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By the students of New School Georgia



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IMMUNE SYSTEM AFTER RECOVERY FROM COVID-19

BY KARINE HOVHANNISYAN

Nowadays Covid19 is the most common threat for the whole world. Even though now there are vaccines for this disease, it's still dangerous. As the number of people who had fought off Covid19 increases day by day, a critical question has become more important: How long will their immunity to the coronavirus last?



A new Rockfeller study gives encouraging answer for this question. He said, that those, who recover from Covid19 are protected against the virus for at least 6 months and likely much longer.

His study states that the immune system “remembers” the virus and continues to improve the quality of antibodies even after the infection has waned. Antibodies produced months after the infection showed increased ability to block SARS-CoV-2, as well as its mutated versions. The researchers found that these improved antibodies are produced by immune cells that have kept evolving, apparently due to a continued exposure to the remnants of the virus in the gut tissue. Based on these findings, researchers suspect that when the recovered patient next encounters the virus, the response would be both faster and more effective, preventing re-infection.

Long-lasting memory

Antibodies, which the body creates in response to infection, linger in the blood plasma for several weeks or months, but their levels significantly drop with time. The immune system has a more efficient way of dealing with pathogens: it creates memory B cells that recognize the pathogen, and can quickly unleash a new round of antibodies when they encounter it a second time.

But how well this memory works depends on the pathogen. To understand this case with SARS-CoV-2, Nussenzweig and his colleagues found that although antibodies were still detectable by the six-month point, their numbers had markedly decreased. The patients' memory B cells, specifically those that produce antibodies against SARS-CoV-2, didn't decline in number, and even slightly increased in some cases.

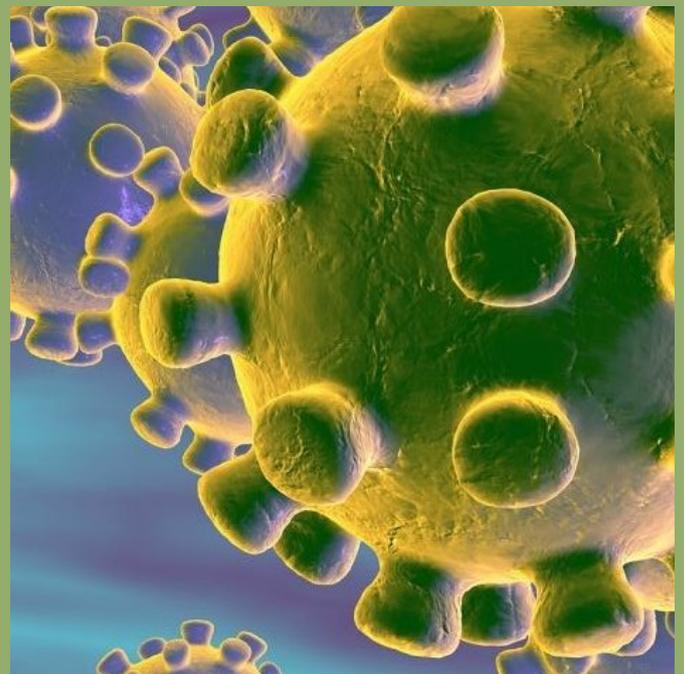
Viral stowaways

A closer look at the memory B cells revealed something surprising: these cells had gone through numerous rounds of mutation even after the infection resolved, and as a result the antibodies they produced were much more effective than the originals. Subsequent lab experiments showed this new set of antibodies were better able to latch on tightly to the virus and could recognize even mutated versions of it.

SARS-CoV-2 replicates in certain cells in the lungs, upper throat, and small intestine, and residual viral particles hiding within these tissues could be driving the evolution of memory cells. To look into this hypothesis, the researchers have been examining biopsies of intestinal tissue from people who had recovered from Covid19 on average three months earlier.

In seven of the 14 individuals studied, tests showed the presence of SARS-CoV-2's genetic material and its proteins in the cells that line the intestines. The researchers don't know whether these viral left-overs are still infectious or are simply the remains of dead viruses.

The team plans to study more people to better understand what role the viral stowaways may play in both the progression of the disease and in immunity.



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PARACHUTING CATS

BY KLEMENS KLECOWKA-MASZKIEWICZ



Malaria has been a problem for a really long time and in the 1950s the Eighth World health assembly held in Mexico has decided to try to eradicate the problem with a mindset that it was done before without bigger problems. Malaysia at the time was reported to have a high malaria rate and the WHO (World Health Organization) focused specifically on one Island called “Borneo”. In order to solve the issue, World Health Organization used DDT a chemical compound to kill mosquitoes. They have solved issue malaria issue, however with using DDT problems came along.

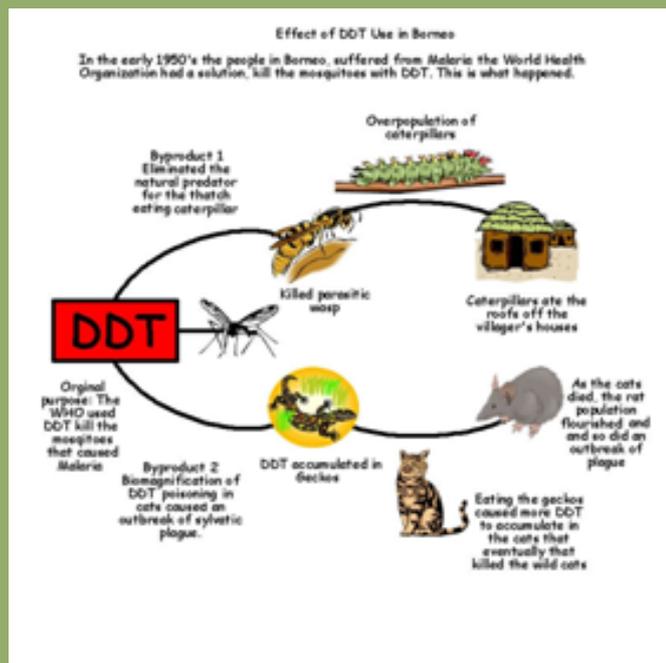
They sprayed the DDT on the roofs of the dwellings, places where the locals lived in. The chemical was so intense that it had left stains.

Spraying was done twice a year and it decreased the percentage of malaria-carrying mosquitos from 35.1% to 1.6%. The operation of erasing Malaria went quite successfully, In that area malaria cases decreased from 2.5 Million (1945) to less than 100 (1963) which is a great success comparing usage of the same method in different parts of the world like Africa. Despite the success in Borneo there was a big number of countries that did not have the logistics, human and financial resources required to maintain the eradication, in Sri Lanka in 1954 there were only a few cases left in different areas but because the government decided to finish the operation due to financial reasons, the cases went up slowly again and in 1969 about 500000 people were infected again.

The spraying in Borneo seemed to be a success at first until locals started to complain about problems that came along with using chemicals. People of the island were unhappy that after spraying their roofs started to break down and became worse.

World Health Organization team was sent there once again to investigate the problem and they found out that the caterpillars that lived in the roof were resistant to the chemicals which increased the population by 50%, whereas wasps that used to feed on the caterpillars died off because of DDT. The solution to that problem was solved by using an even more toxic chemicals on the roofs called dieldrin which also eliminated moths.

In 1962 a New York times magazine wrote an article saying that “American DDT spray killed the cats that ate the rats that devoured the crops that were the main props against Communist agitation in the central lowlands.” They believed that the cats died because of a combination of different factors like climate, moisture, resources of food, and the governments failure the ensure an adequate supply of rat poison. The 1959 report by Robert Desowitz said that the number of field rats was greater than cats, which is obviously not beneficial to the villages. The death of cats and rapid growth in the population of rats created



another problem which was an outbreak of yet another disease called Bolivian hemorrhagic fever, according to the investigation conducted by Karl Johnson it was due to “invasion of house rodents”. Villagers would get very sick, started to shake, linger for a few days, and eventually died.

The most controversial and trouble-making side effect caused by using DDT was the death of cats which did not only happen on Borneo Island but worldwide. The causes of deaths were strongly linked with the use of the chemicals.

One cat was analyzed by a toxicologist and the main cause of death was licking its own fur, because DDT was strong enough to kill cats and those would lick themselves to clean, they died fast. The important thing to add is that also lizards and other creatures eaten by cats were infected which was another cause of Cats death.

After all, these problems WHO had to solve another problem again which was to balance the population of cats, and the solution they came up with was to parachute the cats onto the Island. Tom Harrison who allegedly took part in that event which happened in 1965 described the “cat drop”. He said that cats were collected and packed in “parachute-borne” containers and with the help of the Royal air force the cats were literally parachuted into the Borneo Island. It is said that about 14000 cats with a variety of age was involved in this operation. After few years the situation was slowly improving and it got better.

In conclusion in the 1950s Borneo Island had a problem with Malaria, World Health Organization with a will help, proposed the use of DDT which helped at first but caused problems like falling roofs and the sudden death of cats which caused rat population outbreak. To help to balance the nature, WHO decided to parachute the cats. This story shows how perfectly everything is created in nature and how important it is to sustain the biological food chain.

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TEA POLYPHENOLICS AND THEIR EFFECT ON NEURODEGENERATIVE DISORDERS

BY NICOLETA GANEA

Nowadays, the attention in the health system is directed towards plant-based products, as they are seen as a traditional source of medicine. Because in the past hundreds of years plants have been destroyed they have developed defense mechanisms that are now sought by people, especially in pharmaceuticals, food additives, and cosmetic products.

Tea is a very good source of important secondary metabolites like monoterpenoids, carotenoids, and catechins, etc. Monoterpenoids and carotenoids are important constituents of tea aroma and flavor, while catechins derivatives and their polyphenol compounds are responsible for the beneficial health effects. A process that essentially converts the polyphenols in their monomeric forms, while decelerating the enzymatic activity of polyphenolic oxidase is used to produce green tea (fresh tea leaves from the green tea plant are steamed and dried to produce green tea).



Green tea is enriched with flavonoids which are the largest group of polyphenols. Flavonoids are generally divided into several categories including flavones, isoflavones, catechins, flavanones, anthocyanins, chalcones, and quercetin (Figure 1).

The natural polyphenols in green tea include epicatechin (EC), (-)-epigallocatechin-gallate (EGCG), (-)-epigallocatechin (EGC), (-)-epicatechin-gallate (ECG) (Figure 2). Other minor catechins present in tea including (+)-catechin-gallate, and (-)-gallocatechin. EGCG has the highest concentration followed by EGC, ECG, and EC in decreasing order. Green tea catechins have been found to be more efficient as radical scavengers (substances that protect cells from free radicals damage) than vitamin E and C. Most of the health benefits of green tea are mainly due to its antioxidant properties and in protecting reactive oxygen species, the ability conferred by polyphenols and catechins.

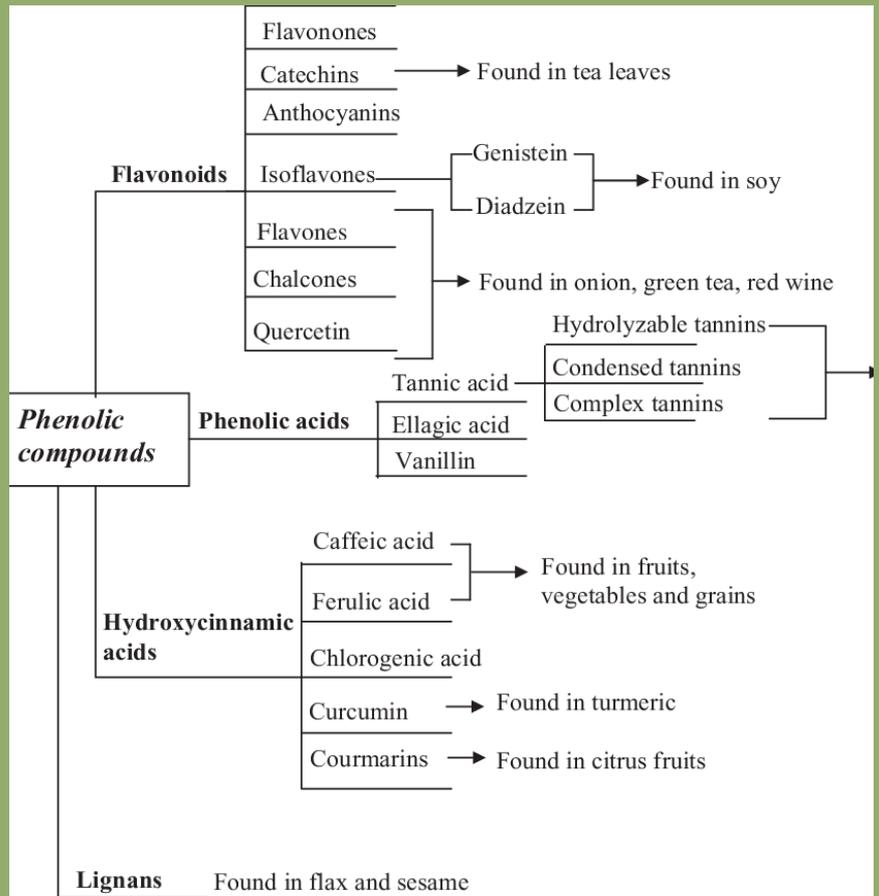


FIGURE 1

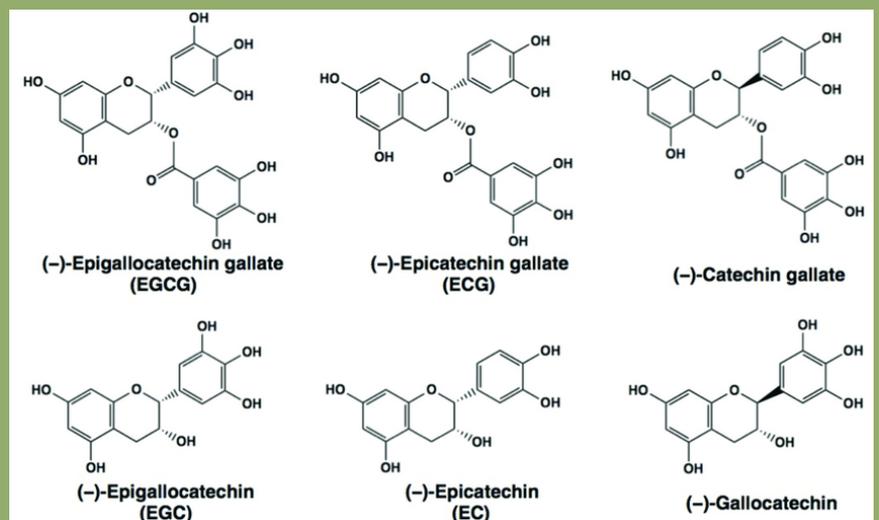


FIGURE 2

These properties are attributed due to the property of the phenolic hydroxyl groups present in the B-ring in EC and EGC and in the B- and D-rings of ECG and EGCG. The antioxidant, as well as radical scavenging properties, are conferred by the presence of the 3,4,5-trihydroxy B-ring.

Green tea's health potential is known worldwide, as it contains rich flavonoid compounds consisting of high antioxidant activity through inhibition of oxidative damage of lipoprotein and DNA. Green tea and constituent catechins are evaluated regarding their antioxidant properties against a number of diseases associated with reactive oxygen species (ROS), including cancer, cardiovascular and neurodegenerative diseases.

In addition to the cancer-preventive properties, green tea and EGCG have been shown to be anti-angiogenic, anti-mutagenic, and hypo-cholesterolemic.

Green tea has anti-diabetic effects in animal models as well as the ability to promote energy expenditure in animal bodies. Other health benefits of green tea include antimicrobial, antiviral, anti-aging, and anti-inflammatory activities. The results indicate that green tea catechins have great potential as therapeutic agents. Several epidemiological studies and studies in animal models have proved that green tea protects against various cancers including skin, breast, prostate, and lung. Epidemiological studies have indicated that a lower incidence of cancer is highly associated with a high intake of green tea.



Alzheimer's disease (AD) is an acute neurodegenerative disorder. Early symptoms are often mistakenly taken to be 'age-related' concerns or manifestations of stress.

Alzheimer's disease is hard to cure, but several plant alkaloids have been proved to be potent inhibitors of the enzyme, which are accepted as existing medication by the FDA but synthetic drugs have side effects. Several AChE inhibitors are being studied for the treatment of Alzheimer's disease but until now, no drug of choice for the treatment of this disease has been decided. In vivo studies showed that green tea improves impairment of memory, cognitive abilities and reduces Alzheimer's disease. So it will be interesting to see whether green tea rather than green tea polyphenols have a direct inhibitory effect on AChE or not.

There is considerable proof that oxidative stress is a primary and critical event in the progression of Alzheimer's disease. The protective effect of green tea EGCG may involve its radical scavenging as well as iron chelation activity and antioxidant protective enzymes.

A study showed that EGCG defends against β amyloid induced neurotoxicity in cultured hippocampal neuronal cells, property contributed to its antioxidant properties, while another one recently demonstrated that EGCG and other green tea catechins help to modulate the processing of APP, thus avoid the formation of the neurotoxic β amyloid. Preclinical Studies on EGCG Neuroprotective Mechanism of Action Green tea has been shown to have a significant preventive effect against age-associated neurodegenerative diseases. Alzheimer's disease and Parkinson's disease are two common types of dementia-related diseases that have been studied as part of the effort to investigate the effect of green tea on neurodegenerative diseases, as its effects may be relatively exquisite, therefore, it's difficult to measure the benefits of green tea on brain function in healthy people quantitatively.

This study has been particularly interesting for me to analyse as one of my family members suffers from dementia and the study has given me in-depth knowledge about what causes neurodegenerative diseases and what might decrease their effects.

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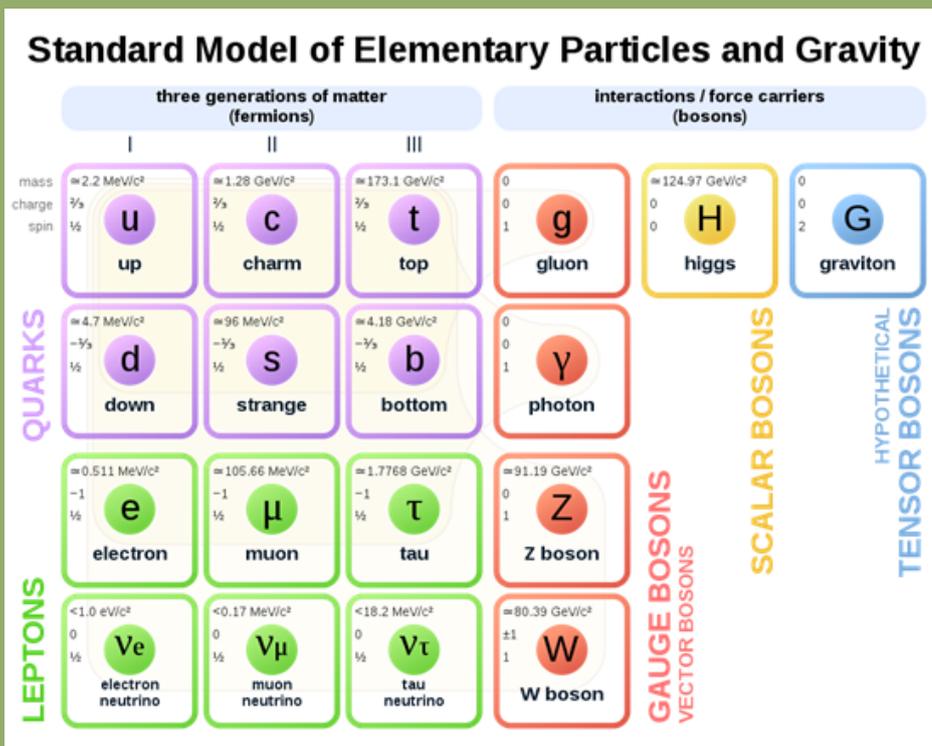
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A NEW BRANCH OF PHYSICS?

BY SHIVANSHU OJHA

Since its opening in late-2008, the Large Hadron Collider based in Geneva and dug under hundreds of feet below ground has been working away to use the massive power of the particle accelerator to try to recreate the conditions which occurred a hundredth of a second after the big bang (UKRI). It is the world's largest particle and is about 24 kilometers and took 12 years to build.

After thousands of tests, with or without the LHC, the standard model, which is used to describe the matter around us might have met its match. The standard model is what we are taught at school and was developed in the 1970s. It consists of many subatomic particles which are too complex to explain in one article, but they govern all the laws of physics.



Above are all the mono-atomic particles which are part of the standard model and make up our universe. However, recently, while running one of the four ongoing projects at the large hadron collider, researchers discovered that there was, again, at experiment b which investigates the nature of quarks and the standard model, there were multiple flaws within the model.

However, these are not enough, researchers claim, as the chance of these findings being based on statistical outliers is one in a thousandth. Therefore, we cannot say if they are right or wrong as of yet, but what would happen if they are?

Like with the discovery of the standard model, if this new theory proves to be acceptable by scientists, it will change the realm of quantum mechanics forever. It will also help us understand many of the different complex phenomena present in the universe, which as of yet, are unexplainable. For example, we still don't know anything about 95% of the universe.

This discovery from the LHC might point us in the right direction and help us lessen the percent of what we don't know. Any new development to the quantum realm might help us seek new knowledge about the universe and understand it better. The discovery of a new branch of physics might help fund more physics projects which can help us understand more; whilst drawing more attention to physics as a whole. This could be a hit or a failure, only time will tell.

"The discovery of a new force in nature is the holy grail of particle physics. Our current understanding of the constituents of the Universe falls remarkably short - we do not know what 95% of the Universe is made of or why there is such a large imbalance between matter and anti-matter."

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INTERVIEW WITH *LILIT GASPARYAN* OF DP2

INTERVIEWED BY LIVIA BELDIGA

1) Hello! Tell me about yourself.

Hello, I am Lilit Gasparyan from Armenia. Nature and natural sciences are my passion, and some of my hobbies are various types of sport (boxing, swimming, volleyball, basketball), musical instruments (I play piano) and Armenian national dances. I learned about the Scholarship program from Facebook, so being here now was not a decision but just an accidental luck.

2) How did you know that the IB Programme was the right choice for you an your prospective career?

IB offers high-quality education and helps to improve our skills that are necessary to solve real-life problems. The IB curriculum contains different study areas, it is full of challenges that make us versatile. Another advantage for me was that I chose what I wanted to study, and it helped me to concentrate on specific fields and go towards my aims with more certainty. But the one thing that attracted me the most was the IB learner profile. The programme not only gives us knowledge in school subjects but also tries to make a better us. I understood that I needed good education and these changes in my life.



3) What are your HL and SL subjects?

I take four HL subjects instead of three: English B, Physics, Chemistry, and Mathematics Analysis and Approaches. My SL subjects are Armenian literature and Economics.

4) How did you manage to adapt to learning 2 sciences in English?

I have been studying sciences deeply since the 7th grade and due to my background and my teachers' efforts, I managed to succeed in two HL sciences. Although studying them in English made me work harder to learn all the terms, I could deal with it with the help, support, and advice of my beloved teachers.

5) What are some tips you have for other students who want to take/are currently taking 2 sciences at HL in IB?

We all know that IB students have to take at least one of the sciences, but taking two is already a choice. I think only "science people" should take two, otherwise it will be more difficult and the student might not enjoy the course.

As for tips, try to relate the topics: the rules of nature do not change. They are named differently depending on their specific subject of study, but there is always something common between them. Also remember, that practicing/continuously solving problems is very important: you cannot study natural sciences by reading the coursebook as a literary work.

6) The Covid-19 pandemic has deeply affected all of us. Specifically students have been struggling with distance learning for more than a year now. What resources would you recommend to those who may need some assistance during these challenging times?

No one will argue that face to face learning is much more effective than distance learning. There are plenty of online resources that could be helpful. I would suggest IXL the K-12 platform, Khan Academy, Academic Earth, and others. Don't forget to make proper use of the resources given by your teachers, like inThinking, some video lessons, etc.

7) How much time did it take do your Internal Assessments?

I wrote the main body within 1-2 days, but it took several days to edit and improve them.

However, it took 2-3 weeks for sciences to design and conduct experiments. My Chemistry IA RQ was: How does the iron ions level in avocado change depending on its ripening degree? I used potassium ferrocyanide, $K_4Fe(CN)_6$, in order to prove that there are iron ions present. Then I smashed the avocado to get juice and added 10 ml hydrochloric acid, HCl. The idea was that acid would react with Fe^{3+} ions thus releasing hydrogen gas. I collected the gas released out using a syringe, measured the volume and calculated moles, then used that number to find the amount of Fe^{3+} , and accordingly, the initial amount of Fe^{2+} ions. I repeated the entire process for 5 avocados of different ripening degrees (5 day-gap in between) keeping constant the volume of juice and acid, and conditions. Although my experiment had several limitations, and there were small inaccuracies,

the overall results were satisfactory and reasonable. I think the most important limitations were the following two:

1) I assumed that all the Fe^{2+} ions present in the fruit are oxidized to Fe^{3+}

2) I did not take into consideration, during the experiment, that there are other metal ions present in the fruit, and the hydrogen gas released out is not only from $2Fe^{3+} + 6HCl \rightarrow 2FeCl_3 + 3H_2$ reaction.

For my Physics IA I made a lemon battery, and tried to find out the relationship between temperature and internal resistance of a cell using aluminium and copper as electrodes. I used lemon juice at $0^\circ C$, put electrodes and connected through wires. I measured the EMF using a multimeter, and which is the voltage without an external resistance, and calculated the current. Then I added a LED light in the circuit and measured the voltage and current, and was able to calculate the internal resistance of a lemon cell.

Continuation of Question 7...

I spent more time on the conclusion and evaluation parts, as they are the most important ones. There you sum up all the work done showing whether you achieved the goal of your investigation or not, what results did you get and how do they correspond to the theory, and so on.

8) In what subject have you done your Extended Essay? Describe your experiment research process.

-I did my EE in Chemistry, the subject which was my favourite since the 7th grade. The main aim of my research was to find out how does the Aluminum foil affect different types of food (of varying pH) wrapped in it, while heated at different temperatures for different time periods. The idea is from everyday life, as a lot of people are used to heat food in a microwave, which causes Aluminum to leach into the food. The entire process was very exciting for me, because I was “playing” with food adding spices and ingredients to change the pH, changing the conditions inside the microwave and observing qualitative and quantitative changes.

In the very beginning I purchased 5 different aluminium foils and tested them using hydrochloric acid to see whether they contain only pure aluminium or other metal mixtures as well. For that I calculated the ideal amount of H₂ gas that would be released if the foil contained 100% pure aluminium, and then according to the reaction I calculated how much actually it is released out and calculated the percentage purities. For the rest of my investigation I used only the brand of foil which contained the least impurities.

I wrapped 5 different types of food (of varying pH) and heated at 3 different temperatures keeping constant the time period of heating, mass of food and mass of aluminum foil. Then measuring the mass of aluminium foil after heating, I calculated the amount of aluminium leached into the food. This way I found out that as we increase the temperature inside a microwave the amount of aluminium leached into food also increases.

Continuation of Question 8...

Next, keeping constant the temperature, masses of food and foil, and other conditions, I heated the same types of food for different time periods.

Repeating the same actions I found the relationship between time period and amount of aluminium leached into food: the more we keep in a microwave, the more aluminium leaches to our food.

In my EE also, my experiments had several limitations and uncertainties, but I could show that constantly using foil and a microwave in specific conditions will cause an increase in the amount of aluminium leached into food which in turn can be a reason for some diseases.

Despite my efforts, investigation would not be successful without the help of my supervisor and Chemistry teacher.



9) Name three lessons IB has taught you? Not academically related

The most important thing that I learned during these two years is that I am the one who is responsible for myself. There will be people who will try or pretend to support, but I am the one who can totally understand my feelings, care, encourage and motivate myself, I have to be strong and rely only on myself in every situation.

I learned to think critically and question everything: but why? Asking the right question in the right place is a big challenge but it helps to understand and to know far more. And last, but not the least, not everything has to be perfect. I am the kind of person who has to do everything in the best possible way, but now I realise that some of my standards of perfection were unrealistic and trivial in the beginning of the IB journey.

You do not have to receive the highest marks every day. For me the knowledge, experience, and adventures are much more important than those numbers.

10) What can you tell me about your future plans? What field are you planning on working in?

I am going to continue my education in International Bachelor of Mechanical, Material, and Aerospace Engineering at INSA Lyon, France. I was inspired by my father who is unfortunately not with me. I hope I will be able to make our dreams come true, and work for the world in the future. I think my dad would be proud of me.



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