PiXL Independence:

Biology – Student Booklet

KS5

Topic - Cells

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 Podcast – 100 credits

V. Level 5 - Video summaries – 50 credits each

PiXL Independence – Level 1
Multiple Choice Questions
A Level Biology – Cells

INSTRUCTIONS **Score: /20**

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

Part 1 – Cell structure & Microscopy

1. Which organelle is responsible for producing fats?
   a Rough ER
   b Smooth ER
   c Golgi apparatus
   d Nucleolus

2. Where are ribosomes manufactured?
   a Nucleolus
   b Centrioles
   c Vacuole
   d Rough ER

3. Which of the rows shows the correct pairs of units?

a	1 mm = 0.1cm	1 nm = 0.001µm	1cm = 1,000,000nm	1µm = 1000mm
b	1cm = 10,000,000nm	1 nm = 0.000001mm	1 mm = 1000µm	1µm = 0.0001cm
c	1µm = 0.01mm	1 nm = 0.01µm	1cm = 10,000,000nm	1 mm = 0.1cm
d	1 mm = 0.1cm	1 nm = 1000µm	1cm = 1,000,000nm	1µm = 1000nm

4. Which table shows the correct comparison of prokaryotes and Eukaryotes?

a

	Eukaryotes	Prokaryotes
Nucleus	×	✓
Naked DNA	✓	×
Ribosomes	✓	✓
Rough ER	×	✓
Cell membrane	✓	✓

b

	Eukaryotes	Prokaryotes
Nucleus	✓	×
Naked DNA	✓	✓
Ribosomes	✓	×
Rough ER	✓	×✓
Cell membrane	✓	✓

c

	Eukaryotes	Prokaryotes
Nucleus	✓	×
Naked DNA	×	✓
Ribosomes	✓	✓
Rough ER	✓	×
Cell membrane	✓	✓

d

	Eukaryotes	Prokaryotes
Nucleus	✓	×
Naked DNA	✓	✓
Ribosomes	✓	✓
Rough ER	✓	×
Cell membrane	✓	✓

5. Which of the following organelles contain hydrogen peroxide?
   a Centrioles
   b Lysosomes
   c Ribosomes
   d Mitochondria

6. Which of the following contain DNA? (may be more than one correct answer)
   a Mitochondria
   b Chloroplast
   c Ribosome
   d Prokaryote

7. Which of the following proteins combine with DNA to form chromatin?
   a Collagen
   b Chaperones
   c Histones
   d Glycoproteins

8. The cytoskeleton has many functions within the cell, from providing support, facilitating movement of molecules around the cell or providing movement in structures like undulipodia.
   Which of the following types of skeleton facilitates movement of molecules within the cell?
   a Microfilaments
   b Microtubules
   c Intermediate fibre
   d Macrotubules

9. What is the correct function of the Golgi apparatus?
   a Synthesis of lipids
   b Modifies and packages proteins
   c Manufactures ribosomes
   d Site of protein synthesis

10. A Eukaryotic cell has 7.2×10^{7} base pairs of DNA per chromosome.
    Each base pair is 0.36×10^{-9}m. The diploid number of a dog cell is 78.
    Calculate the length of DNA in the cell.
    a 2.02m
    b 0.023m
    c 2.02cm
    d 1.56×10^{19}

Part 2 – Cell membranes and cell division

11. What is the function of cholesterol in the cell membrane?
    a To make the membrane less fluid
    b To make the membrane more fluid
    c To make the membrane more fluid at high temperatures and less fluid at low temperatures
    d To make the membrane less fluid at high temperatures and more fluid at low temperatures

12. Transmembrane proteins have different regions. Which statement is correct for transmembrane proteins?
    a Within the phospholipid bilayer, the amino acids exposed to the phospholipids have hydrophilic R groups and the regions within the protein, but not exposed, have hydrophobic R groups.
    b The regions on the outside of the cell contain amino acids with hydrophobic R groups and the regions on the inside contain amino acids with hydrophilic R groups.
    c Within the phospholipid bilayer they contain amino acids with hydrophilic R groups. Regions exposed on the outside and inside contain amino acids with hydrophobic R groups.
    d Within the phospholipid bilayer they contain amino acids with hydrophobic R groups. Regions exposed on the outside and inside contain amino acids with hydrophilic R groups.

13. The permeability of cell membranes varies with temperature. Plants containing pigment in their vacuoles are useful models for measuring the effects of temperature on cell membranes. Investigations typically show two phases, a gradual increase in the loss of pigment between 0^{o}C and 40^{o}C and a rapid loss of pigment above 40^{o}C.
    Which is the best explanation for the changes seen between 0^{o}C and 40^{o}C?
    a The cell membrane melts and intrinsic proteins denature, leaving holes for the pigment to escape.
    b Pigment is actively transported out of the cell at a faster rate at higher temperature.
    c Pigment molecules have more kinetic energy and there is a faster rate of diffusion out of the cell.
    d The cell membrane denatures leaving pores for the pigment to escape.

14. Which table contains a set of correct statements about transport across the membrane?

a

	Direction	Details
Active transport	From high to low concentration	Requires ATP through Channel proteins
Facilitated diffusion	From low to high concentration	No ATP – Requires Carrier proteins
Simple diffusion	From low to high concentration	No ATP – small non-polar molecules such as O_2, CO_2 move between phospholipids
Exocytosis	Inside to outside of the cell	Requires ATP and movement of cytoskeleton to move large molecules
Receptor mediated endocytosis	Outside to inside of the cell	Triggered by ligands / signal molecules / antigens to engulf larger molecules

b

	Direction	Details
Active transport	From low to high concentration	Requires ATP through Carrier proteins
Facilitated diffusion	From high to low concentration	No ATP – Requires Channel proteins
Simple diffusion	From high to low concentration	No ATP – small non-polar molecules such as O_2, CO_2 move between phospholipids
Exocytosis	Inside to outside of the cell	Requires ATP and movement of cytoskeleton to move large molecules
Receptor mediated endocytosis	Outside to inside of the cell	Triggered by ligands / signal molecules / antigens to engulf larger molecules

c

	Direction	Details
Active transport	From low to high concentration	Requires ATP through Channel proteins
Facilitated diffusion	From high to low concentration	No ATP – Requires Carrier proteins
Simple diffusion	From high to low concentration	No ATP – small non-polar molecules such as Na^+ & H_2O move between phospholipids
Exocytosis	Inside to outside of the cell	Requires ATP and movement of cytoskeleton to move large molecules
Receptor mediated endocytosis	Outside to inside of the cell	Triggered by ligands / signal molecules / antigens to engulf larger molecules

d

	Direction	Details
Active transport	From low to high concentration	Requires ATP through Carrier proteins
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Exocytosis	Outside to the inside of the cell	Requires ATP and movement of cytoskeleton to move large molecules
Receptor mediated endocytosis	Inside to the outside of the cell	Triggered by ligands / signal molecules / antigens to engulf larger molecules

15. Which of the following statements about Osmosis is correct?
    a Crenation occurs when the hydrostatic pressure of the cell is less than the oncotic pressure
    b A cell becomes turgid when the hydrostatic pressure of the cell is greater than the osmotic pressure
    c A cell becomes flaccid when the hydrostatic pressure of the cell is greater than the osmotic pressure
    d A cell remains the same size when the oncotic pressure and the hydrostatic pressure act in the same direction.

16. What happens during the G2 Phase of the cell cycle?
    a DNA replication
    b Cell organelles (apart from chromosomes) are duplicated
    c The cell splits into two
    d Duplicated chromosomes are checked for errors

17. Which table shows the correct details for Mitosis and Meiosis

a

	Mitosis	Meiosis
Kinetochore attaches to centromere	✓	✓
Homologous chromosomes form pairs	×	✓
Forms haploid daughter cells	×	✓
Independent assortment of chromosomes occurs	×	✓

b

	Mitosis	Meiosis
Kinetochore attaches to centromere	✓	×
Homologous chromosomes form pairs	×	✓
Forms haploid daughter cells	×	✓
Independent assortment of chromosomes occurs	✓	×

c

	Mitosis	Meiosis
Kinetochore attaches to centromere	✓	×
Homologous chromosomes form pairs	×	✓
Forms haploid daughter cells	✓	✓
Independent assortment of chromosomes occurs	×	✓

d

	Mitosis	Meiosis
Kinetochore attaches to centromere	✓	✓
Homologous chromosomes form pairs	×	✓
Forms haploid daughter cells	✓	✓
Independent assortment of chromosomes occurs	×	✓

18. Independent assortment generates variation. This occurs twice in the formation of gametes. In a cell with 5 chromosomes, how many different genetic combinations would be generated during meiosis?
    a 200,000
    b 10
    c 25
    d 1024

19. What is the function of squamous epithelium?
    a It is a connective tissue
    b Produces mucus in the lungs
    c It has cilia to move substances such as mucus out of the lungs
    d Allows rapid diffusion to take place

20. Which statement is correct?
    a Xylem is a vascular tissue which has sieve plates and sieve tube cells and transports water
    b Phloem is a vascular tissue which is lignified and transports organic nutrients, particularly sucrose
    c Stem cells in the bone marrow are referred to as multipotent as they can differentiate into a range of different blood cell types
    d Totipotent stem cells can form all tissues in the human body, but not placental cells

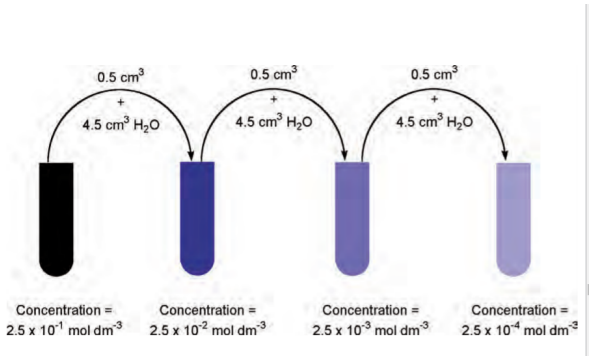
PiXL Independence – Level 2
5 questions, 5 sentences, 5 words
A Level Biology – Cells

INSTRUCTIONS

- **For each statement, use either the suggested website or your own text book to write a 5-point summary. At A-level, 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	**Explain how to carry out serial dilutions**
Source:	**SAPS – Serial dilutions –** www.tiny.cc/serialdilutions

1. Standard form – use 1.0 x 10 and then the number of 0s, e.g. 1000 = 1.0 x 10^{0} Numbers smaller than 1.0, e.g. 0.01 then use a minus sign. . e.g. 1.0 x 10^{-2}
2. (skip to section 5). To calculate a dilution – Take 1cm^3 of stock and add 49cm^3 of water to make it up to 50cm^3
3. Therefore, we have 1/50th of the stock solution. (final volume / volume taken)
4. Calculate concentration by Original concentration / dilution factor.
5. Serial dilutions are used when your experiment only works over a certain range. E.g. when using a colorimeter. Really concentrated samples will be too dark.



Dilution factor The number of times a stock solution has been diluted	Serial dilution The process of making lots of dilutions	Mol dm^{-1} units for measuring concentration (how many moles per dm (litre))	Stock solution – the original solution, the most concentrated one	Aliquot – a portion from the whole sample

Question 1	**Explain how different types of image are produced by an electron microscope**
Source:	**Website –** http://tiny.cc/sem **Interactive** - www.ammrf.org.au/myscope/

Question 2	**Explain how organelles work together to synthesize and export proteins (detailed protein synthesis not required).**
Source:	**Website:** www.tinyurl.com/kprotein **Interactive -** www.johnkyrk.com **(select cell anatomy)**

Question 3	**Compare the ultrastructure of prokaryotes and eukaryotes.**
Source:	**Website: Khan academy –** www.tiny.cc/khancells **(work through links on left)** **Interactive:** www.tinyurl.com/cellint2

Question 4	**Describe how the cell cycle is controlled and regulated.**
Source:	**Website** www.tinyurl.com/kmitosis **Interactive: McGraw hill animation –** www.tiny.cc/cellcycle2 **-** There are two further links on the left to use

Question 5	**Explain how substances are transported across the cell membrane.**
Source:	**Website:** www.tinyurl.com/ktransport2 **Interactive:** www.tiny.cc/memtrans **There are several animations on the left, some are more complex. Start with diffusion, facilitated diffusion, primary active transport and endo and exocytosis.**

PiXL Independence – Level 3
Biology in The News
A Level Biology – Cells

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. At the very least, the US Presidential election has certainly highlighted the impact that misleading information can have. www.tiny.cc/fakenews2

At home, the Brexit vote also suffered from the circulation of misleading news stories www.tiny.cc/fakenews3

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.

Stem cells

News article – www.tiny.cc/stemhowe
NHS article – www.tinyurl.com/ydd7bmb2
Discussion article – www.tinyurl.com/stemcrit
Real article – www.tinyurl.com/stemglas

Task

You need to produce a 1 page essay on the use of Stem cells to help patients who have suffered from a stroke. The table below will give you guidance on how to do it well.

Essay section	Activity
Introduction	Read through the first news article. Write a brief summary of the story. Then offer a brief evaluation on the article, how believable is it, discuss the possible weaknesses in the story. 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 NHS choices article which gives an overview of the article itself and the current science. Include a description of how stem cells can be used to treat stroke and the importance of this treatment.
Explore	Many websites discuss the truth behind science news, now read the discussion article. Write a summary of some of the key points made in the Gordie Howe case that you did not consider in your opening paragraph. This will show areas you need to consider in the future.
Evaluate	Finally, read the article summary by the University of Glasgow. Can you offer any final evaluative thoughts about the trustworthiness of this article… it is written by a University…

PiXL Independence – Level 4
Scientific Podcast
A Level Biology – Cells

Scientific Podcasts
There are several types of evidence you will be asked to produce at university. In addition to the traditional essay and scientific poster, the use of Podcasts is becoming increasingly common. It is actually harder than you think to produce a short concise, detailed and accurate podcast, therefore this task will help you get ahead of the game when you get to university.

Creating your Podcast
There are lots of pieces of software to create podcasts and edit them, however, the easiest would be the voice recorder on your phone, just check that it runs for long enough and you can save it in a suitable format, e.g. MP3, before you complete your master piece and find you need to do it again! Alternatively, get set up with Audacity which is free and will help you familiarise yourself with it.

The University of Southampton has produced some excellent guidance on creating Podcasts, which you can access at www.tiny.cc/podcasts3
Here are three of the key tips:

1. Write out your objective and share it at the start of the podcast.
2. Give it structure like you would in an essay.
3. Whilst it is important to plan a structure, sometimes it is harder to listen to someone who is reading than someone who is more naturally talking, therefore, try to have an outline and allow some natural speech.
4. Think about the recording, pick a quiet room and speak a bit louder than normal. Do a few trial runs and check the quality.

Examples
The naked scientists produce a series of podcasts (and is also a really useful website). Check out an example about a contagious cancer at www.tiny.cc/taz

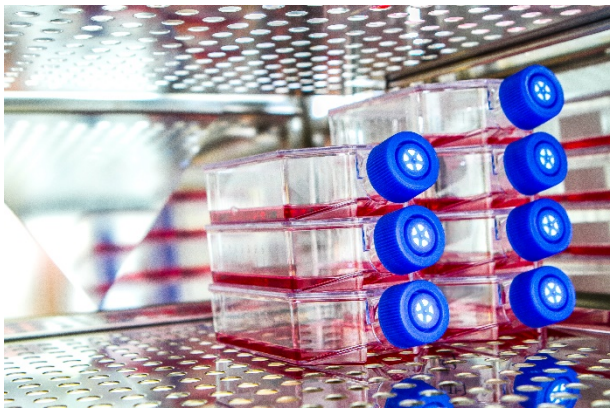


Figure 1 Cell cultures

Who was Henrietta Lacks?

Background

In laboratories around the world, human cells grow in culture, quickly available for scientists to access. However, this was not always the case. Most human tissues will not continuously grow in culture. Cancerous cells, however, switch off the genes that normally limit exponential growth and can be grown in culture. More than 55 years ago, Henrietta Lacks had her tumor biopsied. Unknowingly, these cells were cultured and are now still used in laboratories around the world, known as the HeLa (Henrietta Lacks) line.
Henrietta never knew about the cells, she was a poor lady and never received any compensation for providing a cell line that biotechnology companies sell to laboratories all over the world. Nor did she give consent.

As the pace of biotechnology research increases, other situations arise. For example, what if you were the only person who had a rare version of a gene that provided resistance to a cancer or prevented Zika virus. Then what if a biotech company took a sample of your blood and spent millions making the next miracle drug from your DNA template? Who should benefit, the Biotech company who carried out the research or you that didn't even know about your gene? Could you be forced to provide blood? We are on the verge of an era where genes can be patented, but who should own the rights?

Source article

Nature news : http://www.nature.com/news/deal-done-over-hela-cell-line-1.13511#/timeline1 **or use** www.tiny.cc/hela1
Article 2 - https://www.healthtalk.umn.edu/2014/11/11/origin-of-hela-cells-continues-to-impactresearch-ethics/ or www.tiny.cc/hela2

Task

At university interviews, you will often be asked to discuss ethical issues in science. This is one example that you could discuss.
Read the two articles on Henrietta Lacks.
Then produce a podcast using the guidance below

Describe	Describe the story of Henrietta Lacks.
Explain	Explain why cancer cells can be cultured.
Discuss	Discuss the key ethical issues involved in human research and the use of genetic and cellular material.

PiXL Independence – Level 5
Video summaries
A-level Biology – Cells

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 shows in amazing detail the inner working of the cell. It will really help you appreciate the extraordinary complexity of the cell. The second video is a Ted talk which discusses the use of stem cells. The final video discusses the role of sugars on the cell membrane.

Source article
Video 1 – The secret life of the cell (BBC)
BBC: www.tiny.cc/secretcell **/** http://www.dailymotion.com/video/x4fjy56

Video 2 – Transplant cells not organs
Ted Ed talks: https://www.ted.com/talks/susan_lim **or** www.tiny.cc/tedstem

Video 3 – What the sugar coating on your cells is trying to tell you
Ted Ed talks
https://www.ted.com/talks/carolyn_bertozzi_what_the_sugar_coating_on_your_cells_is_trying_to_tell_you **or** www.tiny.cc/cellsugar

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 how the organelles within the cell work together to transport substances, communicate and carry out cell functions
2. Evaluate the role of stem cells in the treatment of diseases such as Heart disease and blindness
3. Explain how modern drugs can interfere with the growth of a tumor

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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