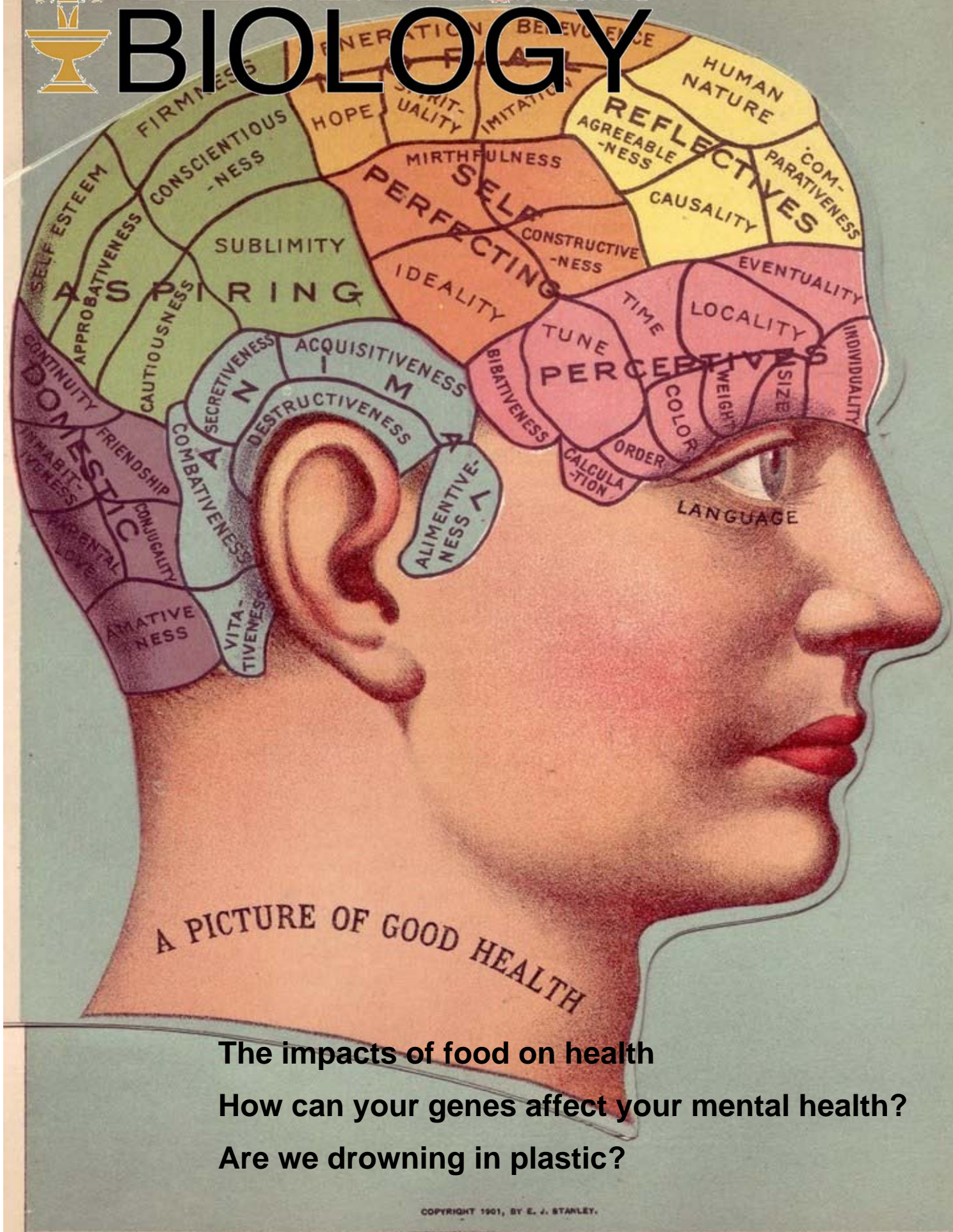




# TEDDIES talks BIOLOGY



The impacts of food on health  
How can your genes affect your mental health?  
Are we drowning in plastic?

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**CHART 1.**

# **TEDDIES**talks **BIOLOGY**

Dear readers,

Teddies talks Biology continues to go from strength to strength and as ever there is an amazing diversity to the articles on offer in this issue.

I am delighted that pupils from across the school have contributed to the current issue, from the 4<sup>th</sup> Form to the Upper Sixth stalwarts (pictured below) who have been the backbone of this magazine for the last 3 issues. They will be passing the reins over to the current Lower Sixth and we are excited to see how they will drive the magazine on next term. I also look forward to seeing the Shells be part of this magazine.

If you wish to get involved in future issues please email me and I'll add you to our mailing list ([waringa@stedwardsoxford.org](mailto:waringa@stedwardsoxford.org)). Involvement is great both for your wider biology education and enrichment. For those pupils higher up the school, it is a wonderful way of bulking out your UCAS form as well as the Creativity and Service experiences for your CAS portfolio!

I hope you enjoy the read,

Mr Waring



*Front row from left to right: Izzy Degroot, Reha Soni, Tinka Hughes*

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# Anxiety

## Chandos Neville - 4th Form

In the run-up to the exam period, anxiety (known as a mental health issue or psychological disorder) can be more common as people wait to see if all of their hard work in revision payed off. Scientists are now aware of the role your genetic traits and mental health can play in the way the issue can develop and manifest in someone. For example, a problem in the flow or low levels of the common neurotransmitter, serotonin, can lead to high levels of depression and anxiety. For this reason, we know how to medically cure or help someone with either of these. By getting to the reason of the problem we can counter the issue by increasing the amount of or correcting the flow of serotonin.



Serotonin is not the only hormone related to anxiety. Cortisol can have such a relationship, too. We need to understand that anxiety is essential in the theory of mental stress. When the human brain gets stressed it responds by causing the release of this hormone, cortisol. But scientific research shows

that cortisol has a stronger relationship with anxiety than I have just described. Scientific research has shown that left over or excess levels of the stress hormones, cortisol, can have an impact on our mental stress levels causing both anxiety and stress to form. Excess cortisol levels can also contribute and increase the chance of having an anxiety attack. Cortisol has some of the most powerful effects on the human brain and anything that can slightly increase your levels of cortisol increases the chance of excess cortisol build up. Things like lack of exercise and lack of sleep have been proven to boost cortisol levels in the human body. But practices like meditation and consuming Adaptogen Herbs have been proven to help. But simple things can help lower cortisol levels like spending more time outside, taking in fresh air, being closer to nature, and switching to whole foods, which lowers blood sugar levels.

# Revolutionary CAR-T Therapy

## Ella Leeson - L6th Form

For years, the foundation of cancer treatments have been surgery, radiotherapy and chemotherapy. Over the last two decades, drugs that target cancer cells by honing in on specific molecular changes seen primarily in those cells (like Gleevec<sup>®</sup> and Herceptin<sup>®</sup>) have cemented themselves as standard therapies.

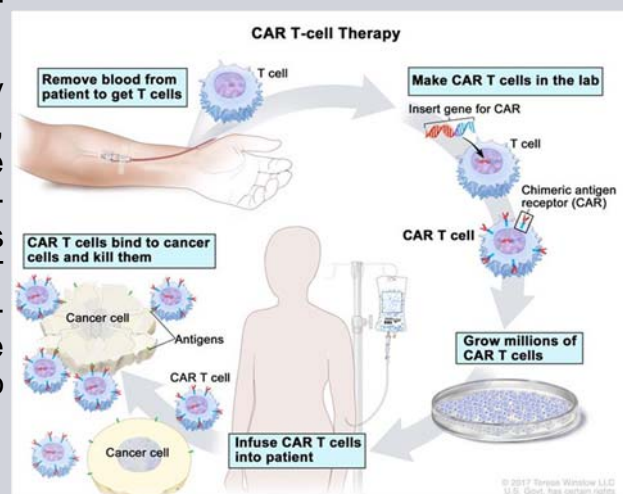
However, in the past few years, immunotherapy - a therapy that enlists and strengthens the power of the patient's own immune system to attack tumors - has emerged as a promising treatment for many.

One immunotherapy approach that is rapidly advancing is adoptive cell transfer. There are several types of this, but the one that has progressed furthest in clinical development is CAR-T therapy. Until recently, the use of this treatment had been restricted. But, this therapy has captured the attention of researchers and the public alike because of the remarkable outcomes that it seemed to have in patients suffering from advanced blood cancers, for whom all other treatments had stopped working.

So how do we actually carry out CAR-T treatment? Well, CAR-T treatment uses gene therapy techniques to enhance T-cells, a type of lymphocyte that plays a central role in cell-mediated immunity. Researchers filter these cells from the patient's blood, reprogram them to harbour a "chimeric antigen receptor", or CAR, which are designed to bind to certain proteins on cancer cells, and grow hundreds of millions of copies. When these cells are returned to the patient's body, they can continue to multiply and help fight the disease for months or even years.

This new immunotherapy was launched in April 2016 so is still very new and we definitely still do not know the full extent of the side or long term effects that it may cause. One of the most frequent side effects reported is cytokine release syndrome (CRS). As part of their immune-related duties, T-cells release cytokines, which are chemical messengers that help to stimulate and direct immune response. In the case of CRS, there is a rapid and massive release of them into the bloodstream, which can lead to dangerously high fevers and precipitous drops in blood pressure. CRS can be managed with standard supportive therapies, like steroids, and as researchers have gained more experience with CAR-T therapy, they have a better understanding of how to manage the more serious cases of CRS.

New approaches to CAR-T cell therapy are being continually tested. At the moment, research is being put into an approach where the immune cells are not collected from the patient's body but from a healthy donor. There is still a lot more to learn about existing CAR-T cell technologies, but for those patients who respond well to it, they could be spared two more years of chemotherapy, which is amazing to think about.



# Biomimicry

## Eva Livingstone - L6th Form

Life has been evolving for 3.8 billion years and in that time it has become incredible at redesigning itself to suit the rest of the natural world. This technique of adaptation comes from natural selection developing species over eons as part of evolution. As the human race develops, the limits we reach are ones that nature has battled for far longer than us. Consequentially, the best possible way for us to design ourselves beyond our limits is to take inspiration from natural form. Nature has already solved engineering problems from the everyday uses of Velcro to the engineering miracle of flight (for which the Wright Brothers took their inspiration from pigeons).

Velcro (also known as “hook-and-loop fasteners”) is a fastener with two components: a strip of fabric with tiny nylon hooks and a strip of fabric with a mess of looped fibres of its surface. When put together, the hooks fasten to the loops attaching the two pieces together. It was invented in 1941 by a Swiss engineer who noticed that burdock burs used this natural

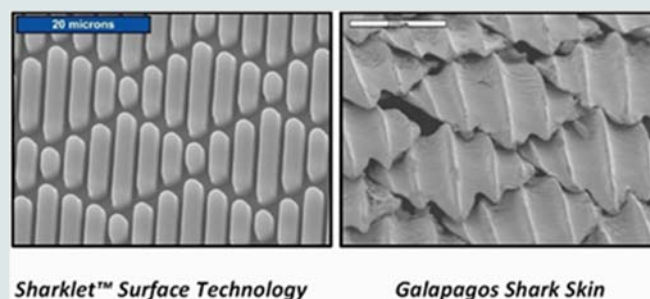


mechanism for seed dispersion. The engineer replicated it with synthetic fibres and sold it commercially. Velcro is now used as shoe fasteners; to close backpacks, briefcases and notebooks, secures pockets. NASA astronauts’ use it fasten objects to the walls and prevent them from floating away. It was even used to hold together a human heart during the first artificial heart surgery.

In 1989, the Japanese 100 series Shinkansen train was the fastest commercial train in the world (155mph) but its design meant that it was too loud for residential areas. The reason for this was, although it was very aerodynamic, it compressed air in tunnels pushing waves of atmospheric pressure to the other end creating a large boom. To solve this Eiji Nakatso, a Japanese engineer (and bird watcher) took inspiration from the beak of the kingfisher for the nose of the train. The kingfisher dives into water to catch its food and does so with almost no splash. When the kingfisher beak model was tested against other models it performed far better. The Shinkansen series 500 from 1997 also utilised the serrations and curvature of owl feathers for the pantograph (the rig connecting the train to the wires above) meaning that slowing could be soundless. Inspiration from the Adelie penguin’s smooth body shape was taken for the support shaft of the pantograph. The resulting train was 10% faster, used 15% less electricity and was under 70 decibels (no louder than a vacuum cleaner).



Health wise, biomimicry is currently being used to produce bacteria repellent surfaces. Shark skin's texture provides an unstable surface for barnacles and algae but by replicating its form, an American company has replicated the diagonal pattern to produce antiseptic surfaces. It was originally designed for the US navy to prevent barnacles on their boats but is being repurposed for health because the surface has 94% less bacteria than flat surfaces. In the US 2 mil people pick up infections from just being in the hospital (e.g. getting an x-ray or visiting family) and coming into contact with contaminated surfaces which costs the US government \$30 billion. Another important aspect of the surface (*sharklet*) is that it prevents the growth of bacteria we don't have to the cures to so by using *sharklet* we could drive out the most deadly of diseases. A similar product is also in production which is a paint that mimics the surface texture of lotus leaves which is hydrophobic meaning that water rolls straight off pulling off bacteria and dirt particles: a self-cleaning paint coat!



Looking to the future, the path for human progression seems to be working towards a circular economy where there are no by-products produced by any process. To do this we must mimic the form and process of ecosystem for which every product is a valued resource for another member. One of the issues of today is that the global economy is being driven by unsustainable factors and is resulting in deforestation, global warming and more. It is intrinsically human to have a disregard for our environment and had led to us being an exceptionally successful species but the monotonous consumption of resources has put the planet in a vulnerable position. Now both governments and private organisations are researching and developing technologies that will simultaneously allow us to develop humanity further whilst attempting to retract the damage already done. Big pushes are being made for sustainable energy sources, reducing waste production and protecting nature reserves.

The end goal for the biology-mimicking system is to produce products, systems and cities that are functionally indistinguishable from the natural world. It is only by drawing inspiration from the natural world can we hope to develop further as a species and backtrack the damage we have done to our home.

# Wiping Out Mosquitoes

## Olivia Heath - L6th Form

A team of scientists at Imperial College London used gene editing to completely eliminate a population of *Anopheles gambiae* mosquitoes. The *Anopheles gambiae* mosquitoes are responsible for transmitting malaria.

In 2016 alone, there were almost 216 million malaria cases, these cases resulted in over 445,000 deaths worldwide, the majority of which were children under the age of five. A leading researcher at Imperial College London said “2016 marked the first time in over two decades that malaria cases did not fall year-on-year despite huge efforts and resources, suggesting we need more tools in the fight.” With this in mind, researchers have developed a new genetic modification technology to combat this very real threat.



The scientists slightly altered a part of the doublesex gene in the mosquitoes DNA which determines whether a mosquito develops as a male or a female. Over 7-11 generations the contained population of mosquitoes collapsed, this is an example of genetic engineering known as a gene drive. A gene drive is a technology that spreads a gene or particular group of genes throughout a population. The scientific researchers used the technique of gene editing, known as Crispr, to adjust a section of the gene, doublesex. This showed no change to the male mosquitoes or female mosquitoes carrying one copy of the modified gene. However, the female mosquitoes carrying two copies of the modified gene showed characteristics of both male and female insects and did not bite or lay eggs. The modified gene, which causes female infertility, was passed down through the generations until the population collapsed.

Previous research had showed that other genes could tolerate mutations and overcome the changes so the researchers targeted the doublesex gene. The doublesex gene is common across the insect kingdom suggesting possibilities of wiping out other disease-carrying populations.

Further research is underway testing the effectiveness of this new technology on mosquitoes in a more realistic environment with competition for food as well as other important ecological factors. This technology, known as Crispr, could prove extremely useful in terms of curing genetic diseases other than malaria including cystic fibrosis, Huntington's, Muscular dystrophy and even cancer.

Professor Crisanti commented that “Gene drive solutions have the potential one day to expedite malaria eradication by overcoming the barriers of logistics in resource-poor countries.”

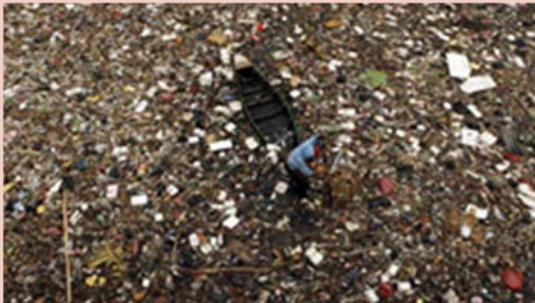


# Are We Drowning in Plastic?

## Gini Hope - 5th Form

Every single minute our world and ecosystem is rapidly sinking under this increasingly difficult issue. Every 60 seconds, we buy 1 million plastic bottles, 1 million disposal cups and 2 million plastic bags. Every minute, a truck load worth of plastic is ending up in our ocean. Every year we produce a staggering 8 million tons of plastic. These are just a few statistics trying to represent some of the huge devastation being instigated in all aspects of our environment, including how over 200 different marine species are being found to ingest plastic.

Furthermore, I would like to formally discuss two main areas of our world being affected by this growing concern, seabirds and rivers.



Scientists tend to frequently describe sea birds as the key indicators of the health for our ocean. If we use this analogy to overview our ocean, I think we can safely say it is extremely unhealthy, as sea birds have recently been discovered to eat more plastic relative to its size than any other animal. Recently, research has been directed towards flesh-footed shearwater birds on Lord Howe island (400 miles off the coast of Australia). 40,000 of these birds migrate to the safety of the island every autumn, but regrettably I have found that their safety is in huge danger and a major concern. The numbers of birds with plastic mistakably in their diet have fluctuated and the average shearwater found dead has had between 30 and 40 pieces of plastic in their stomach contents. The latest record is 260 pieces of plastic found in just one chick. In addition, not only are the thousands of plastic contents killing millions of birds but the chemicals in them are disrupting their hormones, by preventing their growth and hindering their reproduction system. This has serious implications for the health of all of the marine life and shows symptoms for a global crisis, as every day marine life mistake plastic bags for jelly fish and bottle caps for fish eggs.

Moreover, it has been estimated that over half of the plastic that enters the ocean is from rivers. The World's rivers such as, the Nile, Ganges and Citarum have been turned into plastic arteries coursing towards the sea. One of the worst effect river's is the Citarum in Indonesia, as every day an estimated 2,000 tons of plastic flows downstream. They now have over 50 rubbish pickers for this river, they used to be fishermen, but the plastic has dramatically reduced the number of fish by 60 percent and lost all of them their jobs.

In conclusion, every second our world is slowly losing to the growing plastic tide and without sudden changes to our daily routines we will lose the battle and our once green and healthy ecosystem will be no longer achievable.

# Male Seahorses

## Matthew Walton- L6th Form



### **Why do male seahorses give birth?**

Seahorse males do something highly unusual in the animal kingdom; they get pregnant and deliver their offspring. Scientists don't have a clear reason why seahorses evolved this way, but they theorize this is one of the ways seahorses try to help the species survive. When the females create the eggs, she uses her energy to fill the eggs with nutrients to help the babies mature. This takes some of the stress off the dad who is carrying the eggs around, he provides a safe and environmentally controlled environment for his babies, but the mom gives them the majority of their food.

### **How the phenomenon works**

Although the male carries the eggs, he doesn't actually make them. After a male and female seahorse spend time mating, the female empties her eggs inside the male's pouch. He will then fertilize the eggs inside the pouch. His pouch is a complex organ that regulates temperature, blood flow and water salinity for the eggs as they hatch so the babies can be as prepared as possible for life in the ocean.

### **Problems that can occur**

Depending on the species, seahorses can deliver from five to more than 1,000 babies at a time. Unfortunately, only about five out of every thousand survive to adulthood. The babies are so tiny that they can't eat the same plankton as their parents, so they have very few options for food. Also, they tend to get carried away by ocean currents before they can latch onto rocks or other secure objects with their tails, therefore becoming part of the zooplankton other animals eat.

### **Scientific Theory**

It is thought that male seahorses carry the babies because it gives the species the ability to create more babies at a faster rate. The female deposits all of her eggs into his pouch. This just enables her to produce more eggs. While he's carrying one set of eggs, she's creating more, this means that they can be ready when the first group is born. The male can deliver babies in the morning and get pregnant again the same day!

# Impact of Food on Health

## Josh Moore - U6th Form

The different foods we eat contribute to the functioning of our bodies in a variety of ways, for example, to give us energy to perform daily tasks. It is crucial that we eat a variety of food in order to sustain ourselves because our body requires such a range in nutrients. We now understand the body better than ever, due to improved knowledge about how our complex body works and why it does what it does. As a result we know a lot about how to eat in order to maintain good health and how to avoid unhealthy living (which is done in tandem with exercising and sleeping correctly etc.) However we frequently avoid following advice and that can lead to issues regarding wellbeing and the ability of the body to function.

It is well documented that foods high in sugar, trans-fats and alcoholic stuff are hugely damaging to the system. This is because they all heavily impact a number of different elements of the body (like the heart, brain and liver) and can lead to significant disruptions in the daily functions that need to be carried out in order to live comfortably. For example, a study conducted at the University of Southern California showed that rats found that a diet high in sugar increased brain inflammation and impaired memory. Additionally, rats that consumed a diet consisting of 11% HFCS (high fructose corn syrup) were worse than those whose diets consisted of 11% regular sugar (Hsu TM et al, 2015).

However, it is not exclusively the major organs of the body that are negatively affected by poor dietary choices, but almost all aspects of the body can be



damaged; a common example is oral condition. The main issue caused by dietary factors is tooth decay (and cavities), caused predominantly by acidic foods which can erode the protective enamel on teeth. (Highly acidic foods include things like: alcohol, lemons and coffee.) Decay can lead to severe pain due to exposing the nerve endings in teeth and with that the loss of

use of teeth.

Therefore, the different constituents of our diet can cause problems in a range of areas of the body. It is, of course, vital to maintain other aspects of healthy living (sleep, exercise etc.) in order to maintain fitness, however at the core of these habits is a healthy diet to maintain the functions of the body.

# Relationship Between Plants and Other Species

## Bianca Pigorini - U6th Form

The interactions between organisms have clearly evolved, making relationships between different species more common. These interactions can be seen throughout the whole Animal Kingdom; however, the most common and intriguing ones are related to insects and plants.

The belief that plants do not interact with other living organisms had been proved wrong long ago, and as scientists have explored these interactions, more examples that prove plants have symbiotic relationships with other species have arisen. One famous example is the relationship between Acacia Trees and Ants. The tree provides the ants with nectar for food and shelter in the form of hollow thorns. The ants return this favour by protecting the tree from consumers such as caterpillars or deer by stinging them when they come near. This is a form of mutualistic association as both organisms benefit from the relationship.



A new study conducted by the Proceedings of the National Academy of Sciences investigates the genetic history of plants and ants in order to explore the co-evolution of these symbiotic relationships. Researcher Matt Nelsen had the aim of discovering when exactly plants started providing beneficial structures for ants, creating the start of mutualistic relationships between them.

Nelsen and his team were able to establish that these relationships date back to the Dinosaur Era. They did this by analysing fossils of Plants where these structures were clearly present. However, it was not clear to them who started this relationship: the plants or the ants.

In order to investigate this, the team used large amounts of DNA data and ecological databases. They linked these behavioural and physical features with family trees of ants and plants to determine when ants started eating and living on plants, and when plants developed the capacity to produce structures that ants use. From this they were able to come to the conclusion that ants have relied on plants for a longer period of time.

Although many ants and plants have a symbiotic relationship, there is no evidence that the species that interact with each other have greater diversity or grow any faster than those who lack this interaction. Therefore, although these relationships are present, they are not necessarily beneficial to the species.

# Chemical Imbalances and Depression

## Maddy White - U6th Form

Mental illness in comparison to physical illness can often be overlooked and ignored. Depression is one of the most common forms of mental disorders, affecting more than 120 people worldwide (Mental Health Foundation, 2018). Although mainly triggered by a traumatic experience, there are many cases where there is no emotional or physical stimulus.

Scientists have found that the chemical imbalances in the brain that lead to depressive symptoms are due to two neurotransmitters, serotonin and norepinephrine. A research was taken by the ChrisKresser foundation, which tested what kind of neurotransmitter levels different patients obtained. The results showed that patients who shared the trait of low serotonin and norepinephrine levels also shared similar behavioral patterns. These people were more prone to symptoms such as aggression, stress, lack of self-confidence, failure, low impulse control, attempts of suicide and substance abuse. The people who were tested with ordinary amounts of neurotransmitters expressed normal behavioral patterns (Kresser, 2018).

The body usually contains approximately 100 identified neurotransmitters, if it lacks two to three, depressive symptoms or irregular behavioral patterns can appear (New Health Advisor, 2018). According to neurologists, the human brain is an extremely intricate environment. Surrounding the brain are by-synaptic vessels, which take shape below the brains membrane. These vessels discharge endogenous chemicals known as neurotransmitters, which are next required to direct the amplified brain signals to a region of the brain called the neuron. If an error appears throughout this process, a chemical imbalance may appear. On the image above, a scan of two brains are shown. The left scan, is the brain of a depressed person who also shows signs of fewer neurotransmitters (Mason, 2016).

Chemical imbalances are related to clinical depression because of the affects imposed on the brain when individuals lack neurotransmitters. A medical solution to this problem is the antidepressant drug, which has helped medicine to be able to decrease the build up of chemical imbalances that cause people to become depressed.



# Genes and Mental Health

## Robin Wheeler - 4th Form

Our school has taken to wearing yellow ribbons for the charity Young Minds, so I have decided to base my article on how genes can affect your mental health.

Schizophrenia directly related to your genetics for Dr. Goff identified that there is a direct correlation between schizophrenia symptoms and low levels of folate in the blood. Folate is used in many different chemical pathways in the brain including being used to keep the levels of amino acid homocysteine low. An increase in the amount of homocysteine interferes with the functioning of receptors all over the brain, called NMDA (N-methyl-D-aspartate) receptors, that are critical to learning, memory, brain development and general neural processing.

However, one of the main problems of treating low folate levels is that no one knows why it occur. However, one of the theories is that it is caused due to a bad diet during pregnancy for after the Dutch Hunger Winter and the Chinese Famine, scientists found that there was a two-fold increase in the number of children born with schizophrenia. However, in most cases, starvation is not the cause of schizophrenia. Therefore, Dr. Goff and his team have concluded that it is highly likely that the low levels of folate are due to two genes. The GCP11 (glutamate carboxypeptidase II), which controls the absorption of folate and may be deficient in people with schizophrenia, and the MTHFR (methylenetetrahydrofolate reductase), which activates folate for use in the brain, are the two genes that are suspected of being the cause of a folate deficiency. This study is so important, as schizophrenia medicine doesn't necessarily work. Therefore scientists have to discover new ways to treat people with schizophrenia.

Genes can not only affect the likelihood of developing a mental health issue but also cause issues with or negate the effects of the medicine. For instance, antidepressants have many side effects and don't work with all people. During a large government survey scientist found a variation in the TREK1 gene caused poorer response to antidepressant medication.

Tracking schizophrenia and bi-polar disorder is incredibly difficult, as with schizophrenia, only 6.5 percent of people that carry the gene have the disorder and many more in a family may have the carry the genes for schizophrenia with no symptoms apparent. Therefore, scientists have to track the disorder using behavioural characteristics such as sensory negating, syntax errors or idiosyncratic use of language.



# Genetic Modification Today

## Riccardo Kahale - L6th Form

When someone thinks "Genetic Modification," he or she thinks it is science fiction and fantasy, but the truth is that genetic modification is already here. GMOs or Genetically Modified Organisms can be seen everywhere in daily life. Currently, GMOs are illegal within the United Kingdom. However, there are talks for regulations on GMOs post-Brexit, as the Agriculture minister George Eustice said: "as part of preparations for the EU exit, the Government is considering possible future arrangements for the regulation of genetically modified organisms."

On the other side, in the United States, more than 70 per cent of packaged foods sold contain ingredients derived from genetically modified organisms. Corn is an example of a crop that has been altered at the genetic level. A company took the genes from the bacteria known as "Bacillus thuringiensis", and they inserted it into the corn. The genome gave the corn insect-killing properties.

There are many current applications for genetic modification which varies from plant modification. For instance, there is a case wherein goats the heterologous host, in this case, Escherichia coli, which is easy to manipulate, has a short generation time, is relatively low cost and can be scaled up for more significant amounts protein production, was given a specific genome from a spider. This allowed the goat to produce spider silk; solid fibres at ambient temperature and pressure, giving rise to an environmentally safe, biodegradable and high-performance material.

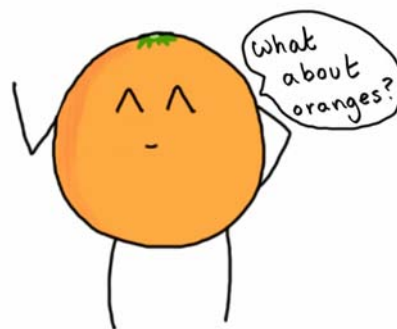
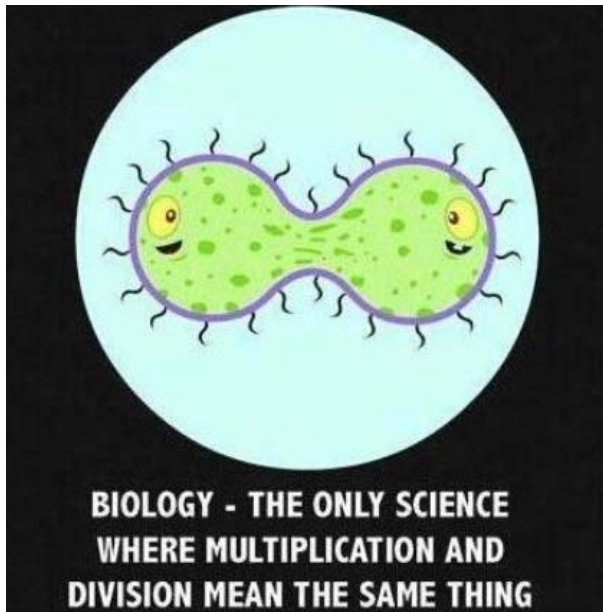
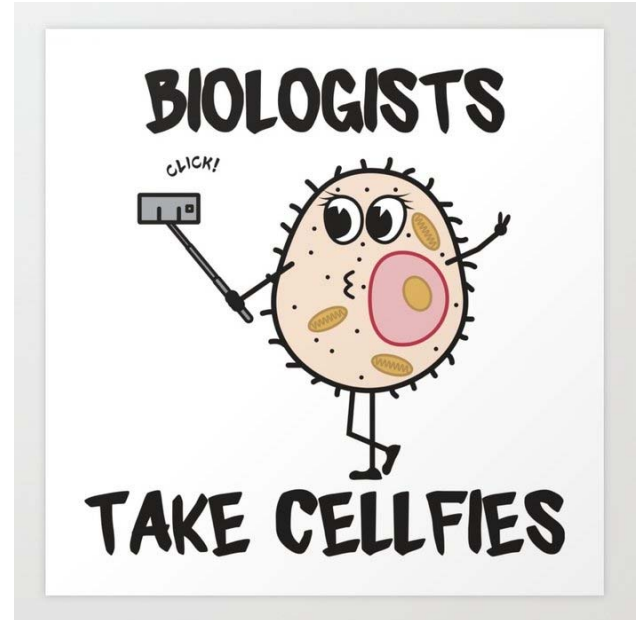
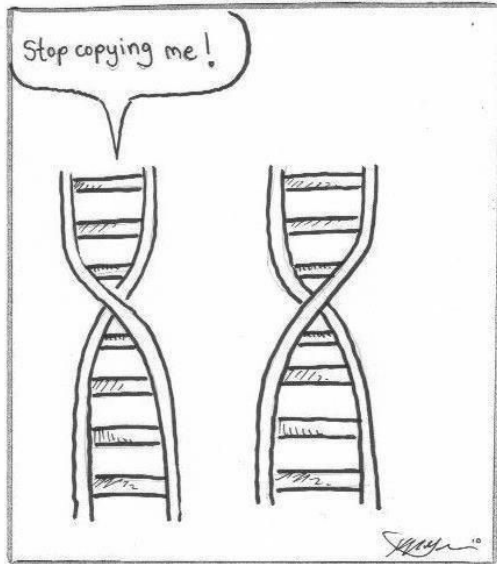


There are four main steps in the process. First off, one must design and then assemble the synthetic silk-like genes into genetic 'cassettes'. Sequentially, the next step is to insert this segment into a DNA vector. Thirdly, the recombinant DNA molecule is transferred into a host cell, and finally, the last step is the expression and purification of the selected clones.

This is just one way of illustrating an application of genetic modification, but there are numerous utilisations such as cows that fatibulate 25% less methane, trees that grow faster for the lumber industry and plants that absorb more carbon dioxide. All of this is achieved through genetic modification.

Recently, there has been a new method of genetic modification in molecular biology discovered called "CRISPR". CRISPR is family of DNA sequences found within the genomes of prokaryotic organisms such as bacteria and archaea. Molecular biologists consider CRISPR so simple to practice, that they are worried. Essentially, the DNA is cut and then one adds a new piece of RNA, the DNA heals itself and once it has healed itself that organism has been altered. Scientists in China used CRISPR to modify non-viable human embryos, and altered human DNA. This showed that human DNA could be genetically modified. This breakthrough has opened many doors in the molecular biology industry and now it is a matter of time before discoveries in this field are made.

# Merry Christmas!



*Chromosomes*