



# Made of Money: Profiting from DNA testing

Key Stage 4 Programme

Pupil Name

Coursebook  
Designed by

Victoria Gray



# Timetable and Assignment Submission

## Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Launch Trip)			
2			
3			
4			
5			
6 (Draft assignment feedback)			
7 (Final assignment feedback)			

## Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline assessment (mini essay)	
Tutorial 2	DNA sequencing technologies (flow chat)	
Tutorial 3	Comparison of ethical arguments (table)	
Tutorial 4	Data interpretation and the public (case study)	
Tutorial 5	Draft assignment (essay)	
Tutorial 6	Final assignment (essay)	

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# KS4 Programme – Pupil Feedback Report

Grade	Marks	What this means
1 <sup>st</sup>	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3 <sup>rd</sup>	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Name of PhD Tutor	
Title of Assignment	
Name of Pupil	
Name of School	
ORIGINAL MARK / 100	FINAL MARK / 100
DEDUCTED MARKS	FINAL GRADE

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

<b>Knowledge and Understanding</b>	<b>Research and Evidence</b>
<b>Developing an Argument</b>	<b>Critical Evaluation</b>
<b>Structure and Presentation</b>	<b>Language and Style</b>
<b>Overall Comments (participation, effort, resilience)</b>	

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# Course Rationale

As DNA sequencing has become faster and cheaper, its uses in research, medicine and business have increased dramatically. More biological research into genetic variation has been performed across the entire human genome, further understanding of basic characteristics, mechanisms of inheritance and development of disease. This has resulted in knowledge of how mutations in DNA can affect many different characteristics - from cancer to height to likelihood of obesity.

As more is understood about the human body and the influence genetics play on it, many companies are now exploiting this information. The increased accessibility of cheap DNA sequencing technologies mean these companies can offer whole genome DNA sequencing services to the public for a little as £100. These services can provide their customers with a variety of information from ancestry, health and wellness programs and risk of certain diseases. In most cases customers are required to read, interpret and contextualise large amounts of biological and mathematical data without face to face support. This can result in misinterpretation, panic and in some cases poor coping mechanisms. Increased use of these services has resulted in increased reliance on NHS services such as genetic counselling and cancer clinics.

This adds to the increasing pool of statistical and scientific data freely available for the public to try and understand every day. Daily government coronavirus briefings included graphs that resulted in differing conclusions depending on interpretation for example. Therefore, a greater understanding of how and why data is presented and interpreted will benefit researchers, the government and the public as more information becomes freely accessible in different spheres.

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# Group Discussions

## How do you make the most of a group discussion?

The purpose of discussions is to allow everyone in the group to express their ideas and learn from each other. Often this will involve coming to a group decision about the issue under discussion, though they may of course 'agree to disagree' on certain points.

### What we don't want in our tutorials:



Artwork by MiaHague.co.uk

### Rules:

1. Pronounce clearly what you are saying
2. Use eye contact and facial expression to help to get your idea across or to support what someone else is saying
3. Speak in a way that is right for a discussion (more formal than a chat between friends)
4. Build on other people's ideas, and summarise your own views and the views of others when necessary
5. Give reasons to support your views and critically examine the views expressed by others
6. Organise the discussion and take turns with others
7. Listen carefully and respond to the views of others

# Mark Scheme Table

Skills	1 <sup>st</sup> (70-100)	2:1 (60-69)	2:2 (50-59)	3 <sup>rd</sup> (40-49)	Mark /100
Knowledge and Understanding	<ul style="list-style-type: none"> <li>o Sophisticated understanding of the course material.</li> <li>o All the content included is relevant to the general topic and final assignment question – this shows clear thought about what to include.</li> <li>o Good evidence of independent thought.</li> <li>o Clear thought about unanswered or unexplored questions.</li> <li>o Very few factual mistakes.</li> <li>o Correct scientific language used, defined when it is useful to do so.</li> </ul>	<ul style="list-style-type: none"> <li>o Good understanding of the course material.</li> <li>o Content included is usually relevant to the general topic and final assignment question.</li> <li>o Some evidence of independent thought.</li> <li>o Some attempt to think about unanswered or unexplored questions.</li> <li>o Very few factual mistakes.</li> <li>o Correct scientific language usually used, defined when it is useful to do so.</li> </ul>	<ul style="list-style-type: none"> <li>o Mostly a good understanding of the course material.</li> <li>o Content included is usually relevant to the general topic and final assignment, but some may have been included without a clear reason.</li> <li>o Some evidence of independent thought.</li> <li>o Little attempt to address unanswered or unexplored questions.</li> <li>o Some factual mistakes.</li> <li>o Sometimes uses the correct scientific language but rarely includes definitions.</li> </ul>	<ul style="list-style-type: none"> <li>o Some understanding of the course material.</li> <li>o Some of the content included is relevant to the general topic and final assignment, but some may have been included without a clear reason.</li> <li>o Little evidence of independent thought.</li> <li>o Does not attempt to address unanswered or unexplored questions.</li> <li>o Some factual mistakes.</li> <li>o Can use the key scientific language, but only uses this correctly occasionally and rarely include definitions.</li> </ul>	
Research and Evidence	<ul style="list-style-type: none"> <li>o Includes research findings from a wide range of sources, beyond what is provided in the tutorials.</li> <li>o Consistently uses scientific evidence to support claims and convince the reader of arguments.</li> <li>o Critically appraises (examines the strengths and weaknesses of) evidence used.</li> </ul>	<ul style="list-style-type: none"> <li>o Includes research findings from different sources from the tutorials and demonstrate some research beyond what is provided in the tutorials.</li> <li>o Often uses scientific evidence to support claims and convince the reader of arguments.</li> <li>o Critically appraises (examines the strengths and weaknesses of) some of the evidence used.</li> </ul>	<ul style="list-style-type: none"> <li>o Make little attempt to research beyond what is provided in the tutorials.</li> <li>o Sometimes uses scientific evidence to support claims and convince the reader of arguments.</li> <li>o Critically appraises (examines the strengths and weaknesses of) some of the evidence used.</li> </ul>	<ul style="list-style-type: none"> <li>o Does not include research or evidence from beyond the tutorials.</li> <li>o Rarely uses scientific evidence to support claims and convince the reader of arguments.</li> <li>o Make no attempt to critically appraise (examine the strengths and weaknesses of) the evidence used.</li> </ul>	
Developing an Argument	<ul style="list-style-type: none"> <li>o Always makes a point of view clear throughout the assignment.</li> <li>o Highlights competing points of view throughout the essay.</li> <li>o Always explains and justifies why certain facts/figures are included and the reader always knows why it is relevant.</li> </ul>	<ul style="list-style-type: none"> <li>o Often makes a point of view clear throughout the assignment.</li> <li>o Often highlights competing points of view.</li> <li>o Explain and justifies why certain facts/figures are included; most of the time the reader knows why it is relevant.</li> </ul>	<ul style="list-style-type: none"> <li>o Tries to make a point of view clear, but sometimes the reader may get confused.</li> <li>o Occasionally highlights competing points of view.</li> <li>o Explain and justifies why certain facts/figures are included but should provide more explanation.</li> </ul>	<ul style="list-style-type: none"> <li>o Tries to make a point of view clear, but sometimes the reader may get confused.</li> <li>o Rarely highlights competing points of view.</li> <li>o Attempts to explain why some facts/figures are included.</li> </ul>	

Critical Evaluation	<ul style="list-style-type: none"> <li>Always chooses research evidence that is related to and appropriate for the arguments made.</li> <li>As well as describing the evidence, always explains its value or significance.</li> <li>Often comments on how reliable the sources are, including potential limitations.</li> <li>Evaluation is always clear, easy to follow and explained.</li> </ul>	<ul style="list-style-type: none"> <li>Often chooses research evidence that is related to and appropriate for the arguments made.</li> <li>As well as describing the evidence; usually explains its significance.</li> <li>Sometimes suggest why a source is/ is not reliable.</li> <li>Evaluation is usually clear, easy to follow and explained.</li> </ul>	<ul style="list-style-type: none"> <li>Sometimes chooses research evidence that is related to and appropriate for the arguments made</li> <li>Consistently describes evidence and sometimes attempts to explain its significance.</li> <li>Can say if a source is reliable or not but does not always explain this.</li> <li>Evaluation is not always clear, easy to follow, or explained.</li> </ul>	<ul style="list-style-type: none"> <li>Rarely chooses research evidence that is related to the arguments made.</li> <li>Consistently describes evidence but does not always explain its significance.</li> <li>Can say if a source is reliable or not but does not always explain this.</li> <li>Evaluation is rarely clear, easy to follow, or explained.</li> </ul>	
Structure and Presentation	<ul style="list-style-type: none"> <li>Introduction clearly outlines what the assignment will contain.</li> <li>Organises ideas in paragraphs with a logical structure that makes it easy for the reader to follow.</li> <li>Excellent answering of the question.</li> <li>Conclusion summarises all of the main points clearly.</li> <li>Where needed, includes the correct units.</li> <li>Tables and graphs are labelled correctly, including titles and units.</li> <li>Demonstrates an excellent understanding of referencing – all sources are cited in text and referenced in the correct format.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction outlines what the assignment will contain.</li> <li>Organises ideas in paragraphs with quite a clear structure that makes it easy for the reader to follow.</li> <li>Good answering of the question.</li> <li>Conclusion summarises most of the main points clearly.</li> <li>Where needed, includes the correct units.</li> <li>Includes most of the appropriate labels for tables and graphs, including titles and units.</li> <li>Demonstrates a good understanding of referencing – most sources are cited in text and referenced in the correct format.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction briefly outlines some aspects of the assignment.</li> <li>Organises ideas in paragraphs, but their order could be more logical to make it easier for the reader to follow.</li> <li>Attempts to address all aspects of the question.</li> <li>Conclusion summarises some of the main points.</li> <li>Includes units where needed, but with some errors.</li> <li>Includes some of the appropriate labels for tables and graphs, including titles and units with occasional errors.</li> <li>Demonstrates a developing understanding of referencing – some of sources are cited in text and referenced correctly, but with errors.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction mentions the main issue.</li> <li>Usually organises ideas in paragraphs, but their order is not always easy for the reader to follow.</li> <li>Does not address all aspects of the question.</li> <li>Conclusion summarises some of the main points.</li> <li>Often forgets to include the correct units.</li> <li>Sometimes forgets to include the labels needed for tables and graphs, such as titles and units.</li> <li>Has not or only occasionally attempts to reference.</li> </ul>	
Language and Style	<ul style="list-style-type: none"> <li>Writing style is consistently clear and appropriate for a scientific document.</li> <li>Spelling, grammar and punctuation are consistently accurate.</li> <li>Worked towards the word limit.</li> </ul>	<ul style="list-style-type: none"> <li>Writing style is mostly clear and appropriate for a scientific document.</li> <li>Spelling, grammar and punctuation are usually accurate, with occasional mistakes.</li> <li>Worked towards the word limit.</li> </ul>	<ul style="list-style-type: none"> <li>Writing style is sometimes clear and an attempt has been made to make it appropriate for a scientific document.</li> <li>Some errors in spelling/grammar/punctuation.</li> <li>Worked towards the word limit.</li> </ul>	<ul style="list-style-type: none"> <li>Writing style is often not clear or appropriate for a scientific document.</li> <li>Errors in spelling/grammar/punctuation.</li> <li>Some attempt to work towards the word limit.</li> </ul>	
Overall Mark (average of the 6 marks from the criteria above)					

# Glossary of Keywords

Word	Definition	In a sentence
Bioethics	The process of posing ethical questions about biological concepts	We should consider the bioethics of testing the general population for the presence of this disease
Direct-to-consumer genetic testing	Genetic testing that is not facilitated by a health care provider but is sold direct to the customer in an open trading environment	23andMe is a direct-to-consumer genetic test focusing on health and ancestry
DNA extraction	The process of removing DNA from the nucleus of cells and preserving it for further analysis	In order for genetic information from blood to be known, DNA extraction of red blood cells occurs
DNA sequencing	The process by which the base sequence of extracted DNA can be determined	DNA sequencing of a blood sample taken at the crime scene could help determine the suspect
Genetic Predisposition	An increased likelihood of developing a disease based on an individual's genetics	Patients who have a BRCA mutation have a genetic predisposition for breast and ovarian cancers
Genome Wide Association Study (GWAS)	An observational study which determines if millions of individual genetic variations is associated with a disease or trait	A GWAS was performed and found a mutation increased the likelihood of a patient surviving longer
Genetic counselling	The process of advising individuals who are at risk of genetic disorders how to adapt to medical and familial implications of the information	After Angelina Jolie found out she had an increased risk of cancer, she sought genetic counselling before decided to undergo surgery
(Genetic) Inheritance	The process by which characteristics are passed from one generation to the next	She inherits her blue eyes from her grandmother
Mutation	A change in DNA sequence as the result of a copying error, exposure to chemical or radiation	A mutation in the lactase gene causes lactose intolerance
Odds Ratio	A quantification of the relationship between two events or groups.	A higher odds ratio means the presence of one event increases the odds of the other event occurring
Statistical Significance	The likelihood that the relationship between two or more events or groups is not the result of chance	There is no statistically significant relationship between gender and IQ

# Tutorial 1 – Ethics of DNA testing for profit - An introduction



Photo by michaelseangallagher

## What is the Purpose of Tutorial 1?

- Consolidate understanding of the components of DNA
- Appreciate the impact of mutations on human characteristics
- Understand the basic ideas around direct-to-consumer genetic testing

*"The past five years have witnessed widespread scientific and social enthusiasm about—and controversy over—new developments in whole genome sequencing technologies and their possible commercial applications to human health. Many proponents of consumer genomics—including direct-to-consumer genetic testing (DTC-GT) marketed publicly to individuals and made available without need for an intermediary medical professional—view direct access to one's genome as an individual right, noting many potential benefits of learning more about one's predilection to disease and likelihood of response to particular medications. Meanwhile, professional organizations representing health professionals and genetics researchers have continued to express concerns regarding DTC-GT and its potential harms"*

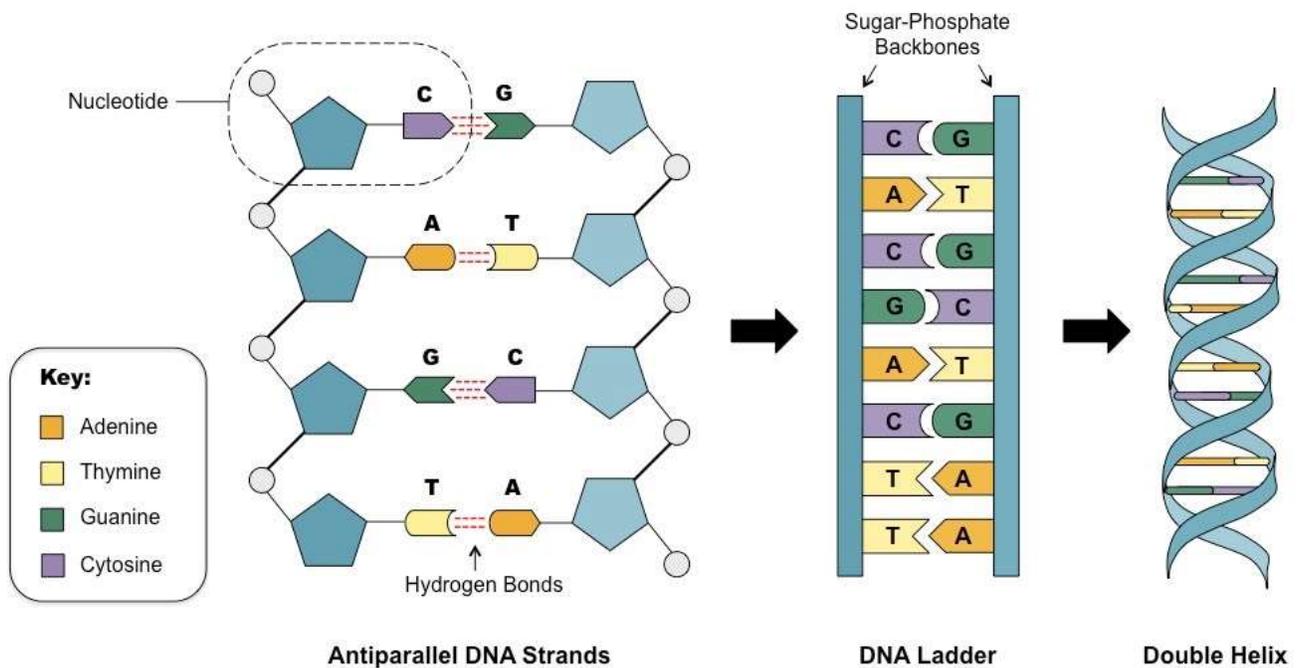
**Roberts & Ostergren (2013),  
Direct-to-Consumer Genetic Testing and Personal Genomics Services:  
A Review of Recent Empirical Studies**

DNA is a key component of each living cell and encodes all the instructions needed to make all living organisms – from cats to viruses to humans. Knowing the sequence of an individual can allow those with this information to predict specific outcomes, including physical characteristics (such as eye colour), risk of developing certain diseases and how well an individual can react to certain drugs or medicines – this is sometimes called pharmacogenetics.

The first full DNA sequence (all 3.2 billion bases of DNA) from a human a being was completed in the year 2003 as part of the Human Genome Project and cost \$2.7 billion. As the cost of DNA sequencing a full human genome has dropped below \$1000, more business are finding ways to market the technology as a way of finding out many different things about a person in order to sell testing kits and make a profit. In order to be able to do this, an understanding the structure of DNA as individual bases and sequences is required

DNA molecules are based on a specific sugar molecule (deoxyribose) with a specific base attached. These bases can be one of 4 molecules – Cytosine (C), Thymine (T), Adenine (A) or Guanine (G).

These molecules are linked together in a long sequence by connecting the phosphate groups found in the sugar molecule for form a phosphate backbone. These bases bond together in pairs (A to T and C to G) to form the double strand that is characteristic for DNA.



DNA Structure, BioNinja

[https://ib.bioninja.com.au/\\_Media/double-stranded-dna\\_med.jpeg](https://ib.bioninja.com.au/_Media/double-stranded-dna_med.jpeg)

The order in which these bases are found in genes determines many characteristics by producing proteins, which are responsible for many things including dictating your eye colour, helping digest food and form muscles when you exercise.

## What is DNA?

Fill in the gaps

D - \_\_\_\_\_  
 N - \_\_\_\_\_  
 A - \_\_\_\_\_

Inside of each human cell is a \_\_\_\_\_ containing \_\_\_\_\_ pairs of chromosomes. Each chromosome is made up of millions of \_\_\_\_\_ pairs of DNA. There are for 3 bases seen in both DNA and RNA (which is \_\_\_\_\_ into proteins), the fourth base in DNA is \_\_\_\_\_ and \_\_\_\_\_ in RNA. DNA is organised into \_\_\_\_\_ and non-coding regions (sometimes called junk DNA) Genes encode all the \_\_\_\_\_ needed in the human body and can dictate many characteristics including disease risk



<b>23</b>	<b>nucleus</b>	<b>proteins</b>	<b>lipids</b>	<b>42</b>	<b>base</b>	<b>Uracil</b>	<b>translated</b>
<b>equal</b>	<b>nucleolus</b>	<b>Guanine</b>	<b>ribosome</b>	<b>acid</b>	<b>transcribed</b>	<b>vacuoles</b>	<b>Thymine</b>
<b>genes</b>	<b>subunits</b>	<b>Adenine</b>	<b>105</b>			<b>Cytosine</b>	

When a DNA sequence changes from the original sequence, this is known as a mutation. There are three main forms of mutations – insertion, deletion and substitution

**Original Sequence:  
GCGCATATGTCTAG**

Using the original (or reference sequence, give an example of a(n)

**Insertion**

**Deletion**

**Substitution**

**Other than genetic mutations, what else can affect the development of disease?**

Hint: List 3 things

1)

2)

3)

Other ideas:



## First thoughts - For and against DTC genetic testing

For	Against

### Homework: Baseline Assignment

Write 500 words to answer the question 'Should the public have the right to know of DNA mutations that increase their likelihood of developing a disease before there are any symptoms?'

Think about introducing the concept, providing a brief balanced argument before coming to your own conclusion. Make sure to cite any resources you need to support your ideas – these could be scientific journals you can find through websites like PubMed or Google Scholar or other resources such as news articles or videos such as Ted Talks.

# Tutorial 2 – Extracting and sequencing DNA

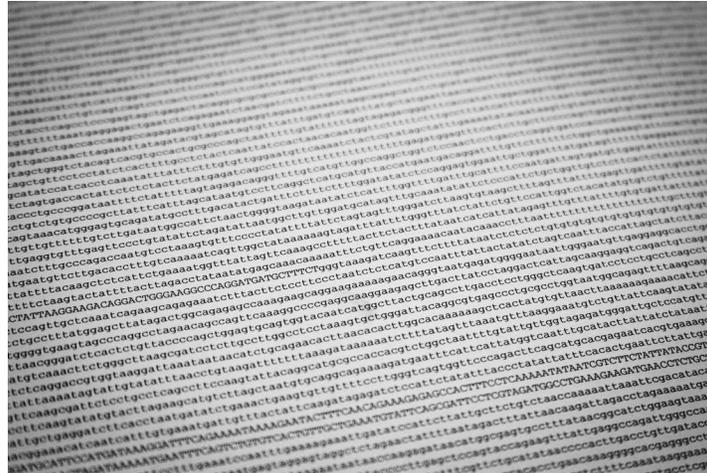
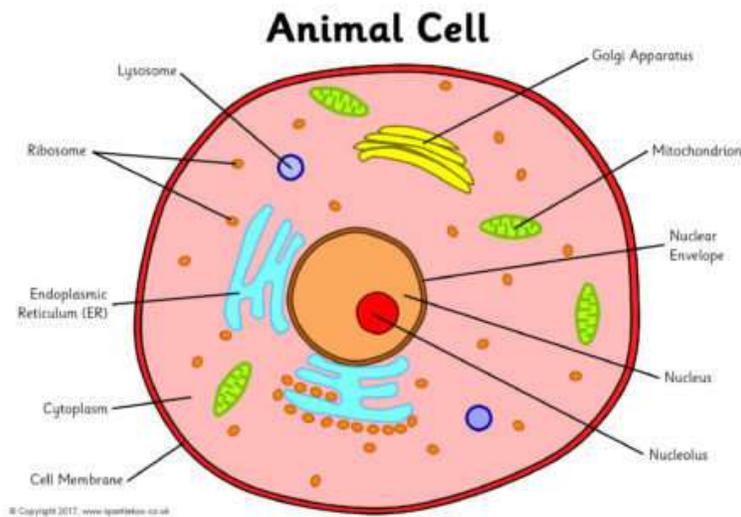


Photo by tom\_bullock

## What is the Purpose of Tutorial 2?

- Understand and explain the process of DNA extraction and sequencing

DNA is found within the nucleus of all eukaryotic cells. Eukaryotic cells contain components separated into compartments by membranes made of fat and other molecules. Examples of eukaryotes (organisms made up of eukaryotic cells) include plants, fungi and vertebrates.



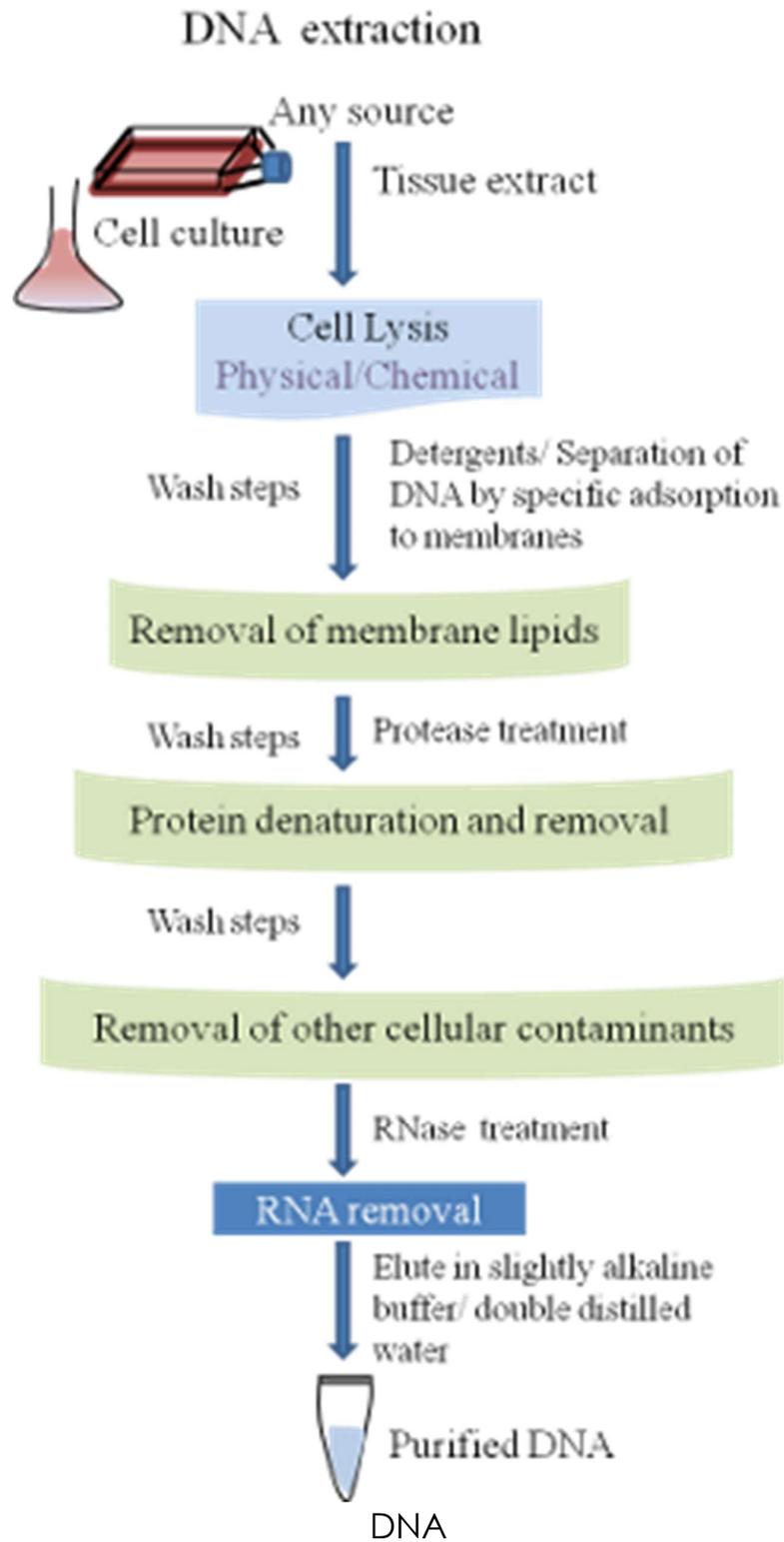
Animal Cell, Sparklebox

<https://www.sparklebox.co.uk/wp-content/uploads/1-10582.jpg>

As the DNA is inside a specific compartment within a cell, we have to find a way to remove the nucleus from the cell and the DNA from the nucleus before we can determine the sequences of the bases.



# DNA Extraction flow chart



DNA extraction, Labome  
<https://aws.labome.com/figure/te-191-1.png>

## What is DNA sequencing?

Answer the questions based on the lecture

What are the key components required for the chain termination reaction in sanger sequencing?

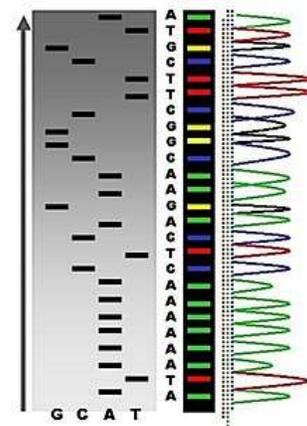
When was Sanger sequencing originally commercialised?

'NextGen' sequencing replaced Sanger sequencing in certain situations. Define the term NextGen. What situations would NextGen be more appropriate than Sanger sequencing?

Some direct to consumer genetics companies utilise ChIP-seq. What does ChIP stand for?

What is Moore's Law?

What is the function of the template DNA during DNA sequencing?



What are the 4 common types of DNA sequences that may be produced by DNA sequencing?

## Homework: DNA sequencing technologies

For each of the 4 most common types of DNA sequence produced by DNA sequencing, write an example (75 words or less) or a use for this particular type of sequence to a researcher or medical practitioner

Think about the differences in the information each type of sequence gives and how the cost of sequencing may influence which type of DNA sequencing method (that produces these different types) that a scientist or doctor may choose.

# Tutorial 3 – Data presentation and the future of genetic testing



Photo byTEDxPeachtree

## What is the Purpose of Tutorial 3?

- Understand how why data is presented in different ways for different audiences
- Be able to interpret risk data well
- Appreciate the implications of poorly presented data
- Appreciate the potential applications of DNA sequencing both for profit and as part of standardised health care

## Starter - A worked example

Imagine there is a new disease discovered, Bluteethitis. Bluteethitis is the development of blue teeth as you age. However, there has been a key gene that has been shown to reduce the age at which symptoms start – *TETB*. Certain mutations in *TETB* increase your risk of someone's teeth turning blue before the age of 30. Using information of the DNA sequence of one base, known as a single nucleotide polymorphism (SNP), the risk of mutations in different parts of the same gene can be calculated and predicted

SNP rs758931 is found in the first intron of the *TETB* gene. SNP rs658592 is found in the last exon of *TETB*

In people of European decent with a C in SNP rs758931 are **10x more likely** to have blue teeth by the time they are 30 than those with a G.

**ATGGATCTAAA**  
**ATGGATGTAAA**  
**SNP rs758931**

People of European decent with an A in SNP rs658592 are **3x more likely** to have blue teeth by the time they are 30 than those with T.

**CGGTAGAAA**  
**CGGTAGATA**  
**SNP rs658592**

WHICH IS THE SNP WITH THE MOST RISK? C IN rs758931 or A IN rs658592?

Based on this exercise it is clear that the way data is presented. Including how it is described and what figures are included and excluded can heavily influence how people interpret and draw conclusions about the numbers they are being shown.

As DNA sequencing becomes cheaper, more and more genetic data is becoming available to investigators whose findings are then passed onto the general public. Therefore, it is important that investigators find appropriate ways to clearly present their data so that is easy to understand for people who are not dealing with the data themselves directly.

There are a number of different ways that mathematical data and concepts can be presented based on requirements of the person producing the data and the person who needs to understand it. However, each different way has distinct advantages and disadvantages that need to be taken into account. This is especially important when looking at potential life changing information or information that may influence how and why people act a certain way such as data supporting advice for public health policies like those related to the COVID-19 outbreak

## Ways data can be presented

Presentation Type	Advantage	Disadvantage

Additional thoughts and notes

The data produced as the result of DNA sequencing and determination of the outcomes of changes in protein structure as the results of mutations. In genes can have a number of applications.

These can be clinically applicable – where the results of genetic testing are used by medical practitioners such as doctors and nurses to influence how or why a patient must be treated. This genetic data must be interpreted by the person in the NHS or other health service and communicated to the patient who has had the test and is undergoing treatment.

These can be commercially applicable, where a scientist is collecting and producing the data for a paying customer who has little to no understanding of the technology or methods behind the data they are given.

Genetic testing is currently available in both health care and in business to some extent. However, the possibilities for the future provide lots of potential for new ways to improve patient outcomes or provide companies revenue for providing such services

### Genetic testing in health care

Present	Future

### Genetic testing for profit

Present	Future

### Homework: Data interpretation and the public

Find at least one example of where data was presented inappropriately and describe incorrect conclusions were made (no more than 300 words)

This does not have to be about DNA testing. This can be any example of where maths or diagrams were used inappropriately or incorrectly. Think about things that can be easily be shown to be wrong such as future predictions that did not come true.

# Tutorial 4 – Bioethics and DNA sequencing



Photo byTEDxPeachtree

## What is the Purpose of Tutorial 4?

- Understand the ethical considerations of businesses
- Appreciate and understand the main concepts of bioethics
- Appreciate the ethical arguments for and against DNA testing for profit

## Bioethics

*"Ethics seeks to determine what a person should do, or the best course of action, and provides reasons why. It also helps people decide how to behave and treat one another, and what kind of communities would be good to live in"*

### Exploring Bioethics

Bioethics is the study of ethical issues as a result of advances in biology and medicine. This can include aspects of healthcare and biotechnology. Rather than biological questions which aim to understand biological ideas, bioethical questions ask what people think and how they reaction to concepts.

Examples of medical procedures and concepts that can divide people due to ethics

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## Key Bioethical Principles

Bioethics has 4 key principles that each new medical technology or practice is measured against. These are supposed to be balanced equally.

Principle	Definition
Autonomy	
Beneficence	
Nonmaleficence	
Justice	

Do you think it is always possible to balance these 4 principles equally?

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## Homework: Summarisation of ethical arguments

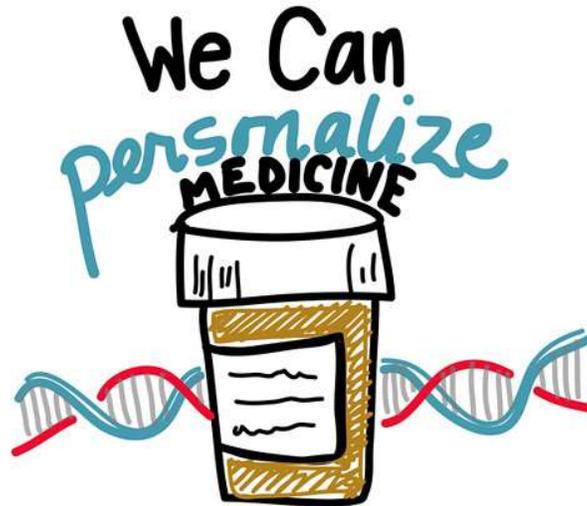
Write 400 words on the opposite argument (for or against DTC genetic testing) to the one you brainstormed in class. This will be marked by one of your fellow students in class next week.

Think of two things you either do not understand or need further explanation from the course so far. We will discuss these next week.

1)

2)

# Tutorial 5 – Preparation for the Final Assignment



Sketch byTEDxPeachtree

## What is the Purpose of Tutorial 5?

- Understand the components of good written assignments
- Consolidate understanding of all the concepts introduced in this course
- Understand the expectations for the final assignment

## Peer Marking an assignment

Using the mark scheme at the front of the booklet, mark someone else's homework. List 2 things that are strong, 2 things they could improve on and give them a grade (1sr, 2.1, 2.2 etc.).

### Good things

1)

2)

### Things to Improve

1)

2)

Grade:



## Homework: Final Assignment

### **'Direct consumer genetic testing should not be allowed in the UK - A discussion**

In the form of 2,000-word essay - discuss this statement, taking into account the scientific and statistical concepts and ethical implications of these tests.

Think about structure of your essay

**Introduction** – 100-200 words to introduce the topic, define any technical terms and set the scene for the essay

**Agreeing with the statement** – 700-900 words on different points (with supporting evidence) to support the idea that genetic testing should not be allowed in the UK. The exact amount of words you spend on each separate idea that supports this statement (which should be organised into their own paragraphs) will depend on how many you wish to cover.

**Points disagreeing with the statement** - 700-900 words on different points (with supporting evidence) to disagree with the idea that genetic testing should not be allowed in the UK. The exact amount of words you spend on each separate idea that disagree with this statement (which should be organised into their own paragraphs) will depend on how many you wish to cover.

**Conclusion** – 100-200 words in a paragraph summarising the 2 contrasting arguments before coming to a conclusion using your own opinion.

**Remember, because of the word count you may not be able to include every idea, so you may have to choose a few stronger statements with evidence rather than covering everything you wish to.**

## Essay writing reflection

Use the checklist below to reflect on your essay writing ability at the moment. Read the statements for each skill and then tick the box that most closely fits how you currently feel about your ability to do that skill.

You will use this to help your PhD tutor give you feedback in your next tutorial. They will give you specific advice on how to improve these areas in relation to your draft assignment so be completely honest.

Addressing the question			Using evidence		
I can... <ul style="list-style-type: none"> <li>identify what the title or question is asking me to do</li> <li>select relevant information from the course to answer the title or question</li> <li>explain why the information I have used is relevant</li> </ul>			I can... <ul style="list-style-type: none"> <li>select evidence that supports my points</li> <li>link evidence to my points and ideas</li> <li>clearly and convincingly explain how my evidence supports my points</li> <li>use references</li> </ul>		
I feel...			I feel...		
Confident	Partially confident	Not confident	Confident	Partially confident	Not confident
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Developing an argument			Critical evaluation		
I can... <ul style="list-style-type: none"> <li>include a point of view or position in response to the title or question</li> <li>develop and explain my point of view</li> <li>argue why my point of view or position is correct</li> </ul>			I can... <ul style="list-style-type: none"> <li>ensure I analyse events and information rather than just describe them</li> <li>assess the relevance and significance of the ideas and examples I am writing about</li> </ul>		
I feel...			I feel...		
Confident	Partially confident	Not confident	Confident	Partially confident	Not confident
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structuring			Use of language		
I can... <ul style="list-style-type: none"> <li>arrange my points in to a logical order</li> <li>write paragraphs that focus on one idea or point each</li> <li>write an introduction that explains how I will deal with the issues of the essay</li> <li>write a conclusion that sums up my main points</li> </ul>			I can... <ul style="list-style-type: none"> <li>minimise spelling, punctuation and grammar errors</li> <li>ensure my writing makes the meaning clear and easy to follow</li> <li>write using an appropriate tone and level of formality</li> </ul>		
I feel...			I feel...		
Confident	Partially confident	Not confident	Confident	Partially confident	Not confident
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# Tutorial 6 – Draft assignment feedback and reflection

## What is the Purpose of Tutorial 6?

- To received feedback on your draft assignment
- To reflect on your essay writing skills
- To identify practical ways to improve your assignment

What three things can you now do to improve your assignment and your essay writing ability?

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# Tutorial 7 – Final assignment feedback and reflection

## What is the Purpose of Tutorial 7?

- To receive feedback on final assignments.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

## Final assignment feedback

What I did well...	What I could have improved on...
<ul style="list-style-type: none"><li>•</li><li>•</li><li>•</li></ul>	<ul style="list-style-type: none"><li>•</li><li>•</li><li>•</li></ul>

My target for future work is...

## Reflecting on The Scholars Programme

What did you most enjoy about The Scholars Programme?
<ul style="list-style-type: none"><li>•</li><li>•</li><li>•</li></ul>

What did you find challenging about the programme?	How did you overcome these challenges?
<ul style="list-style-type: none"><li>•</li><li>•</li><li>•</li></ul>	<ul style="list-style-type: none"><li>•</li><li>•</li><li>•</li></ul>

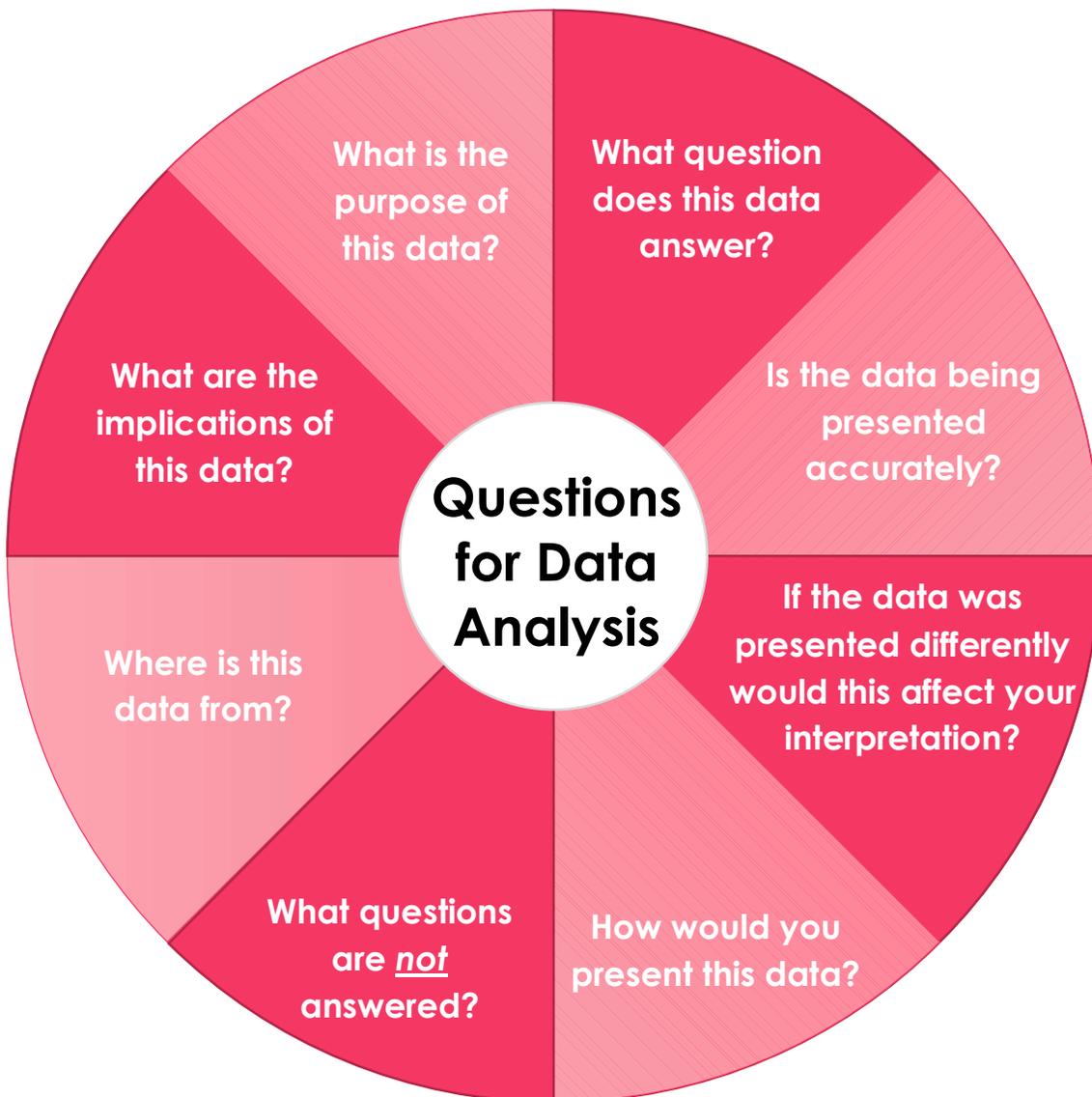
# Appendix 1 – Finding and Evaluating Good Academic Sources

There are so many places to get information that it is important to decide if something will be a good **academic** source for your homework or final assignment. When assessing a source, you don't have to read the whole thing to decide if you may want to use it. Instead read the first paragraph or so and use the checklist below to help you decide if this is a good academic source.

	Questions to Ask	
<b>A</b> uthority	<input type="checkbox"/>	Who is the author? (this could also be an organisation, rather than a single person)
	<input type="checkbox"/>	Check their credentials: what knowledge or skills do they have that lets you confirm they know what they're talking about?
<b>R</b> eliability	<input type="checkbox"/>	Does the information appear correct?
	<input type="checkbox"/>	Does the author tell you where they got their information from?
	<input type="checkbox"/>	Has the information been reviewed or checked by others?
<b>R</b> elevance	<input type="checkbox"/>	Does the source talk about the topic clearly and effectively?
	<input type="checkbox"/>	It is up-to-date? If not, is there a good reason to use an older source?
	<input type="checkbox"/>	Does it provide new and useful information for you?
<b>O</b> bjectivity	<input type="checkbox"/>	Does the author explore or acknowledge multiple points of view?
	<input type="checkbox"/>	Are they stating mostly facts? Evidence? Opinion? – Remember opinion is fine, as long as it is supported by reliable evidence.
	<input type="checkbox"/>	Does the headline or text try to make you scared or angry about the topic? If so, it might not be the best <b>academic</b> source.
<b>W</b> riting Style	<input type="checkbox"/>	Is the source well organised? (Or is it difficult to follow the author's point?)
	<input type="checkbox"/>	Does the text sound academic? (Or is it informal or chatty?)
	<input type="checkbox"/>	Are the author's points backed up by evidence and do they let you know where that evidence came from?

If you're not sure if something would be a good academic source, **send your tutor a message on the VLE** and they can help you evaluate the source together.

## Appendix 2 – Data Analysis Tool – Investigating how data is represented



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## Appendix 3 – Referencing and Plagiarism

**You may well have** heard of plagiarism before, and to have heard that it is something that you need to avoid.

**Plagiarism** is seeking to pass off the work of others as your own and is considered a form of cheating. Universities take a very strict line on **plagiarism** which can sometimes even result in being removed from a course.

How do you avoid **plagiarism**? There are two essential parts to this:

1. Understanding what needs to be referenced
2. Referencing your sources clearly and correctly

### What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article.

Needs to be referenced	Does not need to be referenced
<ul style="list-style-type: none"><li>• Direct quotations e.g. 'A diet low in fruit and vegetables is 'among the top mortality risk factors all over the world'</li><li>• Paraphrased material e.g. For both men and women, adopting a vegetarian diet can significantly reduce the risk of premature death.</li><li>• Facts, figures or statistics e.g. Healthy diet, exercise and being a non-smoker can increase life expectancy by 9 – 15 years.</li></ul>	<ul style="list-style-type: none"><li>• Facts already common knowledge e.g. A vegetarian diet is one that excludes meat.</li></ul>

### What would a good reference look like?

**Text:** The proponents of vegetarian, vegan or largely plant-based diets argue that, coupled with regular exercise and being a non-smoker, these diets can increase life expectancy – some studies suggest by up to 15 years [1].

**Endnote:** [1] Salonen, Arto O. & Helne, Tuula, T., 'Vegetarian Diets: A Way towards a Sustainable Society', *Journal of Sustainable Development* 5:6 (2012), pp. 10-24, (p. 11).

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment.

The example here shows how we would recommend you reference in your Final Assignment.

If you're not sure if something you have used in your essay needs to be referenced, **send your tutor a message on the VLE** and they can help you decide if it needs citation and write a reference. But as a general rule, **if in doubt, reference.**

# Appendix 4 – Planning Effectively and Time Management

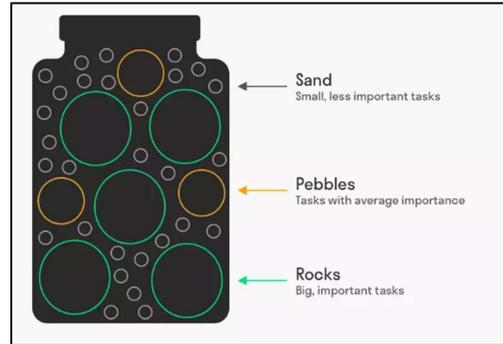
There are lots of things we want to do, need to do and would like to have time for. How do we **manage our time** so that we get all the essentials done, and even have time for some extras? We have some techniques you can try.

## 'Pickle Jar' Theory

If you have to fit stones of different sizes into a jar, they won't fit if you put the sand in first. But if you put the **rocks** in then the **pebbles** then the **sand**, there's enough room.

This theory suggests you should apply the same logic to your time: put in the **essential** tasks first, then the **important** tasks, then **everything else**.

Of course, you have to decide for yourself what is **'essential'**!



## Backwards Planning

1. Work backwards from your deadlines
2. Put the **essentials** in first
3. Estimate how long tasks will take to make sure you start them in good time

## Plan your week

Use the grid below to 'backwards plan' your week, putting in the **essentials** first, then the **important** tasks, then any **less important** things you'd also like to get done.

Monday	Tuesday	Wednesday	Thursday	Friday

## Appendix 5 – Writing an Effective Essay

		Where should I do this?	Have I done this?
<b>R</b>	Restate the Question	In my introduction	
<b>A</b>	Answer the Question	In my introduction	
<b>G</b>	Give evidence from other sources	To support any points I make in my paragraphs	
<b>E</b>	Explain how your evidence proves your point	Each time I give evidence	

### Easy Essay Writing Wins

- Prepare an outline or mind map your ideas
- Make sure your essay has a clear structure
- Analyse don't describe! Description is great to introduce a topic, but make sure your essay also includes your argument and interpretation of the evidence you use
- Remember to PEEL (Point, Evidence, Explain, Link) and RAGE
  - Use relevant evidence and research to support your points
  - Link it back to the question and explain why your point answers the question
- Look at the mark scheme in your handbook or ask your tutor for help if you're not sure what to write.

# Appendix 6 – Recommended reading and further learning resources

## Direct-to-Consumer Genetics

Blell, M. and Hunter, M. A. (2019) Direct-to-Consumer Genetic Testing's Red Herring: "Genetic Ancestry" and Personalized Medicine. *Frontiers in Medicine* 6(48), doi: 10.3389/fmed.2019.00048

Horton, R. et al. (2019) Direct-to-consumer genetic testing. *BMJ* 367, p. l5688. doi: 10.1136/bmj.l5688

Williamson, R. and Duncan, R. (2002) DNA testing for all. *Nature* 418(6898), pp. 585-586. doi: 10.1038/418585a

## DNA sequencing

Chial, H. (2008) DNA sequencing technologies key to the Human Genome Project. *Nature Education* 1(1):219, <https://www.nature.com/scitable/topicpage/dna-sequencing-technologies-key-to-the-human-828/>

Gajewski, M. 2016. *Everything you really need to know about DNA sequencing*. Cancer Research UK Science Blog, <https://scienceblog.cancerresearchuk.org/2016/04/25/everything-you-really-need-to-know-about-dna-sequencing/>

Khan Academy. DNA sequencing, <https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-biotechnology/a/dna-sequencing>

## Bioethics

Bioethics (Journal) - <https://onlinelibrary.wiley.com/journal/14678519>

Domen, R (2015). Bioethics, TEDxYoungstown, <https://www.youtube.com/watch?v=e-wTjH5M-gc>

## Data Interpretation

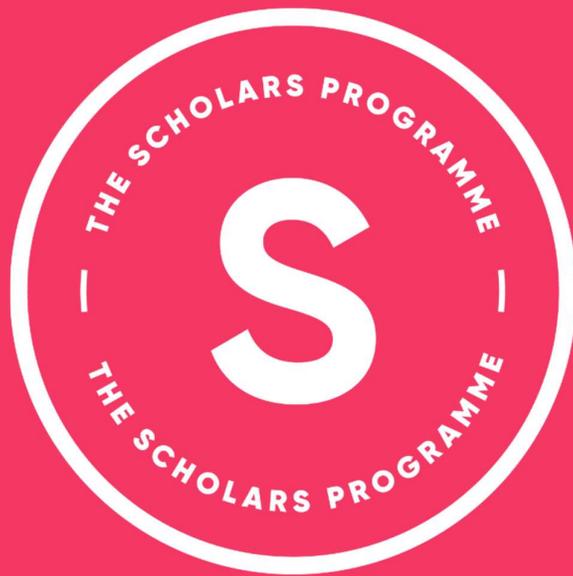
Horgan, L (2015). Data & Perceptions: We are all data scientists, TEDxSanAntonio, [https://www.ted.com/talks/luke\\_horgan\\_data\\_perceptions\\_we\\_are\\_all\\_data\\_scientists](https://www.ted.com/talks/luke_horgan_data_perceptions_we_are_all_data_scientists)











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