



# **PiXL Independence:**

## **GCSE Biology – Student Booklet**

### **KS4**

**Topic: Inheritance, variation and evolution**

**Contents:**

- I. Level 1- Multiple Choice Quiz – 20 credits
- II. Level 2 - 5 questions, 5 sentences, 5 words – 10 credits each
- III. Level 3 - Science 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**  
**GCSE Biology – Inheritance, variation and evolution**

**INSTRUCTIONS**

**Score:**

**/20**

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- **Read the question carefully.**
  - **Circle the correct letter.**
  - **Answer all questions**
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1. Which of the following statements is NOT true of sexual reproduction?
  - a. Sexual reproduction requires fusion of male and female gametes
  - b. Sexual reproduction requires pollen and egg cells
  - c. Sexual reproduction leads to genetically identical offspring
  - d. Sexual reproduction requires meiosis
  
2. Why is meiosis important?
  - a. It halves the number of chromosomes in the gametes so that a full number is restored at fertilization
  - b. It ensures the offspring are genetically identical to the parent cell
  - c. It ensures the four daughter cells are genetically identical to the parent cell
  - d. It is essential for growth and repair of cells in the body
  
3. Which of the following statements is NOT true of asexual reproduction?
  - a. Only one parent is needed
  - b. It is time and energy efficient
  - c. It is faster than sexual reproduction
  - d. Population growth is slow
  
4. Which statement lists the structures in the correct order of size from smallest to largest?
  - a. Genes, DNA, chromosomes, bases
  - b. Bases, DNA, genes, chromosomes
  - c. DNA, chromosomes, genes, bases
  - d. Chromosomes, genes, DNA, bases
  
5. What is the name given to the entire genetic material of an organism?
  - a. Proteome
  - b. Genome
  - c. Genetics
  - d. Genorm
  
6. DNA is a polymer made from four nucleotides. What do nucleotides consist of?
  - a. Adenine, thymine, cytosine and guanine
  - b. Adenine, uracil, cytosine and guanine
  - c. Sugar, phosphate and a base
  - d. Sulfate, phosphate and a base

7. What is the correct word for the characteristics displayed by a gene?
  - a. Phenotype
  - b. Genotype
  - c. Karyotype
  - d. Allele
  
8. Where in the cell are proteins synthesized?
  - a. Nucleus
  - b. Mitochondria
  - c. Cytoplasm
  - d. Ribosomes
  
9. What is the correct word for a cell that has two alleles that code for the same characteristic?
  - a. Homozygous
  - b. Monozygous
  - c. Heterozygous
  - d. Dominant
  
10. A recessive allele is expressed if...
  - a. There are two copies present
  - b. The cell is heterozygous
  - c. There is a dominant allele
  - d. The cell is a gamete
  
11. Ordinary human body cells contain:
  - a. 23 chromosomes
  - b. 23 pairs of chromosomes
  - c. 46 pairs of chromosomes
  - d. 23 pairs of chromosomes and a pair of sex chromosomes (X or Y)
  
12. Why can bacteria evolve rapidly?
  - a. They are resistant to antibiotics
  - b. They reproduce rapidly
  - c. They are immune to antibiotics
  - d. They are a prokaryote
  
13. Organisms do not belong to the same species if...
  - a. They cannot produce fertile offspring
  - b. They cannot produce offspring
  - c. They live in different parts of the world
  - d. They can produce fertile offspring
  
14. Which if the following is NOT an advantage of selective breeding?
  - a. Disease resistance in food crops
  - b. Animals produce more meat or milk
  - c. Inherited conditions
  - d. Large or unusual flowers

15. Why are some people concerned about GM crops?
- Genes are 'cut out' out of other organisms
  - The effects on health are unknown
  - GM crops might not be killed by herbicides
  - GM crops can produce a bigger yield
16. Which is the correct sequence for adult cell cloning?
- Nucleus removed from egg cell, nucleus removed from adult body cell, nucleus inserted into (empty) egg cell, electric shock, inserted into womb
  - Nucleus removed from egg cell, inserted into womb, nucleus removed from adult body cell, nucleus inserted into (empty) egg cell, electric shock
  - Inserted into womb, electric shock, nucleus inserted into (empty) egg cell, nucleus removed from adult body cell, nucleus removed from egg cell
  - Nucleus removed from adult body cell, nucleus inserted into (empty) egg cell, electric shock, inserted into womb, nucleus removed from egg cell
17. Apart from Darwin, who else proposed a theory of inheritance and evolution?
- Andre-Marie Ampere
  - Jean-Claude Juncker
  - Jean-Baptiste Lamarck
  - Antione Henri Bequerel
18. Speciation is when.....
- Organisms can produce fertile offspring
  - A theory is formed without firm evidence
  - Organisms become specialized in their habitat
  - Organisms evolve to become distinct species
19. Which of the following statements does NOT explain how fossils are formed?
- From parts of organisms that have not decayed
  - When the conditions for decay are absent
  - From preserved traces including footprints and roots
  - When an animal from a million years ago dies and is buried
20. When there are no remaining individuals of a species alive, this is called:
- Evolution
  - Speciation
  - Extinction
  - Mutation

## PiXL Independence – Level 2

### 5 questions, 5 sentences, 5 words

### GCSE Biology – Inheritance, variation and evolution

#### 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:

<b>QUESTION:</b>	What are the key differences between sexual and asexual reproduction?			
<b>Sources:</b>	Website – <a href="http://www.diffen.com/difference/Asexual_Reproduction_vs_Sexual_Reproduction">www.diffen.com/difference/Asexual_Reproduction_vs_Sexual_Reproduction</a>			
<ol style="list-style-type: none"> <li>1. Sexual reproduction involves the fusing of male and female gametes</li> <li>2. Asexual reproduction involves only one parent and no fusion of gametes</li> <li>3. Meiosis produces gametes that contain half the number of chromosomes</li> <li>4. Sexual reproduction produces variation and may increase the chance of survival and adaptation</li> <li>5. Asexual reproduction is quicker and can be more efficient</li> </ol>				
Fertilisation	Gametes	Meiosis	Variation	Adaptation

**QUESTION 1:**

Describe the structure of genes, chromosomes and DNA and explain how DNA codes for proteins

**Sources:**

**Website –**

[www.bbc.co.uk/schools/gcsebitesize/science/add\\_aqa\\_pre\\_2011/celldivision/celldivision1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/celldivision/celldivision1.shtml)

**Interactive -** <http://learn.genetics.utah.edu/content/basics/transcribe/>

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**QUESTION 2:** How does genetic inheritance take place?

**Sources:**

**Website** – [www.yourgenome.org/facts/what-is-inheritance](http://www.yourgenome.org/facts/what-is-inheritance)

**Interactive** - <http://learn.genetics.utah.edu/content/basics/inheritance/>

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**QUESTION 3:**

**How does variation occur within a population?**

**Sources:**

**Website** – [www.bbc.co.uk/education/guides/zhp4jxs/revision](http://www.bbc.co.uk/education/guides/zhp4jxs/revision)

**Interactive** - <http://learn.genetics.utah.edu/content/selection/sources/>

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**QUESTION 4:**

**What is the theory of evolution by natural selection?**

**Sources:**

**Website –**

[www.bbc.co.uk/schools/gcsebitesize/science/aqa\\_pre\\_2011/evolution/evolutionrev1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/aqa_pre_2011/evolution/evolutionrev1.shtml)

**Interactive -** [www.bbc.co.uk/timelines/zq8gcdm#z2wc9j6](http://www.bbc.co.uk/timelines/zq8gcdm#z2wc9j6)

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**QUESTION 5:** What is selective breeding?

**Sources:**

**Website –** [www.bbc.co.uk/education/guides/z6trd2p/revision](http://www.bbc.co.uk/education/guides/z6trd2p/revision)

**Interactive -** <https://lbc.msu.edu/evo-ed/pages/Peas/Farming/Farming.html>

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**PiXL Independence – Level 3**  
**Science in the News**  
**GCSE Biology – Inheritance, variation and evolution**

**INSTRUCTIONS**

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**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](http://www.tiny.cc/fakenews2)

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

**Inheritance, Evolution and Variation**

News article [www.globalchange.com/clonaid.htm#](http://www.globalchange.com/clonaid.htm#)

NHS article [www.nhs.uk/news/genetics-and-stem-cells/human-embryo-stem-cells-cloning-breakthrough/](http://www.nhs.uk/news/genetics-and-stem-cells/human-embryo-stem-cells-cloning-breakthrough/)

Discussion article <http://learn.genetics.utah.edu/content/cloning/whyclone/>

Real article [www.newscientist.com/article/dn3234-cloning-may-be-elaborate-hoax-says-monitor/](http://www.newscientist.com/article/dn3234-cloning-may-be-elaborate-hoax-says-monitor/)

**Task 1:**

You need to produce a 1 page essay on Human Cloning

<b>Essay section</b>	<b>Activity</b>
<b>Introduction</b>	Define the term 'clone'.
<b>Describe</b>	Describe some of the applications of cloning plants and animals. In addition, describe some of the potential benefits from cloning human cells.
<b>Explore</b>	Explore the ethics of cloning. Should we do it? Should we clone human cells? Humans?
<b>Evaluate</b>	Evaluate the advantages and disadvantages offered by cloning and the strength of evidence to support further cloning of humans and human cells in the future.

## Genetically Modified Foods

News article <http://sentinel.ht/2017/07/04/mexico-lab-ships-largest-gmo-corn-seed-shipment-haiti/>

WHO article [www.who.int/foodsafety/areas\\_work/food-technology/faq-genetically-modified-food/en/](http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/)

Discussion article [www.scientificamerican.com/article/the-truth-about-genetically-modified-food/](http://www.scientificamerican.com/article/the-truth-about-genetically-modified-food/)

Real article [www.forbes.com/sites/kavinsenapathy/2017/07/13/non-gmo-project-is-spreading-fake-news-again-but-still-has-a-grip-on-our-food-supply/#7fa10a699d41](http://www.forbes.com/sites/kavinsenapathy/2017/07/13/non-gmo-project-is-spreading-fake-news-again-but-still-has-a-grip-on-our-food-supply/#7fa10a699d41)

### Task 2:

You need to produce a 1 page essay on “Genetically Modified Foods”

<b>Essay section</b>	<b>Activity</b>
<b>Introduction</b>	Summarise the size and structure of genes, chromosomes and DNA and define what GM or genetic engineering means.
<b>Describe</b>	Describe how genes are inherited naturally and how genes can be transferred from one organism to another.
<b>Explore</b>	Explore the advantages and disadvantages of GM food products including their social, ethical and economic impacts.
<b>Evaluate</b>	Evaluate the strength of evidence around GM foods and what scientists need to do in the future to support arguments for or against this process.

# PiXL Independence – Level 4

## Scientific Posters

### GCSE Biology – Inheritance, variation and evolution

#### INSTRUCTIONS

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##### Scientific Posters

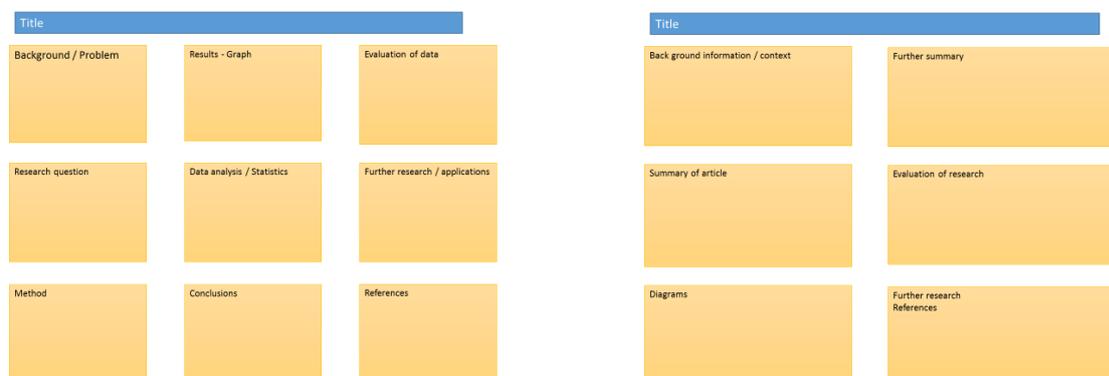
Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific 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 – [www.tiny.cc/posterskills](http://www.tiny.cc/posterskills) (that's Poster Skills not Posters Kill!) More detailed guidance is available at: [www.tiny.cc/posterskills2](http://www.tiny.cc/posterskills2)

##### 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 [www.tinyurl.com/postereg](http://www.tinyurl.com/postereg)

## The Human Genome Project

### Background

The Human Genome Project (HGP) was an international scientific research project with the goal of determining the sequence of nucleotide base pairs that make up human DNA. It also aimed to identify and map all of the genes of the human genome from both a physical and a functional standpoint.

### Source articles

[www.bbc.co.uk/schools/gcsebitesize/science/edexcel\\_pre\\_2011/genes/dnarev3.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/genes/dnarev3.shtml)

[www.genome.gov/10001772/all-about-the--human-genome-project-hgp/](http://www.genome.gov/10001772/all-about-the--human-genome-project-hgp/)

[www.genomicsengland.co.uk/the-100000-genomes-project/](http://www.genomicsengland.co.uk/the-100000-genomes-project/)

<https://ghr.nlm.nih.gov/primer/hgp/description>

<http://whoami.sciencemuseum.org.uk/whoami/findoutmore/yourgenes/whatwasthehuman-genome-project/whatdidthehumangenomeprojectfind>

Use other sources as necessary.

### Task:

Produce a scientific poster on The Human Genome Project

<b>Recall</b>	Recall the size, structure and organization of genes, chromosomes and DNA including base pairs and where these are stored within cells.
<b>Describe</b>	Describe the purpose of the Human Genome Project (HGP) and how scientists collaborated internationally to achieve this goal.
<b>Compare</b>	Compare our knowledge of genetics today with that of 30 years ago and how this has benefitted us.
<b>Evaluate</b>	Evaluate the success of the HGP and how it might be of use in the future. Consider also the ethical issues involved with knowing genes that predispose certain conditions, e.g. life insurance, starting a family.

# PiXL Independence – Level 5

## Video summaries

### GCSE Biology – Inheritance, variation and evolution

#### 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 (in a less well-structured lecture) 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 really will not remember. The NEW knowledge.
- 3 **Summary** – the most important step that is carried out after the lecture. This helps to reinforce learning.

#### Background

The following short TED talks present two topics that link to your learning. The first speculates on the appearance of humans in 100 years' time. The second video discusses survival of humans and how humans could evolve to cope with the rigors of space.

#### Source article:

**Ted talk :** [www.ted.com/talks/juan\\_enriquez\\_what\\_will\\_humans\\_look\\_like\\_in\\_100\\_years](http://www.ted.com/talks/juan_enriquez_what_will_humans_look_like_in_100_years)

We can evolve bacteria, plants and animals. Juan Enriquez asks: Is it ethical to evolve the human body? In a visionary talk that ranges from medieval prosthetics to present day neuroengineering and genetics, Enriquez sorts out the ethics associated with evolving humans and imagines the ways we'll have to transform our own bodies if we hope to explore and live in places other than Earth.

**Ted talk:** [www.ted.com/talks/lisa\\_nip\\_how\\_humans\\_could\\_evolve\\_to\\_survive\\_in\\_space](http://www.ted.com/talks/lisa_nip_how_humans_could_evolve_to_survive_in_space)

If we hope to one day leave Earth and explore the universe, our bodies are going to have to get a lot better at surviving the harsh conditions of space. Using synthetic biology, Lisa Nip hopes to harness special powers from microbes on Earth to make humans more fit for exploring space.

**Task:**

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

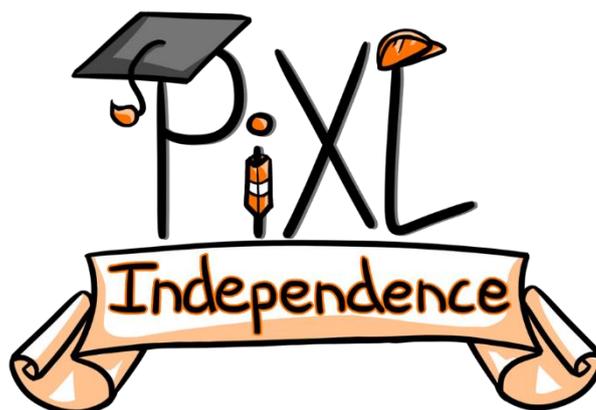
- 1 Discuss the circumstances/environments that might force human evolution over the next 100 years or more.
- 2 Discuss how humans might evolve, or learn from other organisms to ensure their success as a species continues in the future.

<b>Objectives</b> 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

<b>Objectives:</b>	<b>Title:</b>
	<b>Date:</b>
<b>Summary:</b>	



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