

Café Scientifique Newsletter

Half Term 2: 13/12/21

Genetics and Biochemistry Term

INSIDE THIS ISSUE:

Academic Articles

View a range of academic, detailed articles from our editors and members of Lower Sixth.

Documentaries, and Books.

See this term's media recommendations, from books on the environment to documentaries on the corona vaccine.

Cafe Scientifique Events

Here we have an overview of the recent STEM related events that have been held from Cafe Scientifique and the wider school community.



Editors' Note: Chromatography Decorations

Congratulations for once again making it through a busy half term. This term we focused on genetics and biochemistry; we hope that there is something for everyone to enjoy!

We want to take this opportunity to thank all the students, teachers and societies that have put together activities, recommendations, and articles from this term. In particular, thank you to the Moventis Scientiam team for running all the chemistry week events and talks.

Something to try this wintery holiday: chromatography snowflakes. You could try colouring in some filter or chromatography paper using felt tip pens and placing another piece of filter or chromatography paper underneath it. Then spray water over the top of the pair (coloured in one on top) and flip them over and spray water over the pair again (blank one on top). Once this has been done, separate the pair and fold them in half 3 times and cut shapes out of each one as if you were making a paper snowflake. Finally, open the shapes up and leave them to dry to reveal the final design. These can be hung up on a tree, or by the window to display your unique design to everyone!

Thank you for taking the time to read the newsletter,

- Katy and Olivia

Café Scientifique Newsletter: Articles





-By Katy

It is well known that poor body image leads to the development of eating disorders. Whilst many people believe that exposure to "perfect" images on social media is to blame for poor body image thus leading to the development of an eating disorder, research is actually finding that some people are genetically predisposed to have thin-ideal internalization. Thin-ideal internalization means the extent to which an individual believes socially defined ideals of attractiveness and engages in behaviors aimed to produce an approximation of these ideals. This could mean that some people are more genetically programmed to idealize the representation of body perfection, making them more likely to develop an eating disorder.

Scientists sought to investigate the potential link between genetic non-shared environmental factors and in the thinideal internalization. To do this, a team of researchers from Michigan State University carried out their study by interviewing over 300 female twins between the ages of 12 and 22. The girls rated how much they desired to look like people seen in the mass media and this allowed the scientists to evaluate the girl's thinideal internalization. The researchers found that the scores on the thin-ideal internalization were much more similar among identical twins than fraternal twins. Based on these findings, scientists were able to conclude that genetic factors are contributors to body image issues. They could successfully conclude this as it is known that identical twins share all of their genes whereas fraternal twins share only half of their genetic identity. This allowed the researchers to estimate that the heritability of thin idealization could be estimated to about 43%. The authors of the study hypothesized that the genetic factors that determine the internalization of a thin ideal may be similar to heritable factors that affect personality characters, for example perfectionism.

CRISPR

-By Nathania

CRISPR is a cheap and effective technology that is used to edit genomes. It stands for 'Clustered **Regularly Interspaced Palindromic** Repeats' which describes short sections of genetic code, made up of a sequence that is recurring and often reversed in order. This explains the 'palindromic' in the term, where palindromes are sequences of characters which are read the same backward as forward. Between the repeated sequences are 'spacers', which are important pieces of genetic code inserted by a group of enzymes (known as 'Cas' enzymes) that recognize specific repeats in the DNA and 'cut them out' to replace them with the spacers.

CRISPR was developed from natural defense mechanisms of bacteria against viral DNA, first discovered by researchers in the 1980s in E. coli. In this process, the bacteria use 'Cas' enzymes to take spacers form the viral DNA and add it to their own genome. RNA is transcribed from the new added bits of DNA, so that when a virus with the same viral DNA enters the cell, the RNA can bind to it, for the 'Cas' enzymes can attack and destroy the virus. Cas9 is a 'Cas' enzyme which can easily be programmed to cut almost any part of the genome, using labmade RNA sequences as a quide for where Cas9 should cut the DNA. This technique was discovered in 2012 by biochemist Jennifer Doudna and microbiologist Emmanuelle Charpentier who both went on to win the Nobel Prize in Chemistry in 2020. Since then, CRISPR-Cas9 has been widely used for scientific research. For example, it's being used in crops to improve yield and during Covid-19 CRISPR-Cas9 has been used in India to develop various tests to diagnose viral infection. As well as this, researchers are working on reviving extinct species like the passenger pigeon by editing genes of birds that are similar and in April 2018 CRISPR was upgraded to edit thousands of genes simultaneously.

How do your genetics determine your entire life?

-By Phoebe

Genetics: the study of heredity and the variation of inherited characteristics and moreover the phenomena of an organism, type, group, or condition.

To put it simply, a gene is the basic physical and functional unity of heredity. Genes are made up of DNA. Some genes act as instructions to make up molecules - proteins. Within humans, genes vary in size from a few hundred DNA bases to more than 2 million bases.

In less scientific terms, genes affect a person's sense of purpose, how well they get on with people and their ability to continue learning and developing through life.

DNA, that makes up genes, is pivotal to your growth, reproduction, and health. It contains the instructions necessary for your cells to produce proteins that affects many different processes and functions in your body.

They play a very important role in determining physical traits how we look and carry information that makes YOU who YOU are and what you look like: for example, having curly or straight hair, having longer or shorter legs, or even how you may smile or laugh.

In the age we are living, we are constantly wanting to change ourselves, and of course... we can, but we also must come to the realisation that we have been genetically determined to be as we are. And trying to oppose our natural selves and forms could possibly be damaging to both our physical and mental health.

Human personality is 30-60% heritable. We are born with a personality type, meaning there are some aspects that we feel more comfortable with than others. However, our personality is more malleable, flexible, and less predetermined than our physical traits. It is also our personality traits that take us through life and so we should be less caught up on the things such as our appearance that our genetics determine

from birth and focus more on our personality.

There is lots of room to alter our behaviour and our approach to life, yes, we are born with a specific sequence of DNA bases that code for a protein, but as we grow physically, we need to take into account that we can indeed tweak our personality traits slightly. That being said, it is not positive to defy our genetic makeup in our mentality, as well as well as it is not healthy to oppose our physical determination. But what is important to think about, is that we have such powerful minds, that we need to use to accept who WE are, which will help us to not only benefit ourselves but others around us.









How can archaeologists and geneticists work together to study Ancient DNA without conflicting opinions?

-By Olivia

Inspired by the recent presentation given by eminent Professor Turi King given at our Lower Sixth GCSE results award ceremony, I have decided to explore the link between archaeologists and geneticists in the field of Ancient DNA analysis.

In the last few decades, we have found ourselves entering a technological revolution with scientists across several subject specialisms discovering information which changes our perspectives of the world and the people around us.

One area of keen interest is *Bioarchaeology*; defined as a unique discipline focusing on the human skeletal remains within their archaeological and historical contexts. In order to understand the key areas that are explored within this discipline we must consider the role of Genetics and Biology in our History.

- What is the significance of genetics within archaeological studies?
- And to what extent does the study of Genomics support our understanding of civilisations through time?

What is aDNA?

Biological anthropologists study bone and teeth to discover clues about past lives and origins but it is the geneticists who are able to extract ancient DNA from skeletons found within archaeological digs.

The first full sequence of an ancient human genome was published in 2010 and it related to a man who lived about 4000 years ago in Greenland. At this time, the research was solely centred on cold climates where DNA molecules were well preserved.

The chart below shows how many ancient human genomes have been sequenced since research began in 2006.

How many ancient genomes have been sequenced?

In the decade since researchers began sequencing ancient DNA, the number of archaic hominin and ancient human individuals sequenced has grown. The pace continues to increase, with almost 700 genomes sequenced just in the <u>first</u> three months of 2018.





Source of DNA within the skull.

A significant breakthrough in the extraction of aDNA has been through the analysis of the petrous: the casing of the inner ear. The ability to extract a concentrated source of DNA from this area of the skull has led to geneticists being able to study aDNA from skeletons originating from hot climates. DNA studies of individuals have expanded dramatically since this unique discovery.

How do DNA results inform our knowledge of the past?

DNA studies primarily focus on the 'genetics of a population' which considers how people move or mix with other groups. There are many critics of this form of genetic research who suggest that sample skeletal groups are too small and that statements about the population and migration are not specific enough.

Ethical Implications

When we consider the field of aDNA research, there are some ethical issues which may affect individuals past and present.

Due to the nature of how archaeological specimens are removed and the limited number of remains available to study, some scholars agree that regulations must be put in place to protect the bones already in collections so that they can be analysed again in the future.

Café Scientifique Newsletter: Documentaries



Human Nature

-By Katy

Sickle Cell Anaemia: 'an inherited red blood cell disorder in which there aren't enough healthy red blood cell to carry oxygen through your body.' Caused by a single change in DNA of a one 'A' to one 'T'. Could genetic disorders like this be cured with CRISPR?

CRISPR: Clustered Regularly Interspaced Short Palindromic Repeats. In all cells, there are two identical strands of DNA, known as 'sister DNA', which help to repair each other when disrupters like viruses attempt to hijack the cell. Furthermore, if artificial 'sister DNA' is placed next to a broken strand, intentional modifications can be made using a 'Cas9' protein which finds and cuts DNA. These were first found in bacteria, who use them to recognize and kill invaders; in between the repeated parts of the DNA were spacers, each spacer was individual and acted as memory of invaders to be removed by the Cas9 protein.

Should these genes be readily available to all? Should any of the modifications be required? Should genetic modifications be allowed to be passed into future generations? Are we playing God? Watch Human Nature - available on Netflix to find out more. Click <u>here</u> to watch the advert.

Horizon Special: The Vaccine

-By Katy

Vaccine design, clinical trials and manufacturing: learn about how the covid 19 vaccine was designed, tested and produced. The Viral Vector Vaccine - the spike protein RNA injection from Oxford. The Protein Vaccine - injection of the spike protein itself from Queensland (learn about why this did not get to manufacturing). The Inactivated Virus Vaccine - injection of the whole virus once treated to prevent infection from China. The mRNA Vaccine - from Pfizer/Biontech and the USA's NIH, a new type of vaccine. From the genetic sequencing to the failures and successes of the speedy development. Available on the BBC iPlayer.

Unnatural Selection

-By Katy

This short series focuses on ethics, politics and economics of the upcoming genetic engineering industry of modifying animals - big and small alike. Biohacking is defined as biological experimentation (in this case genetical engineering) done to improve the qualities and capabilities of living organisms. Luminescent dogs? Muscular frogs? Disease resistant mice?

Episode 1 looks at an introduction to biohacking and introduces some emotional story lines that are followed throughout the remaining episodes. Episode 2 begins to look at the economic costs of innovative health care, especially in the USA. Episode 3 opens up a conversation about the political opposition to modifications and how it is affecting international relations. Episode 4 finalizes the series by making dramatic statements, contradictory to the rest of the series, about how before developing a scientific company and accusing scientists of inadequate work, they should put more research into it. The documentary also produces many ethical dilemmas much like in Human Nature. However, they are explored with a more personal target rather than a scientific aim. Click here to watch the advert, full documentary is available on Netflix.





Down:

- 1. Reagent used to test for protein
- 3. Different versions of a gene
- Acts as a catalyst in living organisms
- A compound consisting of only carbon and hydrogen
- 8. Having the same allele

Across:

- 2. The first stage of mitosis
- 5. Used to test for lipids
- 7. Stage before mitosis
- 9. Contains DNA
- 10. Speeds up a reaction
- 11. The section of DNA that codes for a protein
- 12. Solution used to test for starch

Silent Spring

-By Rachel Carson, Review by Sofia

Throughout Rachel Carson's 1962 classic *Silent Spring*, the first thing you feel is a strong sense of panic. As she authoritatively lists the copious chemicals polluting the soil and water all around us, it becomes uncomfortably clear, even to the untrained chemist, the heavy impact our actions have on the world in which we live. For this very reason, *Silent Spring* has been an immense influence on the modern-day environmental movement and acted as an eerie warning against conformity.

But this succinct book, a canary in the coal mine of environmental destruction, has shaken the world for other reasons, and perhaps as a young lady, it hits on a more personal level. Published only a few months before Carson's untimely death due to breast cancer, it highlights an act of supreme courage by an unmarried middle-aged woman in the 1950s and 60s to take on various male-dominated chemical industries. Throughout the entire book, *Silent Spring* harps on themes of noise and silence as signs of life and death. Through Carson's mastery over language and breakdown of scientific jargon for the average layperson to digest, readers are faced with the silence that is beginning to blanket the earth due to chemical control methods.

The Making of the Atomic Bomb

-By Richard Rhodes, Review by Dr. Mather

This book is a comprehensive summary of twentieth century physics and its application to making of the first nuclear reactor and nuclear bomb. It covers the scientific, moral and political issues associated with such a complex subject in depth. All of the important physicists are covered in depth including Niels Bohr, Ernest Rutherford, Enrico Fermi and Albert Einstein. The project was so secret that when US president Franklin Roosevelt died his deputy was not aware of the project. As well as a scientific history it reads like a thriller as the United States and Great Britain raced to beat Nazi Germany to develop the weapon first.

Cut and Paste Genetics, a CRISPR Revolution

-By Sahotra Sarkar, Review by Olivia

Within this highly academic book, Sahotra Sarkar, a prominent philosopher and professor in Integrative Biology, a sharp eye is turned towards the historical events surrounding genetics, while encompassing a broad review in current advancements in the field of Molecular Biology; particularly CRISPR gene editing. His work encompasses a wide range of ethical and political issues surrounding the use of bioengineering, whether that be the *Watson Scandal*, and the annulment of sterilization in the United States.

This balanced book covers topics such as 'Breeding a Perfect Society, Molecular Diseases, The Human Genome Project, Inevitable Eugenics, Elimination of Genetic Diseases and Designer Baby Delusions'.

A few of the thought-provoking questions include: 'what does the future hold for the fields of Genetics and Cellular Biology?' and 'could we overcome the ethical issues surrounding CRISPR to use it beneficially in the healthcare sector in the upcoming future?'

Sahorta suggests that in the future, we should not be looking to use CRISPR for unethical or malicious ends or to benefit the advantaged in our society and instead advocates that this ground- breaking, gene-editing technology should not be controlled by corporate biotech companies.









Polymers Talk from Birmingham University

-By Max

On 29th of November, we had a talk from Birmingham University. They talked about polymers and how they help to make insoluble drugs ingestible. They also talked about how they are doing research into renewable or biodegradable plastics that have similar properties to some we have now so that they can be replaced. They showed us how generally polymers melt at low temps and compared two of the polymers showing how one was more malleable than the other. When forming nylon, by putting two liquids on top of each other, they react in the interface to form the polymer.

Chemistry Fête

-By Olivia

For part of chemistry week this November, the Moventis Scientiam team put together a chemistry fete where we managed to raise £170 for our chosen charity, Cancer Research UK. Not only did we have some fun stalls like the homemade chemistry themed chocolate chip cookies, a massive tombola with lots of fantastic chemistry themed prizes, and a stall to test your speed by seeing how many words you could locate on a wordsearch in only 30 seconds. We also had some more educational stalls such as the teacher's favourite molecule quiz where you had to guess the teachers' favourite molecule based off of the clues given and guess how many atoms in a jar of rock salt challenge where we were able to teach some of the younger students about Avogadro's constant and also show them that 'a million!' is not actually a very big number when it comes to chemistry.

We think this event was a real success and we can't wait for the next opportunity to get everyone involved in the subject that we all enjoy so much.



Careers Talk with Old Girl Dr. Harriet Mintz

-By Katy

Dr. Mintz spoke to us on the 6th of December about her career in biomedical sciences, her doctorate and now her studies of medicine. Her main point was the importance of networking and how many opportunities it can provide, including many job offers, her PHD topic and endless opportunities. She discussed how her work on oncology research led her to travel the world, speaking at conferences and listening to others present their work. Despite initially not wanting to pursue medicine, she went on to study medicine after her PHD and development of confidence. After her medical degree, she would like to work either as a medical consultant or in medical research, as she initially intended to.

Café Scientifique Newsletter: The Future

Thank you for reading the newsletter this term! Just a quick reminder about the poster competition with the Lit and Phil Society around underrepresented voices in STEM. Good luck to all of those entering.

We are pleased to announce that next term we will be having a talk from Stephen Busby, a professor of biochemistry at Birmingham University. There will also be a science week fête with many fun activities after the february half term.

We look forwards to hear all of your ideas, thank you once again for all of the articles written for us and we hope to see some more soon! Next half term's theme is psychology!!

Have a good Winter Break!



Answers and memes of the month:

