

PiXL Independence:

Biology – Student Booklet

KS5

Topic - Exchange and Transport

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 – Exchange and Transport

INSTRUCTIONS

Score: /20

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

Part 1 – Transport across the cell membrane and the Lungs

1. How does a virus gain entry into a host cell?
 - a. Active transport
 - b. Facilitated diffusion
 - c. Receptor mediated endocytosis
 - d. Exocytosis

2. The Na⁺/K⁺ pump is a protein found on the surface of axons in nerve cells. It is responsible for maintaining a concentration gradient of Na⁺ outside the cell and K⁺ inside the cell. Which mechanism is used to do this?
 - a. Active transport
 - b. Facilitated diffusion
 - c. Passive Diffusion
 - d. Endocytosis and Exocytosis

3. Glucose needs to efficiently move across the cell membrane. It is a large uncharged molecule that uses facilitated diffusion to pass across the membrane. Which statement is most likely to be correct about the inside of the channel protein that sits within the phospholipid bilayer?
 - a. It is charged
 - b. It is hydrophobic
 - c. It is hydrophilic
 - d. It is oleophilic

4. During formation of tissue fluid, water, solutes and glucose move between the capillaries and tissue fluid. What is the role of albumin in this process?
 - a. As a channel protein to allow facilitated diffusion to take place.
 - b. As a carrier protein to transport Glucose back into the capillaries.
 - c. To maintain the osmotic pressure of the tissue fluid.
 - d. To maintain the oncotic pressure of the blood.

5. During an investigation into cell membrane permeability a student took samples of beetroot and immersed each sample into water at different temperatures. They then used a colourimeter to measure the absorbance of light passing through the samples. It is essential that the student washes the beetroot discs before starting the experiment. What would be the impact on the results if the samples were not washed?
- The absorbance will be lower at each temperature than expected, reducing accuracy.
 - Cutting the beetroot discs will break open cells releasing beetroot pigment.
 - The absorbance will be higher than expected at each temperature, reducing accuracy.
 - The absorbance will be higher than expected at lower temperatures only, reducing accuracy.
6. Your ventilation rate is your tidal volume x breathing rate. A runner has a tidal volume of 500cm^3 which rises to 1280cm^3 during exercise and her breathing rate rises from 13 breaths per minute to 22 breaths per minute. What is the percentage increase in ventilation rate?
- 21660
 - 333.2
 - 69.2
 - 433.2

7. During breathing, which row shows the correct information?

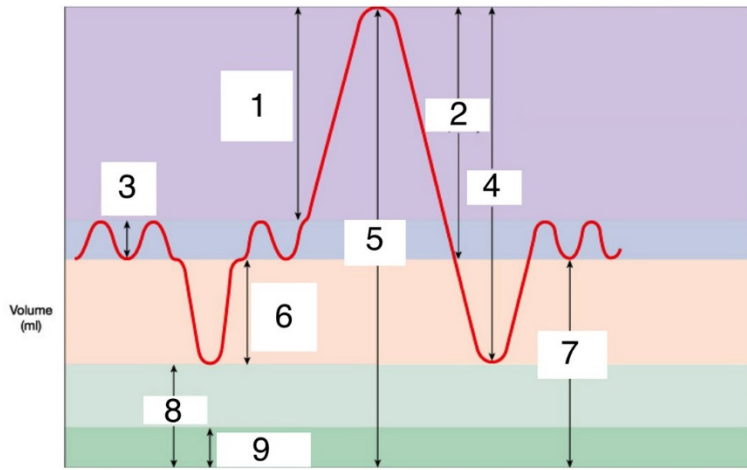
Answer	Muscle	Expiration	Inhalation	Forceful expiration	Deep inhalation
A	Diaphragm	Relax	Contract	Relax	Contract
	Intercostal muscles	External relax	Internal relax	Internal contract	Internal relax
B	Diaphragm	Relax	Contract	Relax	Contract
	Intercostal muscles	External contract	Internal contract	Internal relax	Internal contract
C	Diaphragm	Contract	Relax	Contract	Relax
	Intercostal muscles	External relax	Internal relax	Internal contract	Internal relax
D	Diaphragm	Contract	Relax	Contract	Relax
	Intercostal muscles	External contract	Internal contract	Internal relax	Internal contract

8. Insects still have a need for gas exchange, despite their small size.
Which table shows the correct similarities between humans and insects?

a.		Terrestrial Insects	Humans
	Mechanical ventilation	Absent	Present
	Branching network of tubes	No	Yes
	Major tubes	Spiracles	Trachea
	How does the tube network meet with the inside of the body?	Capillaries wrapped around spiracles	Capillaries wrapped around alveoli
b.		Terrestrial Insects	Humans
	Mechanical ventilation	Present in some species	Present
	Branching network of tubes	Yes	Yes
	Major tubes	Trachea	Tracheae
	How does the tube network meet with the inside of the body?	Capillaries wrapped around spiracles	Capillaries wrapped around alveoli
c.		Terrestrial Insects	Humans
	Mechanical ventilation	Present in some species	Present
	Branching network of tubes	Yes	Yes
	Major tubes	Spiracles	Trachea
	How does the tube network meet with the inside of the body?	Spiracles sit in internal fluid (haemolymph) or penetrate muscles	Capillaries wrapped around alveoli
d.		Terrestrial Insects	Humans
	Mechanical ventilation	Present in some species	Present
	Branching network of tubes	Yes	Yes
	Major tubes	Tracheae	Trachea
	How does the tube network meet with the inside of the body?	Tracheae sit in internal fluid (haemolymph) or penetrate muscles	Capillaries wrapped around alveoli

9. What is the function of squamous epithelium in the lungs?
- To move mucus and debris out of the lungs.
 - To produce mucus.
 - To provide a short diffusion pathway.
 - To produce lung surfactant.

10.

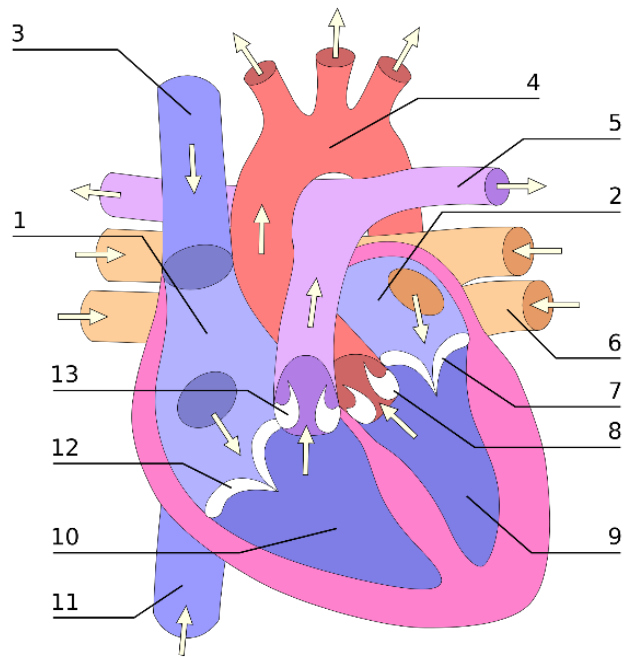


At rest, the breathing i is the number of breaths per minute. The ventilation rate, which is the volume of air inhaled in one minute, can be calculated as the tidal volume (as shown by point ii on the graph) by the breathing rate. The breathing rate can be increased when there is a demand for more oxygen. The maximum volume of air you can breathe in over and above a normal inhalation is the inspiratory reserve volume and is shown by point iii. The lungs cannot be fully emptied due to the residual volume, as shown by point iv. The maximum volume of air that can be breathed in is known as the v.

	i	ii	iii	iv	v
A	Rate	3	1	8	Inspiratory capacity
B	Volume	4	2	9	Tidal volume
C	Rate	3	6	8	Vital capacity
D	Rate	3	1	8	Vital capacity
E	Rate	4	6	8	Vital capacity

Part 2 – The Heart and plant transport

11. The following diagram shows the human heart.
Which is the correct set of labels?

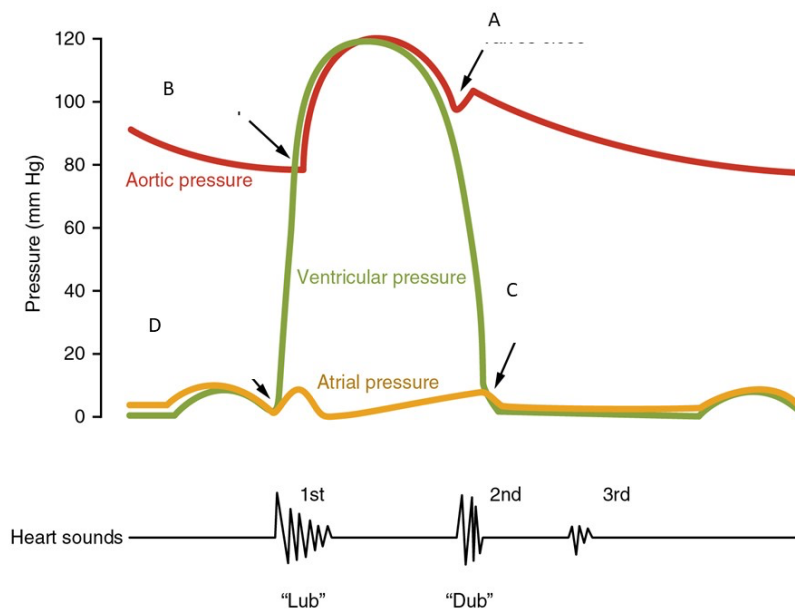


Wikimedia commons – No restrictions

a.	Label no.	5	7	10	3
	Part	Pulmonary artery	Atrioventricular valve	Right ventricle	Vena cava
b.	Label no.	5	11	6	12
	Part	Pulmonary artery	Vena cava	Pulmonary vein	Semi – lunar valve
c.	Label no.	4	7	6	6
	Part	Aorta	Atrioventricular valve	Pulmonary vein	Vena cava
d.	Label no.	5	8	9	1
	Part	Vena cava	Semi lunar valve	Right ventricle	Left atrium

12. The following diagram shows the pressure changes that take place during contraction of the heart.

At which point do the semi-lunar valves open?



- a. A
- b. B
- c. C
- d. D

13.

Heart muscle is a special type of muscle called1..... muscle. This muscle can contract independently of nervous control and is referred to as2.....

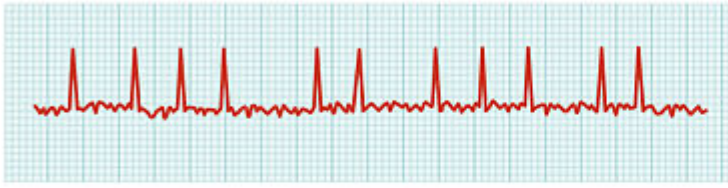
Blood passes from the left atrium to the left ventricle through specialist valves called3..... that prevent back flow. Blood then passes into the Aorta through the4..... Valve. This valve is forced closed by rising pressure in the5.....

Which row shows the correct set of labels?

a.

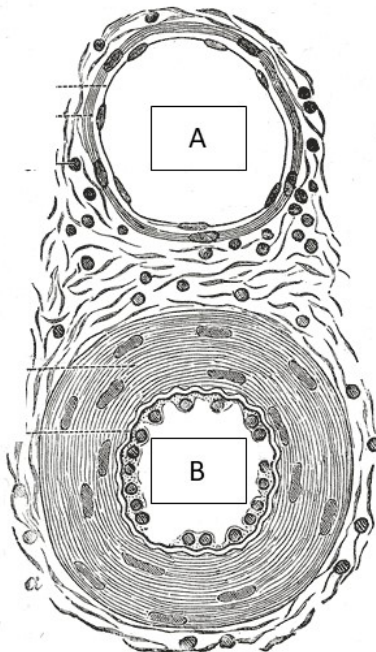
	1	2	3	4	5
A	Heart	Myogenic	Semi lunar valve	Atrioventricular valve	Pulmonary artery
B	Cardiac	Autogenic	Atrioventricular valve	Semi lunar valve	Pulmonary artery
C	Cardiac	Myogenic	Semilunar valve	Atrioventricular valve	Aorta
D x	Cardiac	Myogenic	Atrioventricular valve	Semi lunar valve	Aorta

14. The following diagram shows an ECG trace for a patient.
Which statement correctly describes the current state of their heart beat?



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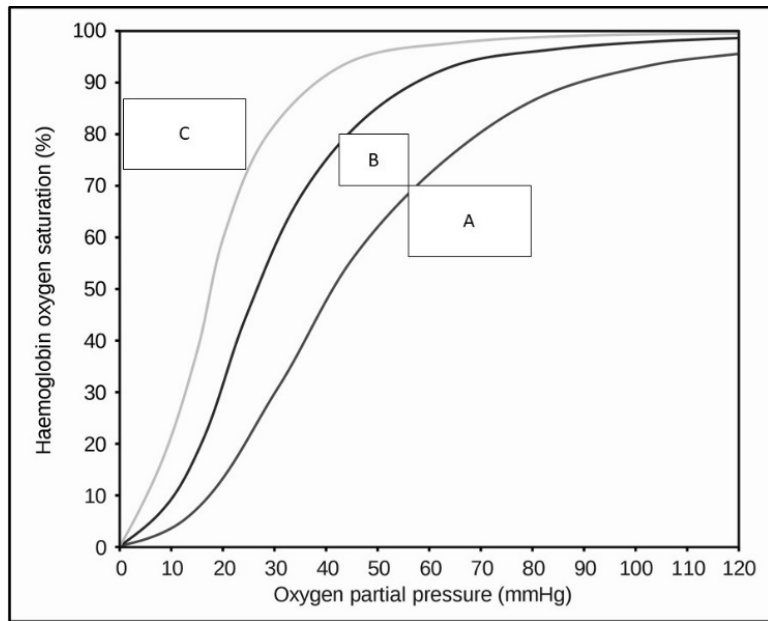
- a. Sinus Rhythm
 - b. Tachycardia
 - c. Ventricular fibrillation
 - d. Atrial fibrillation
15. The following drawing shows a low power drawing of two blood vessels. Which is the correct label for B?



Wikimedia commons – no restrictions

- a. Vein
- b. Capillary
- c. Artery
- d. Venule

16. The following diagram shows an oxygen dissociation curve for Haemoglobin.

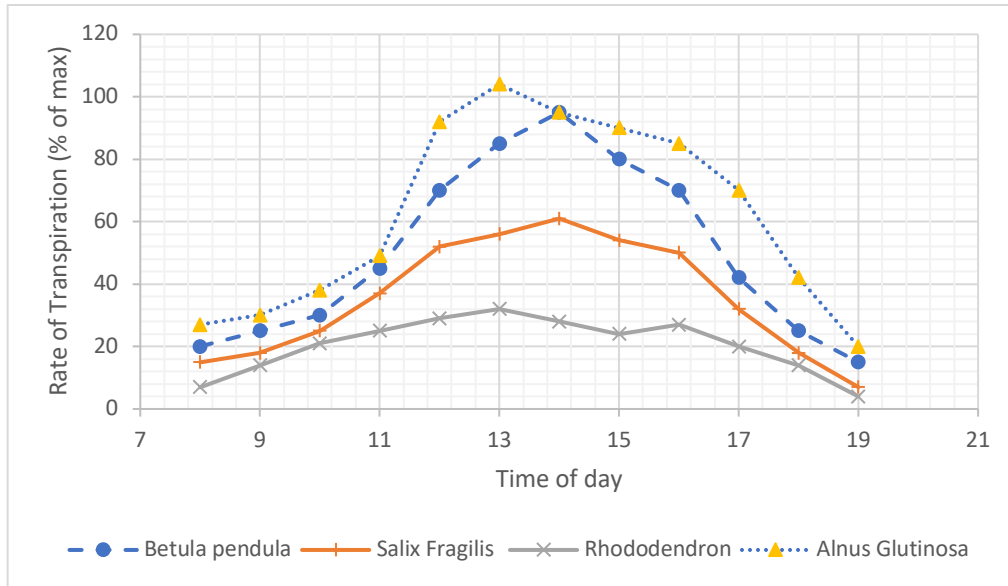


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What change in conditions has caused the oxygen dissociation to shift from curve B to curve A?

- a. An increase in pH
 - b. Presence of Carbon Monoxide
 - c. A decrease in temperature
 - d. A decrease in pH
17. Plants may be classified as Mesophytes, Xerophytes or Hydrophytes. What adaptations would you expect to see in Xerophytes?
- a. Stomata located in pits, no waxy cuticle
 - b. No stomata on the upper leaf surface and no waxy cuticle
 - c. Stomata present on both surfaces and thick waxy cuticle
 - d. Stomata in pits and thick waxy cuticle

18. A student investigated the rate of transpiration of 4 tree species found in the UK.



Which species is most likely to be adapted to living in very wet conditions?

- Betula pendula*
- Salix Fragilis*
- Rhododendron*
- Alnus Glutinosa*

19. The following diagram shows a cross section from a plant. Which part of the plant has this image been taken from?



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- Stem (Dicotyledon)
- Root
- Leaf
- Stem -Monocotyledon (Grasses)

20. During phloem loading of sucrose into the phloem, which of the following statements is correct?
- a. H^+ ions are actively pumped into the companion cell and sucrose and H^+ ions passively move through a co-transporter out of the companion cell.
 - b. H^+ ions are actively pumped out of the companion cell and sucrose and H^+ ions passively move through a co-transporter into the companion cell.
 - c. Glucose is actively transported through a carrier protein into the companion cells. H^+ ions follow through passive diffusion.
 - d. A proton pump transports H^+ ions and glucose into the companion cells using ATP.

PiXL Independence – Level 2
5 questions, 5 sentences, 5 words
A Level Biology – Exchange and Transport

Example:

QUESTION:	Explain how tissue fluid is formed			
Source:	Website – https://www.s-cool.co.uk/a-level/biology/transport/revise-it/transport-in-mammals Interactive – https://highered.mheducation.com/sites/0072507470/student_view0/chapter21/animation_fluid_exchange_across_the_walls_of_capillaries.html			
	<ol style="list-style-type: none"> 1. Tissue fluid is the fluid surrounding blood vessels and in between cells. It contains water, oxygen, glucose, small proteins, but not red blood cells or most proteins. 2. At the arteriole end of the capillary, the hydrostatic pressure is higher than the surroundings. The “pull” of the osmotic effect is lower. Therefore, the fluid is forced out of the capillary. 3. At the venule end, there is less fluid and this decreases the hydrostatic pressure and increases the osmotic “pull”. Therefore, fluid is pulled into the capillary. 4. Around 90% of the fluid is returned, the remaining 10% travels into the lymph system and is returned to the blood in the spleen. 5. The formation of tissue fluid allows exchange of oxygen, glucose, CO₂ and other nutrients. 			
Hydrostatic pressure – the pressure created by the contraction of the heart on the blood	Osmotic pressure – the pull created by dissolved substances in the blood	Oncotic pressure – a type of osmotic pressure but referring to the pull by proteins in the blood, e.g. albumin	Lymph – a network of vessels that allow movement of white blood cells around the body.	Arteriole – small arteries linking capillaries to arteries

QUESTION 1:	Describe how a cell such as a lymphocyte is able to engulf a bacterial cell.
Sources:	Website – https://www.khanacademy.org/science/ap-biology/cell-structure-and-function/membrane-transport/a/bulk-transport Interactive – https://highered.mheducation.com/sites/9834092339/student_view0/chapter5/endocytosis_and_exocytosis.html

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QUESTION 2:

Describe how the volume of the lungs and breathing rate can be measured with a spirometer.

Sources:

Website – <https://practicalbiology.org/cells-to-systems/ventilation-systems>

Interactive – [ANALYSING DATA on LUNG DISEASE: Risk Factors, spirometer trace and correlation. A-level Biology. - YouTube](#)

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QUESTION 3:

Explain how the conditions found in the muscles and lungs allow efficient oxygen transport.

Sources:

Website –

http://www.wiley.com/legacy/college/boyer/0470003790/structure/HbMb/mbhb_intro.htm

Interactive – <https://opentextbc.ca/biology/chapter/20-2-gas-exchange-across-respiratory-surfaces/>

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QUESTION 4:

Explain how the heart is controlled by the nervous system.

Sources:

Website – <https://www.s-cool.co.uk/a-level/biology/transport/revise-it/the-heart>
Interactive – [Innervation of the heart: Sympathetic and parasympathetic | Kenhub](#)

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QUESTION 5:

Compare the structure and functions of the xylem and phloem.

Sources:

Website – <https://www.s-cool.co.uk/a-level/biology/transport/revise-it/transport-in-plants>
Interactive – <https://www.saps.org.uk/teaching-resources/resources/1274/transport-of-water-and-sugar-in-plants/>
https://highered.mheducation.com/sites/9834092339/student_view0/chapter38/animation_-_phloem_loading.html

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PiXL Independence – Level 3

Biology in The News

A Level Biology – Exchange and Transport

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.

Pig Organ Donors:

News article – <https://www.bbc.co.uk/news/health-40886600>

Background – <https://virologyj.biomedcentral.com/articles/10.1186/s12985-017-0836-z>

CRISPR – <https://www.yourgenome.org/facts/what-is-crispr-cas9/>

Pigs without PERVs – PDF available (Article 1)

Original article – Exchange article PDF (extension only) (Article 2)

News – [Pig heart transplants for humans are being monitored by NHS after groundbreaking US operation \(inews.co.uk\)](http://www.inews.co.uk/pig-heart-transplants-for-humans-are-being-monitored-by-nhs-after-groundbreaking-operation/)

Media Bias – <https://mediabiasfactcheck.com/ifl-science/>

Task

You need to produce a 1-page essay on the use of Pig Hearts for Human Transplant

Essay section	Activity
Introduction	Read the news article and write a summary paragraph on the new breakthrough in Xenotransplantation. Write a brief summary on your thoughts on the validity of the article. At this stage, do not carry out further research on the validity. It is about how your opinion changes that is important in this task.
Describe	Read the beginning of the first background article, the abstract and conclusions. Describe why there are concerns about Xenotransplantation and why medical technology may not yet be developed enough to identify all the hazards. Briefly outline the role of CRISPR if you have not already learnt about this technique, the CRISPR link will help with this.
Explore	Read a shortened version of the original article (Pigs without PERVs) and explain how CRISPR was used to target a key gene in the retroviruses present in Pigs (Porcine endogenous retrovirus – PERV) known as the PERV Pol gene. This gene is present in all PERVs.
Evaluate	Evaluate the validity of the news article – you may find it is accurate, you may find it is not. Use the “Media Bias” link and the NHS choices article to put the main evaluation points. Write a final paragraph which discusses the points you read from these two articles compared to the points you had previously considered.

Please note: The Website IFL science can be found under other names when it advertises on Face Book, although only displays the abbreviation IFL Science on the website. Given the frequency of news articles on Face Book and the level of exposure to students, we felt this was an important website to evaluate. No offensive language was found on the website at the time of writing.

PiXL Independence – Level 4

Scientific Oral Presentation

A Level Biology – Exchange and Transport

Scientific Oral Presentations

There are several types of evidence you will be asked to produce at university. In addition to posters and podcasts, you will frequently be asked to give an oral presentation. Whilst many students enjoy the spotlight, others hate it. However, during the delivery, many students make common mistakes which make the talk hard to follow and shallow in content. Use the guidance below to give you a head start to the first year of your degree.

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 oral presentations at http://www.engageinresearch.ac.uk/section_a/giving_an_oral_presentation.shtml

Here are three of the key tips:

1. Keep to the rule of 6, there should be no more than 6 points on a page.
2. The content should not be a script, but short headings or points to help the audience follow your speech.
3. Use engaging high resolution pictures, but if you put them behind the text, make sure you use a semi-transparent fill colour to maintain the contrast and readability.
4. It is good to have a plan, but do not write a script. It is actually quite hard to follow someone who is reading formal notes. It is easier to follow someone who speaks naturally. Therefore, have a list of points, but allow yourself to discuss each naturally.
5. Rehearse at least once so that you can plan timings.

Examples

This short video has been created by Keele University and demonstrates every bad technique that students commonly use. It is worth watching to make sure your talk goes well. <https://www.youtube.com/watch?v=3kgtpl4Q5OY>

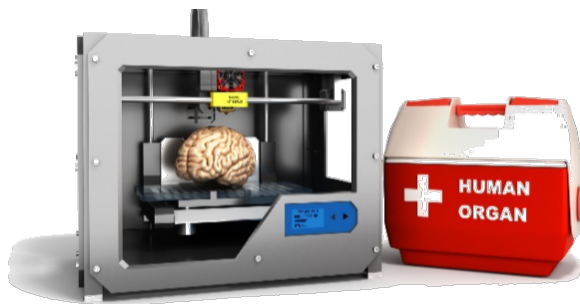


Figure 1 Conceptual 3D Organ printer

Cybernetics... is it here?

Background

Cybernetics – or communication and control in a living organism may seem like science fiction, but there are many aspects of the human body that have currently been created artificially, so how far can we go?

Recently, Japanese scientists worked out how to convert somatic body cells into stem cells, known as induced pluripotent stem cells. This significant breakthrough bypassed many of the ethical concerns over the use of embryonic stem cells, whilst perhaps creating a few new ones. However, as the technology matures, other teams are putting the technology to use and a range of new organs are being synthesized. Simultaneously, as our understanding of how the body works increases, other technologies are being utilized to recreate parts of the human body. The following articles are all examples of the latest technology.

Source articles:

3D heart printer – <https://www.sciencealert.com/researchers-have-just-3d-printed-a-mini-heart-using-human-tissue>

Artificial muscle – <https://www.scientificamerican.com/article/a-new-twist-on-artificial-muscles/>

Artificial spleen – <https://www.nature.com/news/artificial-spleen-cleans-up-blood-1.15917>

Artificial womb – <https://www.bbc.co.uk/news/av/health-50056405/the-world-s-first-artificial-womb-for-humans>

Artificial intestines – <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4847756/>

3D printed ovaries – <https://www.theguardian.com/science/2017/may/16/3d-printed-ovaries-allow-infertile-mice-to-give-birth>

3D printed bone – <https://www.sciencedaily.com/releases/2019/05/190516155338.htm>

Task

You need to produce a talk, either in groups or individually. You will each pick a different organ to research. The above links give a starting point (but you will need to go further) and the www.sciencemag.org is an excellent website (filter your search by news rather than journal articles). The table below will guide you on producing all the right components to your talk.

Describe	Describe the functions of your chosen organ in a healthy person. You should use your text book to find out what you need to know for the exam, this is a great chance to read ahead.
Explain	Explain why there is a need for a replacement organ. Outline the different causes and be sure to explain any new terminology you use.
Evaluate	Discuss how artificial organs can be made, whether it be through nanotechnology, stem cell science or even 3D printing. Outline how the technology works and how near scientists are to being able to use the technology... is it a pipe line dream or is it already in use? Discuss the barriers to the technology from becoming a key treatment on the NHS. You will need to research beyond the original article.

PiXL Independence – Level 5

Video summaries

A-level Biology – Exchange and Transport

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 uses CGI to explain many of the functions of the human body. The second video explains how lungs can be bioengineered. The final video is an exciting documentary by David Attenborough exploring how plants first colonized land.

Source article

Video Series 1 – Climbing Everest

You Tube: <https://www.youtube.com/watch?v=QpWkOiyTx1E>

Video 2 – Bioengineering lungs

Ted Talk (You tube) – <https://www.youtube.com/watch?v=eyHVIU1dNoE>

Video 3 – David Attenborough – Kingdom of Plants, Life in the Wet Zone

You Tube: <https://archive.org/details/KingdomOfPlantsLifeInTheWetZone> (if this link expires, just look for the video title in You Tube)

Task:

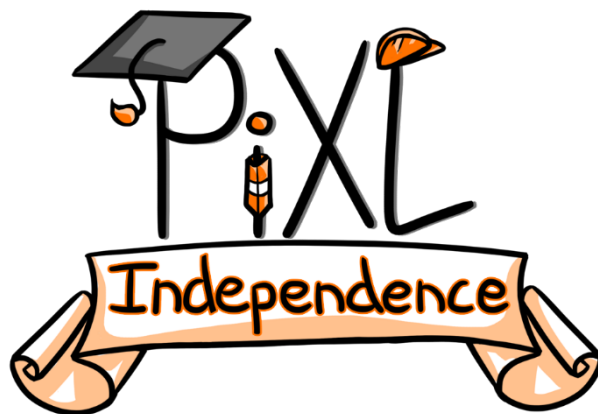
You need to produce a set of Cornell notes for each of the videos given above. Use the following objective to guide your note taking, this links to your learning.

1. Outline how the heart and lungs develop and function in the human body
2. Explain how lungs can be bioengineered and give details of the key structures that need to be formed
3. Explain the adaptations, with reference to transport systems, that allowed plants to colonize land.

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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