khanacademy.org/science/biology/dna-as-the-genetic-material/dna-replication/a/mode-of-dna-replication-meselson-stahl-experiment>

Interactive – <https://www.youtube.com/watch?v=JeoegQaF8ig>

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QUESTION 4:	Explain how the use of enzymes in a chemical reaction effect the activation energy of a reaction.
Sources:	Website – https://www.khanacademy.org/science/biology/energy-and-enzymes/introduction-to-enzymes/a/enzymes-and-the-active-site Interactive – https://www.youtube.com/watch?v=np2JUCVvBwQ

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QUESTION 5:

Explain how nucleotides bond to form the double DNA helix.

Sources:

Website – <https://www.khanacademy.org/test-prep/mcat/biomolecules/dna/a/dna-structure-and-function>

Interactive – <https://www.youtube.com/watch?v=QG5xiCG-Bgk>

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PiXL Independence – Level 3

Biology in The News

A Level Biology – Biological molecules

Fake news

Sensationalised 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.

Artificial sugars cause cancer

News article – <https://www.dailymail.co.uk/health/article-3082524/Is-sweetener-hidden-6-000-products-danger-health.html>

Journal article – <https://onlinelibrary.wiley.com/doi/pdf/10.1111/ijcp.12703>

NHS Choices – <https://www.nhs.uk/live-well/eat-well/are-sweeteners-safe/>

Task

You need to produce a 1 page essay on the health effects of artificial sweeteners.

Essay section	Activity
Introduction	Read through the first news article. Outline the main arguments put forward for the health effects (beneficial or otherwise) of artificial sweeteners. Then evaluate the trustworthiness of this article. Do not worry about having the perfect evaluation at this stage, it is more important to show by the end of the essay you have developed your evaluation skill.
Describe	Read the journal article on artificial sweeteners. This article is a metastudy, it has reviewed other literature. Outline the evidence for and against the health effects of artificial sweeteners.
Evaluate	Discuss the reasons why some articles are less trusted than others. Consider sample sizes, whether animals or sick people were used or whether there is any evidence that the researchers have an underlying bias.
Conclude & Reflect	Finally put forward your OWN opinion on the health risks of artificial sweeteners. Then read the NHS choices article to look for points that you have not made. Write a final paragraph reflecting on the points you have made compared to the points you did not make to demonstrate and reflect on your learning.

PiXL Independence – Level 4

Scientific Posters

A Level Biology – Biological Molecules

Scientific Posters - Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific posters. During a science degree, you would practice all three of these skills.

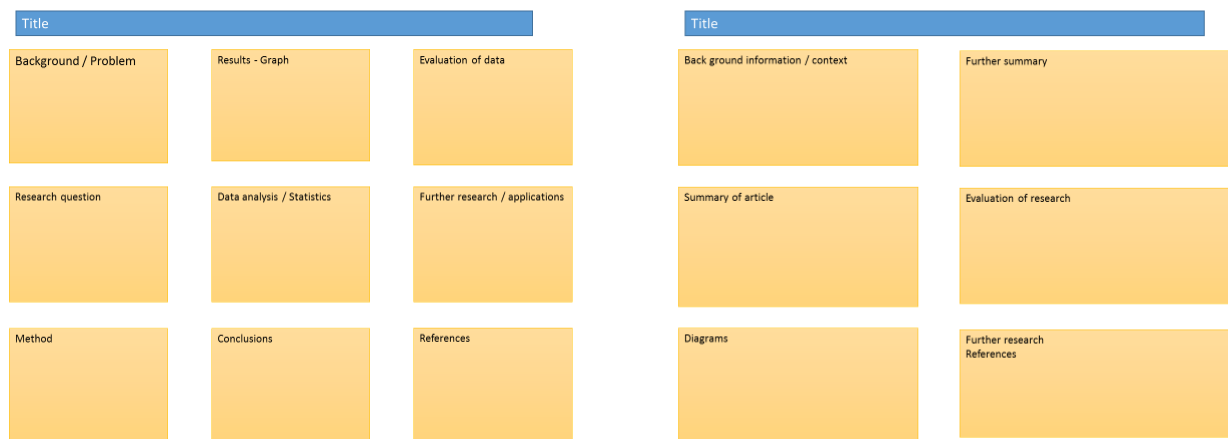
Scientific posters are a fine balance between being graphically interesting and attracting attention and sharing just the right amount of text to convey a detailed scientific message. They are more detailed than a talk and less detailed than a paper.

Use this information to help structure your poster – <https://www.wikihow.com/Make-a-Scientific-Poster>

More detailed guidance is available at: <https://guides.nyu.edu/posters>

Creating your poster

It is easiest to create a poster in PowerPoint; however, you need to add custom text boxes rather than using the standard templates.



Posters need to be eye catching, but readable from a distance. If you use PowerPoint, start with a 4:3 slide (for easier printing, it can then be printed on A3) and use a 14-16 pt font. The first box could be larger to draw people in. You can use a background image, but pick a simple one that is of high quality. Select text box, fill and select change the transparency to maintain the contrast and partially show the picture.

You can experiment with different layouts and you should include images.

Avoid a chaotic layout, posters are read from top left column downwards.

Remember to include the authors and references.

Finally, look at the examples given on the University of Texas website which also offers an evaluation of each: <https://ugs.utexas.edu/our/poster/samples>



Figure 1 Not a mad cow!

Prions

Background

In 1984, a new disease emerged, effecting British cattle. Mad cow disease or Bovine spongiform encephalopathy to give the full name, infected more than 180,000 cows. 4.4 million cows were slaughtered to prevent the disease from spreading. The huge devastation was in part due to the slow response of the government who did not act until 1986.

Mad Cow disease strikes fear amongst health care workers, government officials, farmers and scientists because it can be transmitted to humans through eating infected tissues, usually nervous tissue, but it is present in all tissues. 177 people have died of the human form of the disease known as Creutzfeldt-Jakob disease. However, it is not just the human death toll, but the restrictions that get placed on cattle exports. It has been reported that the impact on the UK economy cost £5 Billion.

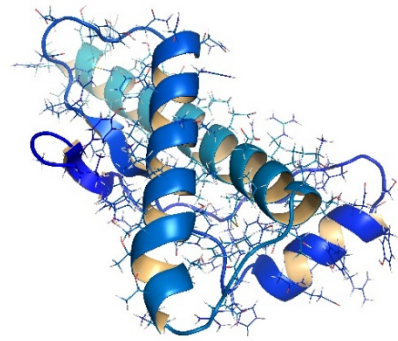


Figure 2 Prion protein

What is the pathogen that causes mad cow disease? It is not actually a pathogen in the traditional sense, it is a protein that fails to fold correctly and “infects” other proteins causing them to do the same. It is a Prion.

Source article:

<https://www.telegraph.co.uk/news/uknews/1371964/The-recipe-for-disaster-that-killed-80-and-left-a-5bn-bill.html>

Prion diseases: <https://www.cdc.gov/prions/index.html>

Animations:

https://highered.mheducation.com/sites/9834092339/student_view0/chapter27/how_prions_arise.html (there is a second animation on the left)

Use other sources as necessary.

Task

Produce a scientific poster **on a different Prion disease**. Decide in your class who researches each disease.

You should start with an outline of the structure of a protein and how it folds. Target your poster at educated scientists of at least A-level standard, who may understand the concept of Proteins, but not Prions.

Recall	Describe the basic structures of a protein.
Describe	Write a description of your disease.
Explain	Explain how prions cause disease.
Discuss	Discuss the global impact of your disease, both in terms of economy and health.

PiXL Independence – Level 5

Video summaries

A-level Biology – Biological molecules

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 explains how life evolved from a primordial soup and how the first biological molecules formed that later led to the formation of a cell. The second one discusses the famous work of Watson and Crick and the evidence they used to discover DNA. The final video discusses how proteins fold into 3D shapes, something that happens naturally and correctly in a cell but does not always happen if scientists try to recreate this in a laboratory.

Source article:

Video 1 – Origin of Life

You Tube: [The mysterious origins of life on Earth - Luka Seamus Wright - YouTube](#)

Video 2 – Discovery of the double helix

HHMI Bio-education – <https://www.biointeractive.org/classroom-resources/double-helix> You can also find further resources linked to this video at: <https://www.biointeractive.org/classroom-resources/activity-double-helix>

Video 3 – The protein folding problem

TedX Talk – www.tiny.cc/fold

Task:

You need to produce a set of Cornell notes for each of the videos given above.

Use the following objective to guide your note taking, this links to your learning.

1. Discuss the major developments in biochemistry that took place in order for life to evolve
2. Discuss the evidence used to identify the structure of DNA
3. Explain how proteins fold and how we could infer its 3D structure if we know the genetic code

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).

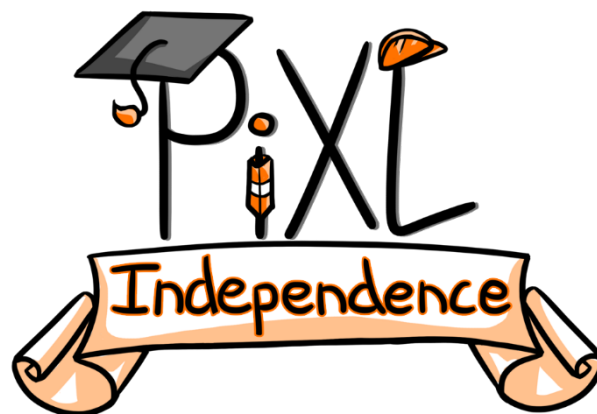
Summary (after the video)

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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