Haziran 2022

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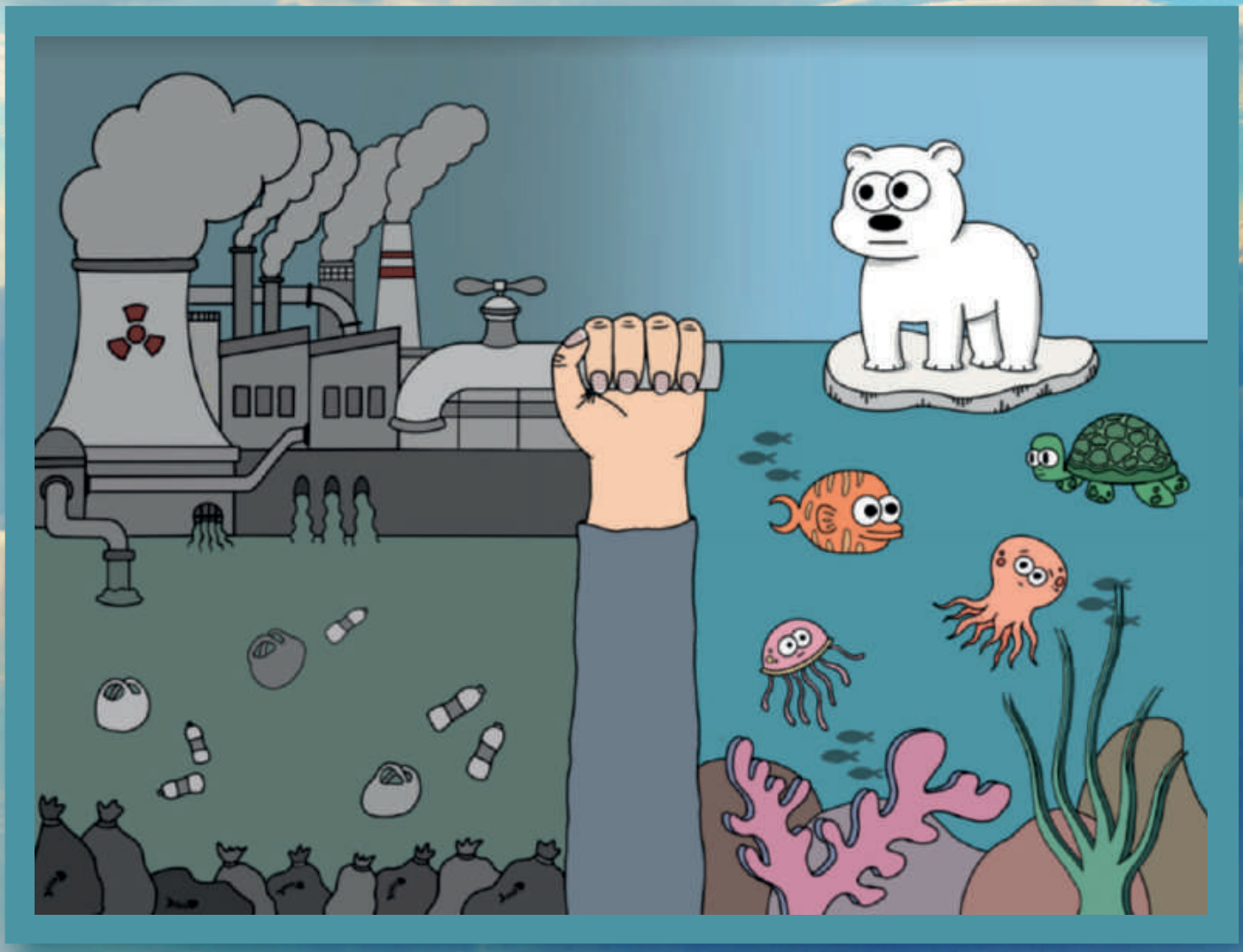
VKV Koç Özel İlkokulu, Ortaokulu ve Lisesi
Öğrenci Dergisi



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Kapak Tasarımı: Deniz Pala / 10

VKV Koç Özel İlkokulu, Ortaokulu ve Lisesi Öğrenci E-Dergisi
Haziran 2022

E-Dergi Yayımlayan:
VKV Koç Özel İlkokulu,
Ortaokulu ve Lisesi
Tepeören - Tuzla - İstanbul

İmtiyaz Sahibi:
Prof. Dr. Murat Günel

Sorumlu Yazı İşleri Müdürü:
Zeynep Kurmuş Hürbaş

Kurumsal İletişim:
Buse Merve Eren

Dergi Tasarım ve Uygulama:
Dilek Seferoğlu

İçindekiler

International Academic Marathon 2022 Başarılarımız

26 ülkeden 679 takımın yer aldığı IAM final aşamasında öğrencilerimiz ülkemizi ve Okulumuzu, 4 farklı branşta temsil ederken hem bireysel hem de takımı olarak yarıştılar.

http://www.academic-marathon.org/

Sonuç olarak: 4 branşta bireysel birincilik (Historithon, Mathethon, Psychothon, Biothon), 2 branşta da takım (Historithon, Biothon) birinciliği elde edildi.

Bu takımları temsilen ve de bireyselde derece yapan öğrencilerimizin isimleri aşağıdaki gibidir. Süreç boyunca hem bana hem de öğrencilerimize destek veren rehber öğretmenlerimizi de cc'ye ekledim.

Tarih : Elif Maviş (bireyselde 1.)
Biyoloji: Yavuz Selim Başer (bireyselde 1.)
Matematik: Kenan Hekimci (bireyselde 1.)
Psikoloji: Batuhan Sarıdede (bireyselde 1.)

Aynı zamanda takım olarak Tarih ve Biyoloji Takımları Avrupa 1.liği elde etti.

Where Your Journey Starts for TÜBİTAK Science Project Competition

Have you ever wanted to join TÜBİTAK Science Project Competition and felt like you didn't know where exactly to start? Here is a detailed guide that can help you in your TÜBİTAK project journey.

Ms. Prof. Elif Damla Arısan came to do a presentation in Biotechnology Club about this competition. Let's explore the guide prepared from the information conveyed by Ms.Arısan.

First of all, the general aim of TÜBİTAK project competition is to encourage the youth to think, observe and research the subjects that they are curious for to make them acquire the 21st century skills that will enable them to solve the problems that they will face in the future.

The competition is held in 12 main branches: biology, geography, value education, physics, chemistry, maths, sociology, phycology, history, Turkish language and literature, technology and design and software computing and students are asked to prepare a project based on research about the chosen branch. The projects are specialized under one of the thematic areas like smart transportation mechanisms, renewable energy, biodiversity, financial literacy, genetics and biotechnology, STEAM, robotics and coding, AI, etc.

Some rules to pay attention to are that a student can join the competition with only one project and a project can be prepared at most by three students. In one project, there might be only one advisory teacher. It is not compulsory to have an advisory teacher for a project.

This year, according to the competition plan, the applications started on 3rd of January and finished at 11th of February. The projects are evaluated by juries and in March 2022, the results of the preliminary consideration are announced. According to these results, the students with more successful projects are

invited to the Regional Competition in 14-17 March, where the regions include Adana, Ankara, Bursa, Erzurum, İstanbul-Asia, İstanbul-Europe, İzmir, etc. The projects that deserve the title of first place of the regional competition is invited to the Final Competition which is planned to be held in 23-26 May.

Moving on to the criteria, there are 5 main titles named "Creativity" (worth 10 points), "Scientific Method" (worth 15 points), "Conclusion and Suggestions" (worth 10 points), "Applicability/ Influence" (worth 5 points) and "Report Preparation" (worth 10 points).

You can try to answer the following questions to assess the success of your project for the main titles below:

Creativity:

Does your project have the potential to create competition through a new/ advanced technological product, beneficial model, design, etc.?

Scientific Method:

Is the problem or the research question openly stated?
Is there a convenient process applied to reach to the results of the project?
Are the variables used in the project openly stated and defined?
Are the data obtained sufficient to answer the problem or the research question?

Results & Suggestions:

Are the results coherent with the data obtained?
Is there any mention of how this project can be the fundamental of new research projects?

Applicability & Influence:

Does the project demonstrate an applicable result?
Does the project have a contribution to the society or the chosen subject of the project?

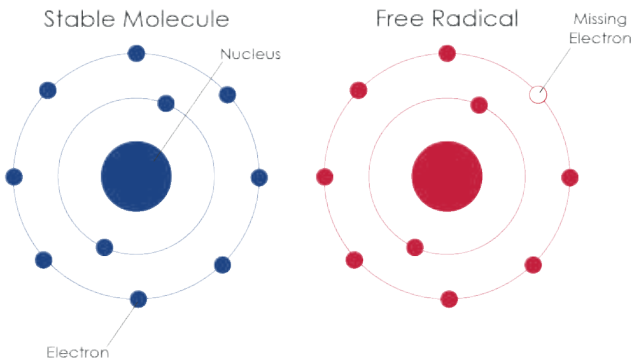
Lastly, TÜBİTAK BiDEB website *(https://ebideb.tubitak.gov.tr/giris.htm)* is a great way to be informed of different projects of this kind. Make sure to explore it to if you are eager to join more competitions.

Idil Ada Aydos / 9

Can we stop aging by preventing oxidative stress?

What are free radicals and how does oxidative stress occur?

The electronic bonds that hold billions of molecules together in the human body can weaken and split, resulting in the formation of



Stable Molecule – Free Radical molecular comparison
https://osumex.co.uk/strategic-health-markers/free-radicals/

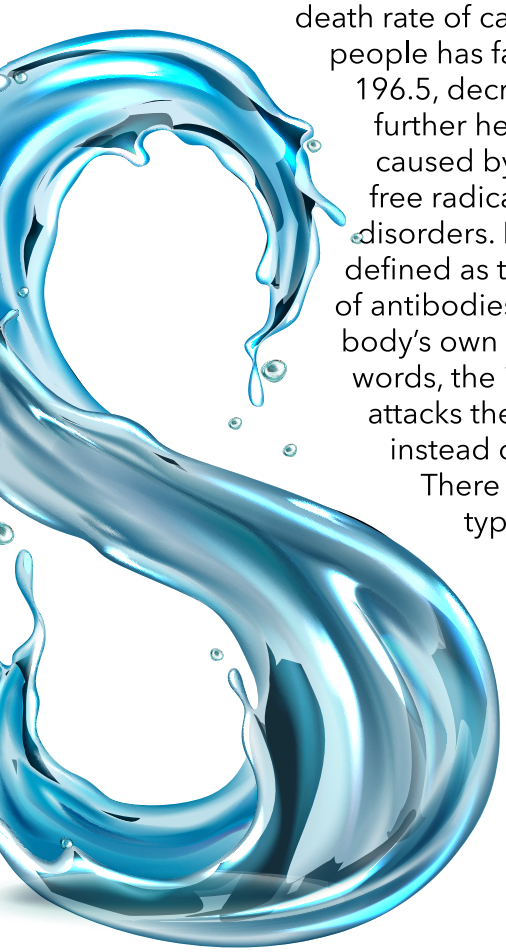
unstable molecules known as free radicals. These molecules are highly reactive because they have an unpaired electron, and they frequently initiate a chain reaction that disrupts millions of neighboring cells to restore their missing electron. Free radicals cause oxidative stress which can be defined as the phenomenon generated by the accumulation of free radicals in the body when an overload of them cannot be destroyed. In other words, when free radicals build up, generating an imbalance between free radicals and antioxidant defenses, oxidative stress on the cells occurs due to the overwhelming of free radicals. The development of ailments such as heart disease, cancer, autoimmune disorders, and aging have been linked to oxidative stress. In many diseases, the crucially important oxygen-containing free radicals are shown to be hydroxyl radical, superoxide anion radical, hydrogen peroxide, oxygen singlet, hypochlorite, nitric oxide radical, and peroxynitrite radical. These species are highly reactive and responsible for damaging vital molecules such as DNA, proteins, carbohydrates, and lipids. Free radicals target significant macromolecules and lead to cell damage and homeostatic disruption. Although free radicals target all molecules, the major targets are lipids, nucleic acids, and proteins. Free radicals can be produced from either external sources or essential metabolic processes in the human body. Exposure to X-rays, ozone, cigarette smoking, air pollutants, and industrial chemicals could be given as examples of external sources. The formation of free radicals depends on both enzymatic and nonenzymatic reactions. Enzymatic reactions serving as the source of free radicals comprise those involved in the respiratory chain, phagocytosis, prostaglandin synthesis, and the cytochrome P-450 system in the liver. On the other hand, nonenzymatic processes form free radicals through the reaction of oxygen with organic compounds and ionizing reactions.

What do we know so far about the role of free radicals in the etiology of different human diseases?

Free radicals are continuously synthesized in the human body, and to counteract the damage of the free radicals, antioxidant defense mechanisms work. When these protective systems are insufficient, some serious diseases occur. It has been proven by scientific studies that oxidative stress contributes to the etiology of many chronic health issues. One of the most common health problems is heart disease. The term heart disease is extensive, and it includes blood vessel disease, such as coronary artery disease, arrhythmias, congenital heart defects, heart valve disease, disease of the heart muscle, and

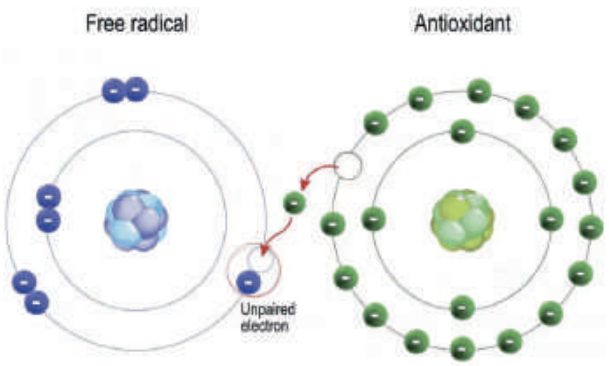
heart infection. In the United States, the most common heart disease type is the coronary arteries, which can lead to myocardial infarction also known as heart attack. The mortality rate of a heart attack is about 12%. Also, in the United States, the number of people dying because of heart disease each year is around 659,000, while this number is 200,000 in Turkey. Another serious health problem caused by free radicals is cancer.

The cells of people who get cancer grow uncontrollably and spread to other parts of the body. Cancer can start in almost any part of the body. Our cells grow through a process called cell division and form new cells. When this process breaks down, the damaged cells grow and spread in the body, causing the formation of tumors, which can be defined as the lumps of tissue. Tumors divide into two groups: Cancerous (malignant) and not cancerous (benign). While cancerous tumors invade the body to form new ones and so become life-threatening, benign tumors do not spread nor continue their growth when they are removed. Thankfully, with science and technology developing, in the last 20 years, the death rate of cancer per 100,000 people has fallen to 144.1 from 196.5, decreasing 27%. A further health problem caused by the damage of free radicals is autoimmune disorders. Basically, it can be defined as the development of antibodies against the body's own cells. In other words, the immune system attacks the human body instead of protecting it. There are more than 80 types of autoimmune disorders, but the most known ones are type 1 diabetes and rheumatoid arthritis. Even though the majority of these diseases are not fatal, people who suffer from autoimmune diseases tend to have a shorter lifespan and a poorer quality of life. Another health problem associated with free radicals is aging, which is the process of getting older.



Prevalent effects of aging on the human body are slowdown in the cardiovascular system, shrinking in bones and muscles, increased risk of constipation, bladder and urinary tract problems, decline in thinking skills, sight and hearing issues, and wrinkles.

Do we have evidence for the therapeutic role of antioxidants in different pathophysiological conditions of the human body?



Stable Molecule – Free Radical molecular comparison
https://osumex.co.uk/strategic-health-markers/free-radicals/

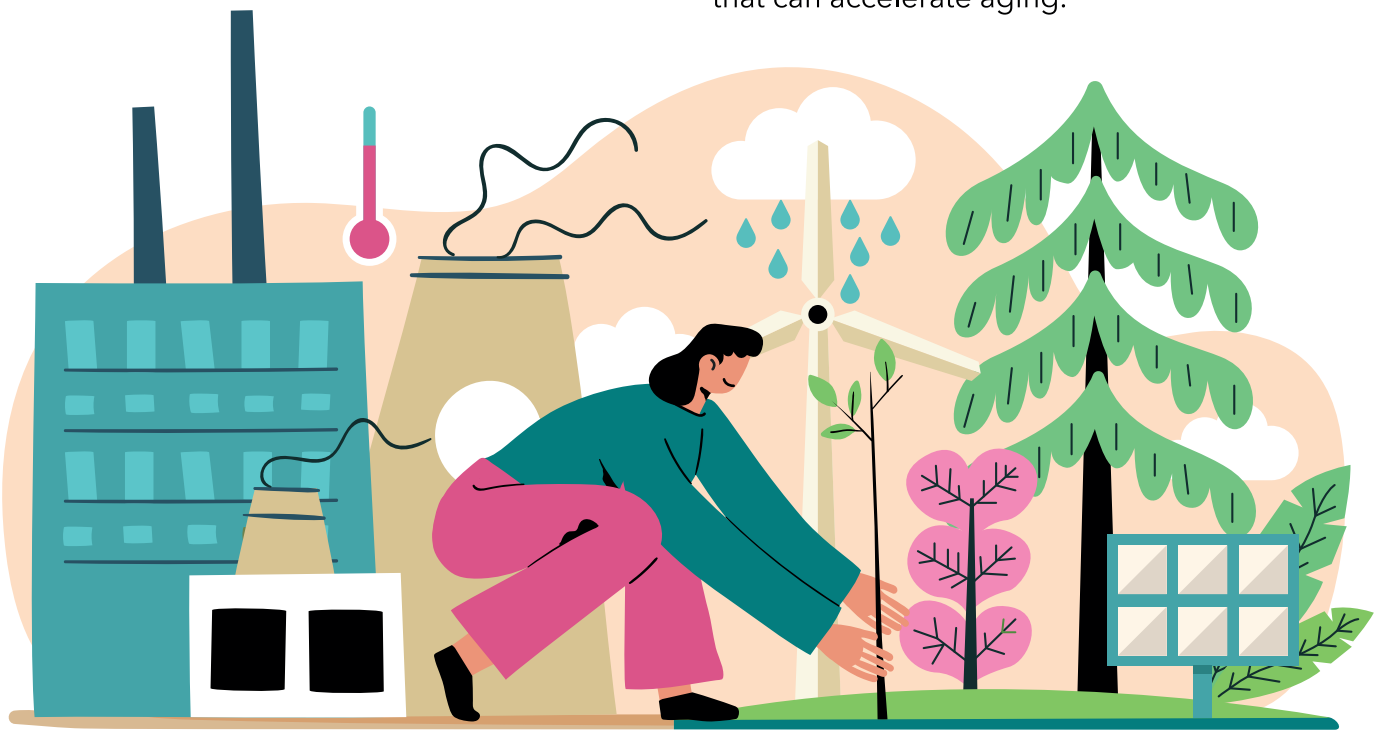
As aforementioned, the human body has defense mechanisms to protect itself from the damage caused by free radicals. The body's key defense systems against excessive quantities of free radicals are called antioxidants. Antioxidants are molecules that assist to neutralize excess free radicals and protect cells from toxicity-induced cell death, thus contributing to preventing disease. They can serve as defense agents on multiple levels, including reducing free radical generation, scavenging for active radicals to terminate chain reactions, and transporting oxidative proteins to prevent accumulation within the body. There are thousands of chemicals that can act as antioxidants. Vitamin C, Vitamin E, B-carotene, and flavonoids are some of the

sources of antioxidants found in the diet, while glutathione, ubiquinol, and uric acid are antioxidants produced during metabolism in the body.

For a proper physiological function, a balance between free radicals and antioxidants is essential. Antioxidants help the body to keep the balance by interacting with free radicals and terminating the chain before crucial molecules are damaged. Because oxidative products can cause genetic harm, B-antioxidant carotene's activity may protect against tumors. The protective properties of B-carotene may thus protect against UV light-induced carcinogenesis. B-carotene immunotherapy may help to protect the body from cancer. It can also have an anticarcinogenic impact by changing the effects of carcinogens on liver metabolism. Another antioxidant source vitamin C might aid in the prevention of cancer. Vitamin E, an important antioxidant, aids immunocompetence by boosting humoral antibody protection, bacterial infection resistance, cell-mediated immunity, tumor necrosis factor generation by T-lymphocytes, mutagen inhibition, DNA membrane repair, and microcell line development. As a result, vitamin E may be beneficial in cancer prevention and carcinogenesis inhibition through immune system stimulation. The administration of a combination of the three antioxidants resulted in the greatest reduction in the risk of heart malignancy.

Can we stop or reverse aging with antioxidant treatment?

There has been a scientific debate about whether restraining the damage caused by oxidative stress can cease aging. In 1956, gerontologist Denham Harman postulated that reactive molecules called free radicals broke down cells over time and were the main reason for aging. According to Harman's theory, body's ability to combat the impacts of free radicals deteriorates as it matures. As a result, there are more free radicals, oxidative stress, and cell damage, leading to degenerative processes and aging. The free radical theory of aging has been altered throughout time to focus on the mitochondria. Mitochondria are small organelles found in cells that digest nutrients to provide energy. Mitochondrial free radical theory of aging explains how high levels of free radicals cause oxidative damage to the mitochondrial DNA leading to mutations that can accelerate aging.



Thus, an increase in free radicals is correlated with a decreased lifespan. Although the free radical theory of aging is new, various research back it up. Free radical levels in rats, for example, increased significantly as the rodents aged. These alterations corresponded to age-related health deterioration. According to the research on rat animal models, free radicals created in the mitochondria harm the components that the cell requires to function properly. This damage creates mutations, which release additional free radicals, hastening the cell's degeneration. However, a critical review done by Sanz and Stefanatos in 2008 concludes that mutations or oxidative damage to mtDNA (mitochondrial DNA) do not decrease longevity and aging is not a direct cause of oxidative damage, also indicating that reducing free radicals by antioxidants is not linked to aging.

Moreover, replication mistakes, rather than accumulated oxidative damage, may be the source of mtDNA mutations, according to evidence from the growing number of experimental experiments. Furthermore, treatments to reduce reactive oxygen species (ROS) levels in humans and animal models have not consistently resulted in disease development being delayed or lifetime being extended. A slew of recent experimental findings has cast doubt on the mitochondrial free radical theory of aging, prompting the formation of other theories about how age-related mitochondrial malfunction may contribute to aging. These novel theories are founded on the idea that, despite their negative effects, ROS are important signaling molecules that mediate stress responses in general and the stress response to age-related damage particularly.

Aging is marked by a decline in maximal function and the accumulation of mitochondrial DNA alterations, which are most visible in organs with post-mitotic cells, such as the brain. Oxygen radicals increasingly cause part of these aging effects. The rate of mitochondrial oxygen radical formation is directly related to the steady-state degree of oxidative damage to mitochondrial DNA and is inversely associated with maximum lifespan in higher vertebrates, according to comparative studies of animals with varying aging rates, such as the mentioned rat experiment. Maximum lifetime is also negatively related to the degree of unsaturation of tissue fatty acids. Thus, the debate on whether aging can be prevented by excessive consumption of antioxidants has still not ended in the scientific world. Pursuant to the existing evidence, even though it may be possible to extend people's lives, it is not a realistic approach for people to live for centuries or be immortal. Future studies in this field are certainly needed to better understand the causative relation between oxidative stress and aging.

Bora Tarcan / 9

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A Look on Neurodegenerative Diseases –What makes them this scary?

You may simply know them as variations of Alzheimer's disease; however, there is so much more to know about neurodegenerative diseases than being forgetful and unclear memory.

What are "Neurodegenerative Diseases"?

According to Peter O'Donnell Jr. Brain Institute, neurodegenerative diseases "encompass a wide range of conditions that result from progressive damage to cells and nervous system connections that are essential for mobility, coordination, strength, sensation and cognition". Therefore; diseases such as Alzheimer's, Huntington's, Parkinson's, Lewy Body dementia, ataxia, motor neuron disease, multiple system atrophy and progressive supranuclear palsy can be given as examples of these disorders. Most of these diseases being incurable and worsening over time results in extremely high rates of mortality, making the diagnosis and examinations of these diseases extremely difficult yet really crucial.

Why are these diseases incurable?

As mentioned before, neurodegenerative diseases affect the neurons in the patient's brain and spinal cord. These damages towards the neurons cause them to either become terribly harmed or die. When this happens, the patient's brain can't communicate with the rest of the body the way it normally would. Therefore, these diseases are generally referred to as "incurable". Neurodegenerative diseases have very different pathophysiologies and today, researchers lack understanding of the causes and mechanisms of these diseases, which leads to a lack of treatment.

Briefly, as Durães and his collaborators state "Currently, no neurodegenerative disease is curable, and the treatments available only manage the symptoms or halt the progression of the disease.

Therefore, there is an urgent need for new treatments for this kind of disease, since the World Health Organization has predicted that neurodegenerative diseases affecting motor function will become the second-most prevalent cause of death in the next 20 years.".

What are the symptoms of these diseases?

Though there may be more specific symptoms of each disease; symptoms of all neurodegenerative diseases generally include a variety of symptoms related to emotions, movement and cognition. Early signs of most of the diseases include memory loss and forgetfulness with an extreme apathy and lack of concentration.

Emotionally, the patients may develop anxiety, agitation and paranoia with severe mood changes. Movement problems majorly include muscle rigidity, frozen stance, shaking, balance problems, loss of coordination, vision problems and speech difficulty. Cognitive symptoms include visual hallucinations, a loss of inhibition and severe loss of thinking abilities. Some other symptoms of neurodegenerative diseases include serious changes in body temperature, problems with blood pressure, dizziness and sensitivity to heat and cold.

What causes these diseases?

As Medline Plus indicates, "Many of these diseases are genetic. Sometimes the cause is a medical condition such as alcoholism, a tumor, or a stroke. Other causes may include toxins, chemicals, and viruses.". Most of the time, genetic dementia is expected in the patients. To be more exact, there are few mutations in the genes that result in the patient having a neurodegenerative disease. According to Bertram and Tanzi, there are "mutations in the β-amyloid (Aβ) precursor protein, causing Alzheimer disease (AD); in α-synuclein, causing Parkinson disease (PD); or in microtubule-associated protein tau, causing frontotemporal dementia (FTD) with parkinsonism". Mutations in these genes often result in aggregation of toxic proteins, misfolding, mislocalization, degradation of vital proteins, and oxidative stress due to mitochondrial dysfunction. Most of these aberrant mechanisms eventually result in cellular abnormalities that trigger apoptosis of more neurons in a cascade-like manner resulting in progressive neurodegeneration.

Briefly, almost all these disorders are genetic, either dominant or recessive gene mutations lead to the gain or loss of function of associated proteins resulting

What are the treatment processes?

Though neurodegenerative diseases cannot be cured, some symptoms may respond to treatment for some period of time. The stand "every patient is unique" is extremely crucial in these treatments; therefore a treatment plan that is specific to the patient is considered in cases. A typical neurodegenerative disease treatment plan may involve medications, physical and mental therapy and counseling. For example, treatment for mild to moderate Alzheimer's disease include drugs that help reduce or control some cognitive and behavioral symptoms. Galantamine, rivastigmine and donepezil are cholinesterase inhibitors prescribed for mild to moderate Alzheimer's symptoms.

Diagnosis of a neurodegenerative disease:

Diagnosis of these types of diseases are held extremely critical as Agrawal and Biswas also states. They state in their research that "Molecular diagnostics provide a powerful method to detect and diagnose various neurological diseases such as Alzheimer's and Parkinson's disease. The confirmation of such diagnosis allows early detection and subsequent medical counseling that help specific patients to undergo clinically important drug trials.

This provides a medical pathway to have better insight of neurogenesis and eventual cure of the neurodegenerative diseases." Using imaging techniques such as PET (positron emission tomography), MRI (magnetic resonance imaging) and NMRS (nuclear magnetic resonance spectroscopy), biomarkers may be measured which sometimes gives out the information needed to diagnose.

What causes these diseases?

In addition to MRI scans and the observed decrease/increase in protein levels in the brain, there are beneficial tests made by specialists in order to test the symptoms of a neurodegenerative disease. To begin with, Geriatric Depression Scale tests out the emotional symptoms of the patient. In this test, the patient is asked about their feelings related to everyday situations. This test is used in order to find out if the patient is mentally stable or not, resulting in the diagnosis of a possible depression. Moreover, CLOX, an executive clock drawing task, is also used in the diagnosis of a neurodegenerative disease. In this test, the patient is asked to draw a clock with certain elements and then observed by the way they draw this clock. Some patients with a neurodegenerative disease tend to draw smaller clocks, forget to include numbers or confuse the lines' lengths. Furthermore, MMSE (Mini- Mental State Examination) is a widely used test of cognitive function among the elderly; including tests of orientation, attention, memory, language and visual-spatial skills. Simple questions such as "What is the year, where are we now?" and orders such as "count backward from 100 by sevens, copy this shape" are given in order to test the patient.

Moreover, neurotransmitters also play a role in diagnosis of several neurodegenerative diseases. For example, two neurotransmitters seem to play a role in Alzheimer's Disease: acetylcholine and glutamate. Acetylcholine (ACh) activates muscles and helps with arousal, short-term memory, and learning. Individuals with AD have low levels of ACh.

Duru Yavuz / 9

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Sustainable Industrial Complex of the 21st Century

Perhaps the greatest obstacle standing between the human race and a sustainable future is the innumerable manufacturing facilities spread across the globe. According to a UN report in 2010 largest 3000 companies have caused environmental damage of 2.2 trillion dollars. However, the damage isn't just limited to economic loss. US factories emit 1.2 trillion gallons of untreated sewage and industrial waste into water every year, discharge 3 million tons of toxic chemicals, and consume nearly 16 billion gallons of water per day. It is estimated that every year 12.6 million people die due to industrial pollution, 10 million deaths are caused by air pollution alone. Trying to calculate the total damage caused by warped industrialization since the industrial revolution in the 19th century would be almost impossible. Yet, things are changing. Manufacturers all across the planet are nowadays trying to make their facilities as sustainable and clean as possible

Just like in every other revolution, in the new sustainable industry some radical decisions must be made for the sake of the planet and humanity. Sustainable manufacturing is the production of materials through eco-friendly ways and minimalize or completely cancel the pollution impact it has on the environment. The large manufacturing companies needs to take into account several factors such as designing the factory using carbon free architecture and plant their facility in a way that it can't damage the already existing natural habitat and water resources, carefully picking the right fully renewable energy sources to power up the plant and even find the least carbon-free ways to deliver the product with eco-friendly logistic chains and finally it should be certified that it is sustainable by authorities to confirm it. However all of means extra expense for the

manufacturer and cuts its profit, adding the pressure from shareholders, most companies diverge from the idea of creating a brand new sustainable industry. Yet the tide is slowly turning and the trend of sustainable factories is taking over.

In recent years some big hitters came up with great ideas to reshape the global industry with their green ways. The latest Tesla factory in Berlin was built upon a completely artificial 3km2 forest which was later cut down. The entire facility has net zero energy which means it has zero energy consumption and carbon emission, the main goal by designing the facility this way is to completely cut off the pollution and the entire factory is fueled by completely renewable energy sources, making it the single largest sustainable manufacturing plant on the planet and a milestone for a sustainable industry. Another corparate giant, Apple is completely carbon neutral since 2020 and by 2030 they are planning to go fully carbon-free by using recycled materials and renewable energy in manufacturing. Other companies like Amazon and Microsoft are also following their footsteps and organizing to become less and less pollutive by increasing their sustainable operations

Global environmental goals by 2050 are to have zero greenhouse gas emissions and use 100% renewable energy in all areas, considering around 30% percent of greenhouse gases is factory related and 70% of total industrial waste is dumped into water. Having a cleaner planet solely depends on transforming the global manufacturing industry into a more sustainable one, humanity surely does still have a long way from cleansing the planet from industry-related pollution and the harm it spreads. However, the collective will of humanity is capable of overcoming any obstacle.

Mehmet Fuat Karaosmanoğlu / 9

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Does Interleukin-6 have a common role in the pathogenesis of the cognitive symptoms in Covid-19 and autism?

I. ABSTRACT

Several studies have shown that central nervous system inflammation may contribute to autism spectrum disorder (ASD) and IL-6 is one of the known factors. Most recent cases of Covid-19-related neurological symptoms during the current pandemic are also linked to cytokines, especially IL-6. Improving the knowledge in the field of cytokines and brain disorders is important to facilitate effective early response and treatments. By performing a literature search in the PubMed database, I investigated the question if IL-6 affects the brain areas associated with autism and Covid-19-related brain conditions similarly. A correlation could suggest that the Covid-19 may be associated with development of neurodevelopmental disorders.

II. THE ROLE OF INTERLEUKIN-6 IN SPECIFIC BRAIN AREAS

Several factors may cause neuroinflammation of the brain, which increases the proinflammatory cytokines, including Interleukin (IL)-6. For example, recent studies show that neuroimmune factors play a significant role in the effect of alcohol on the central nervous system (CNS). Cerebellum shows high sensitivity to alcohol, and it is the brain region that expresses the highest level of IL-6 mRNA in the CNS. Alcohol targets both cerebellar neurons and glial cells. The effects of alcohol on synaptic pathways can be influenced by IL-6 generation produced by alcohol. Those pathways' mediated behaviors are likely to be altered. Neuroadaptive changes were found in the expression of synaptic related proteins (the proteins examined included neuronal and glial proteins associated with inhibitory synaptic transmission) in the cerebellum because of chronically expressing elevated levels of IL-6, a state that happens with excessive alcohol consumption.

The findings revealed that IL-6 causes neuroadaptive changes in the cerebellum and that these changes interact with the effects of chronic intermittent alcohol exposure. Proteins involved in inhibitory GABAergic synaptic transmission were found to be major targets of both IL-6 and alcohol in the cerebellum of non-transgenic and IL-6 transgenic mice. These results indicate that IL-6 affect cerebellum, which is a major brain area involved in autism. One of the neurological symptoms that COVID-19 patients present is cerebellar ataxia, indicating that the cerebellum could also be a vulnerable region to Covid-19.

III. INTERLEUKIN-6 AND AUTISM

Maternal immune activation (MIA) happens when mother's maternal immune system is triggered by infectious stimuli. A cascade of cytokines and immunologic changes occur, and this is transmitted to the fetus, resulting in

Y. A. Author is with Koc High School, Istanbul, Turkey functional deficits in the brain. MIA from infections has been shown to increase risk for autism through IL-6 increase. Individuals with autism have higher IL-6 levels in their blood. it has been suggested that microglia and astrocyte stimulation could lead to an IL-6 elevation in the brain.

IV. INTERLEUKIN-6 AS A MEDIATOR OF NEUROPSYCHIATRIC SYMPTOMS OF COVID-19

An increased secretion of pro-inflammatory cytokines and chemokines such as IL-6 are also found in the blood of COVID-19 patients. The neural pathway of coronavirus through the olfactory nerve may lead to a neuroimmune response in the brain, leading to neuroinflammation. This is also seen in autism patients, through different activation pathways. Autism is known to be associated with not only social deficits but also anxiety, and cognitive deficits. Therefore, during the pandemic not only social isolation is disadvantage for individuals with autism but also the direct effects of the virus could be a higher risk to induce severe neuroinflammation. For that reason, we could suggest that individuals with autism could be at higher risk of developing a cytokine storm due to the already increased levels of the implied cytokines.

II. CONCLUSION

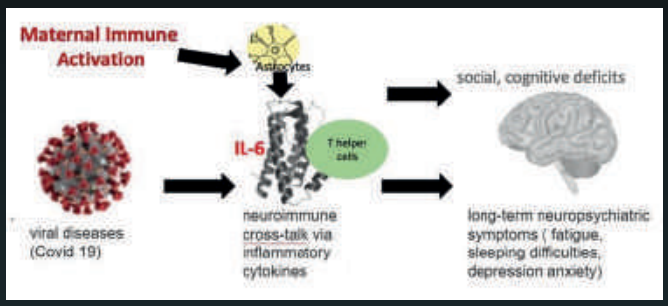

Figure 1. Possible common mechanisms for IL-6 in cognitive symptoms.

ACKNOWLEDGMENT

I thank Dr. Ozlem Gunal for the remote research opportunity.

Yağmur Argac / 11

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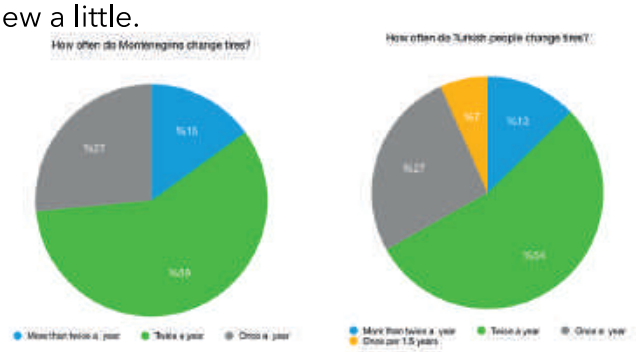
Alphan Alpaydın / II

YOUNG REPORTERS OF THE ENVIRONMENT

As the representatives of Turkey, me and my teammates joined an international environment contest called "Young Reporters of the Environment". Here, we collaborated with another team from a high school at Montenegro and tried to find a common environmental problem that impacted both Turkey and Montenegro. After long researches, we decided to focus on the problem of burning old tires.

A massive fire erupted at Jahra tire dumpsite in Kuwait in April 2012

Even though this first seemed like a problem that was irrelevant, after researching we saw that indeed, it was very common to burn tires in Turkey and sadly it had huge impacts on the environment. We did surveys on the streets about how well people knew about this tire problem and saw that people knew little about this issue. Similarly, when comparing Montenegro's surveys with ours, Montenegrin knew a little.



Thus, we wrote a news report with Montenegro about this problem to raise awareness and suggest solutions to prevent further damage to our environment. We applied to the contest with this idea and waiting for the results to be announced. You can read the full version of our essay by clicking the following link or by using the QR code.

https://www.flipsnack.com/7D88DC5569B/tire-fire-a-big-threat.html

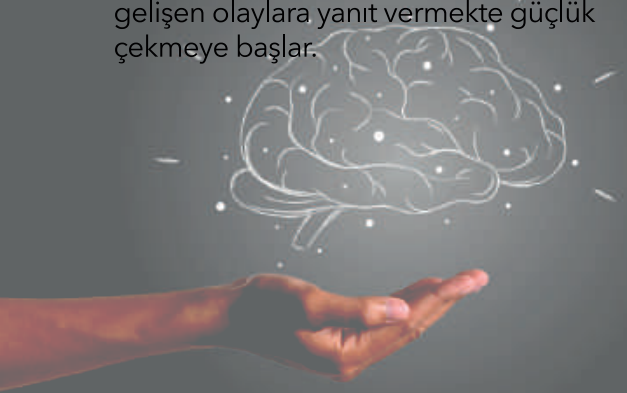
Zeynep Işık / 11

ALZHEİMER HASTALIĞI

Nörodejeneratif bir hastalık olan Alzheimer, merkezi sinir sistemi hücrelerinin çalışmayı durdurduğu veya öldüğü bir hastalıktır. Nörodejeneratif bozukluklar genellikle zamanla kötüleşir ve kesin bir tedavisi yoktur. Genetik olabilirler veya bir tümör veya felçten kaynaklanabilirler. Nörodejeneratif bozukluklar, çok miktarda alkol içen veya belirli virüslere veya toksinlere maruz kalan kişilerde de görülür. Bu bozuklukların birden fazla örneği vardır: Huntington hastalığı, Alzheimer hastalığı, Parkinson hastalığı, ataksi, motor nöron hastalığı, çoklu sistem atrofisi, ilerleyici supranükleer felç vb.

https://www.google.com/search?q=alzhei%CC%87mer&source=lnms&tbm=isch&sa=X&ved=2ahUKEwimoaDs2Nf3AhVFSPEDHQ6cCAsQ_AUoAXoECAIQAw&biw=1476&bih=887&dpr=1.5#imgrc=n7TerEwjK0

Düşünce, hafıza ve davranış fonksiyonlarında azalmaya neden olan bu hastalıkta belirtiler yaşla birlikte yavaş yavaş ortaya çıkar. Hastalığın ileri seviyelere ulaşması yıllar sürebilir. İlerleyici bir hastalık olması nedeniyle Alzheimer'da erken belirtiler genellikle son yaşanan olayların unutulması şeklinde görülürken birkaç yıl içerisinde bireyler günlük aktivitelerini tek başlarına gerçekleştirmekte zorlanacak hale gelebilirler. Sosyal aktiviteler, davranışlar ve mantıklı düşünme yeteneği de zamanla olumsuz etkilenir. İleri evre Alzheimer hastaları çoğunlukla bir kişiyle karşılıklı olarak sohbet edebilme yeteneğini kaybeder, kendilerine yöneltilen sorulara ve çevrelerinde gelişen olaylara yanıt vermekte güçlük çekmeye başlar.



Alzheimer'ın 3 temel aşaması vardır,

1. Biri erken dönem olarak bilinir.
Alzheimer'ın erken evresinde, bir kişi bağımsız olarak işlerini görebilir, kullanabilir, çalışabilir ve sosyal aktivitelere rahatlıkla katılabilir. Buna rağmen, kişi tanıdık kelimeleri veya günlük nesnelerin yerini unutmak gibi hafıza kayıpları yaşıyormuş gibi hissedebilir.

2. Evre orta evredir.
Orta evre Alzheimer tipik olarak en uzun evredir ve uzun yıllar sürebilir. Hastalık ilerledikçe, Alzheimer'lı kişi daha fazla bakıma ihtiyaç duyacaktır.

3. Son aşama geç alzheimer durumudur.
Hastalığın son aşamasında ise demans (bunama) belirtileri şiddetlidir. Bireyler çevrelerine yanıt verme, konuşmayı sürdürme ve nihayetinde hareketi kontrol etme yeteneklerini kaybederler.

Hastanın MR sonuçları, beynin Alzheimer nedeniyle hasar gördüğünü ve küçüldüğünü açıkça gösterir. Alzheimer hastalığında, beyindeki nöronlar yaralanıp ölürken, nöron ağları arasındaki bağlantılar bozulabilir ve birçok beyin bölgesi küçülmeye başlar. Alzheimer'ın son aşamalarında, bu süreç (beyin atrofisi olarak adlandırılır) yaygındır ve önemli ölçüde beyin hacmi kaybına neden olur. Mikrotübülle ilişkili protein olan Tau, Alzheimer hastalığında ve ilgili tauopatilerde nörofibriler yumaklar olarak biriken çözünmeyen filamentler oluşturur.

ALTERNATİF TEDAVİ

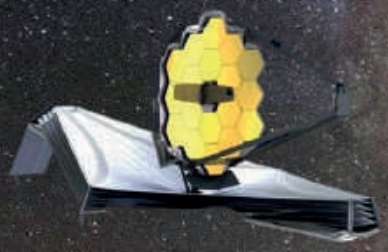
Şaperon tedavisi, protein yanlış katlanma hastalıklarına yönelik yeni geliştirilmiş bir moleküler terapötik yaklaşımdır. Şaperonlar, proteinlerin doğru şekli almasına ve sabit kalmasına yardımcı olarak işlevsel hale gelmesine yardımcı olan küçük moleküllerdir. Şaperon tedavisi ile, alfa-galaktosidaz A'nın bazı hatalı formları düzeltilebilir ve fazla Gb3'ün parçalanabilmesi için lizozomlara iletilebilir. Hsp70, Hsp27, aB-kristalin ve DJ-1 gibi şaperonlar, kimyasal olarak katlanmamış polipeptitleri bağlayabilir ve zararlı kümelenmeyi önleyebilir.

Uygar Karakuş / LP-A

Are We Alone?

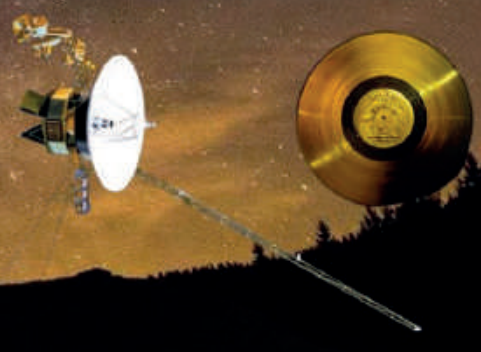
Life Beyond Earth

Are we alone? In this infinite and ever-expanding universe is there anyone besides us? For thousands of years, in all different eras, people have asked this question. Ancient astronaut proponents believe some of them got the answer, ancient astronaut petroglyphs from Val Camonica, Italy. They claim that these pictures match modern astronauts, and believe they affected ancient civilizations. Also, these petroglyphs and many others like these are cited as evidence of extraterrestrial life.



To answer question this question we the humanity made telesopes and we sent it to space to get a better and clear look. One example for this is the James Webb Space Telescope which is far more better than the Hubble Telescope. The James Webb Telescope uses infrared radiation in order to ensure astronomers scientific advantages such as infrared radiation telescope is dust transparent, so the James Webb Telescope is able to see stars covered with dust while optic telescopes can't

Trying to communicate with the aliens that we are definitely not sure if exists was thought as well. As we know the Voyager. The Voyager is a space probe launched for it to discover outer space. The Voyager's interstellar mission is believed that it would continue until 2025, when its RTGs (radioisotope thermoelectric generators) no longer will supply enough electric power to the scientific instruments. Every Voyager carries a audio-visual disk, the Golden Record. The Golden Record has a lot of information about humanity which is both scary for us and the the possible who can possibly find the disc.



İdil Sena Keskin• Grade 11 • Water Pollution

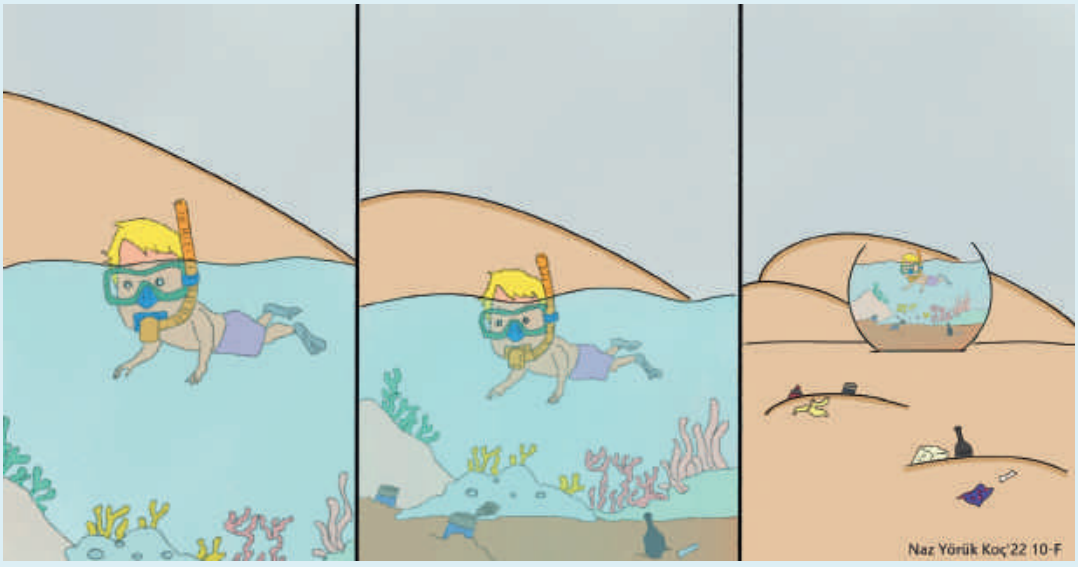
"Dünyada yaklaşık 700 milyon insan 43 farklı ülkede su kıtlığı çekiyor. 2,7 milyar insan ise yıl içerisinde en az 1 ay su kıtlığı yaşayan havzalarda yaşamını sürdürüyor."

Sarp Gürel, Koç'22, 10

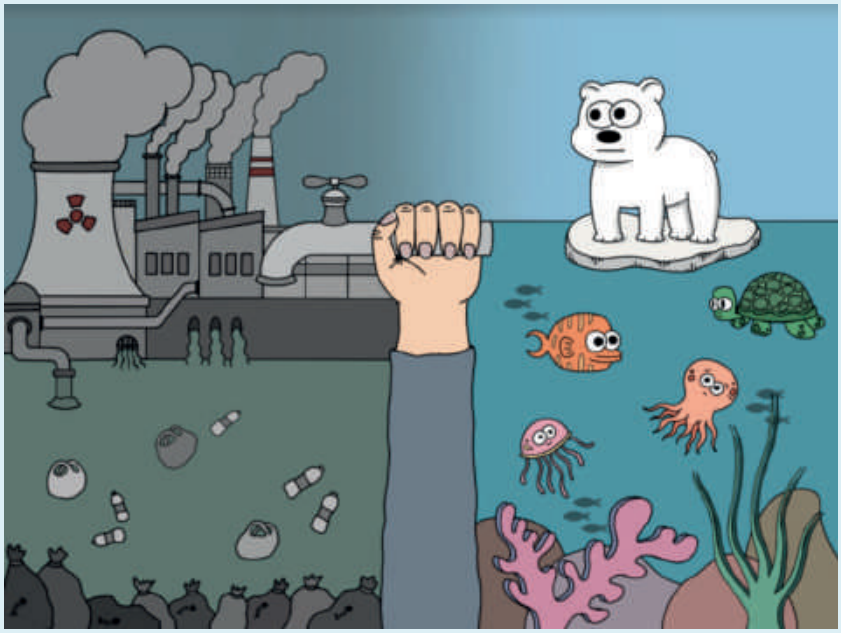
"Artan nüfusu, gelişen ekonomisi ve büyüyen kentleriyle Türkiye, "su fakiri" olma yolunda ilerlemektedir."

Sarp Gürel, Koç'22, 10

22 MART "DÜNYA SU GÜNÜ" KARİKATÜR SERGİSİ



Naz Yörük Koç'22 10



"Her yıl sudan kaynaklanan nedenlerden dolayı 3.5 milyon insan hayatını kaybetmekte"

Deniz Pala Koç'22 10

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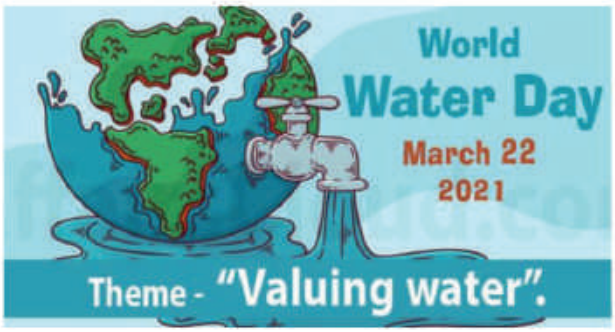
United Nations



The importance of water

World Water Day, held on 22 March every year since 1993, focuses on the importance of freshwater.

World Water Day celebrates water and raises awareness of the 2.2 billion people living without access to safe water. It is about taking action to tackle the global water crisis. A core focus of World Water Day is to support the achievement of Sustainable Development Goal 6: water and sanitation for all by 2030.

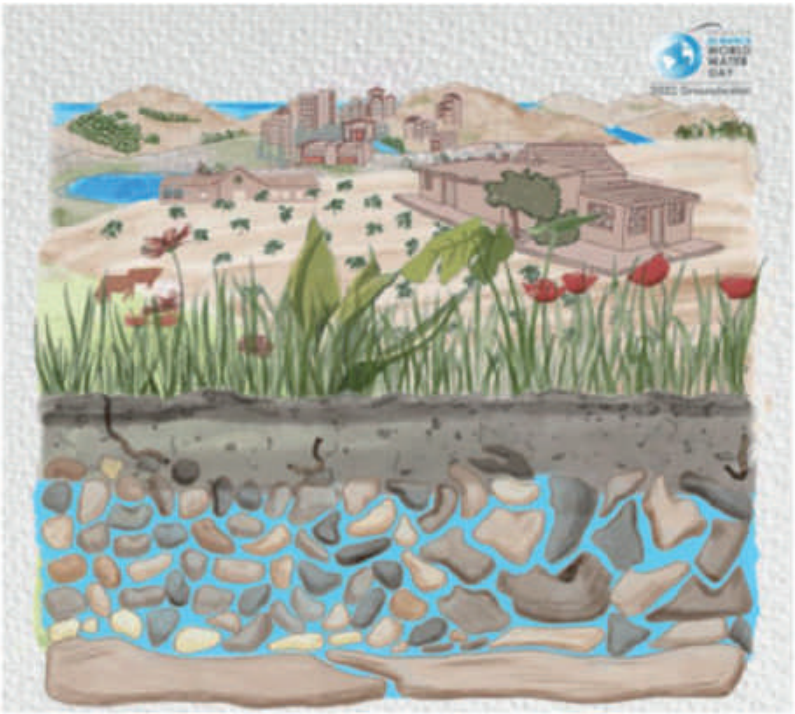
Caption: Women draw water from a well in Nepal.
PHOTO: WikimediaImages/Pixabay

History of the Day

The idea for this international day goes back to 1992, the year in which the United Nations Conference on Environment and Development in Rio de Janeiro took place. That same year, the United Nations General Assembly adopted a resolution by which 22 March of each year was declared World Day for Water, to be observed starting in 1993.

Later on, other celebrations and events were added. For instance, the International Year of Cooperation in the Water Sphere 2013, and the current International Decade for Action on Water for Sustainable Development, 2018-2028. These observances serve to reaffirm that water and sanitation measures are key to poverty reduction, economic growth, and environmental sustainability.

Groundwater, making the invisible visible



Groundwater is water found underground in aquifers, which are geological formations of rocks, sands and gravels that hold substantial quantities of water. Groundwater feeds springs, rivers, lakes and wetlands, and seeps into oceans. Groundwater is recharged mainly from rain and snowfall infiltrating the ground. Groundwater can be extracted to the surface by pumps and wells.

Life would not be possible without groundwater. Most arid areas of the world depend entirely on groundwater. Groundwater supplies a large proportion of the water we use for drinking, sanitation, food production and industrial processes

https://www.un.org/sites/un2.un.org/files/wwd2022-hidden-solution.gif

It is also critically important to the healthy functioning of ecosystems, such as wetlands and rivers. We must protect them from overexploitation – abstracting more water than is recharged by rain and snow - and the pollution that currently haunts them, since it can lead to the depletion of this resource, extra-costs of processing it, and sometimes even preventing its use.

Exploring, protecting and sustainably using groundwater will be central to surviving and adapting to climate change and meeting the needs of a growing population.

Did you know?

- Almost all of the liquid freshwater in the world is groundwater.
- About 40 per cent of all the water used for irrigation comes from aquifers.
- Asia and the Pacific region has the lowest per capita water availability in the world, with groundwater use in the region predicted to increase 30 per cent by 2050.
- In North America and Europe, nitrates and pesticides represent a big threat to groundwater quality: 20 per cent of European Union (EU) groundwater bodies exceeds EU standards on good water quality due to agricultural pollution.

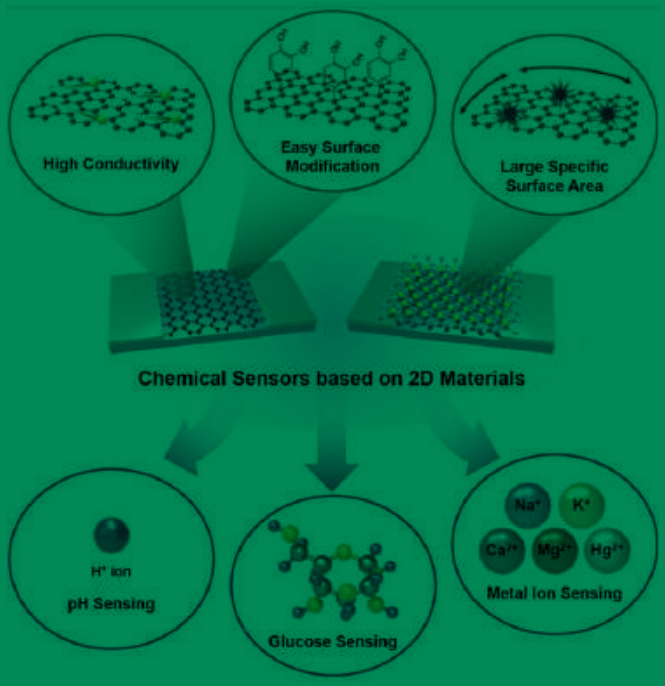
https://www.un.org/en/observances/water-day
https://www.un.org/en/observances
https://www.eea.europa.eu/highlights/world-water-day-attention-on
https://affairscloud.com/world-water-day-2021-22nd-march/

Süleyman Utku EROL / 9

Technological Revolution for Pharmaceutical Applications: Nanomaterial-Based Electrochemical Sensors

A chemical sensor identifies and measures chemical characteristics in a chemical substance and converts the chemical data into digital information. Therefore, chemical sensors play a very significant role in everyday life. Even though there are many different types of chemical sensors, the receptors and transducers are present in all chemical sensors. The receptor is the part that interacts with the analyte and the transducer is utilized to convert chemical signals into measurable data.

Electrochemical sensors, which have a conductor to generate electrical contact with a nonmetallic part of the circuit, are one form of chemical sensor. The conductor used is known as an electrode which is utilized as a transducer. Electrochemical systems monitor a variety of parameters in our lives by integrating distinctive features. Environmental monitoring, health and instrumentation sensors and sensors associated with machinery are just a few examples.



Advances in nanotechnology have improved sensor systems by enabling the production of smaller sensors with greater selectivity and sensitivity and reduced manufacturing costs. Since electrochemical sensors can lead to accuracy, reliability, sensitivity, and speed, they are effectively being utilized in the pharmaceutical field. In pharmaceuticals, detecting and identifying numerous analytes in sophisticated mixtures are significant. Therefore, electrochemical sensors with enhanced performance for fast, reliable, accurate, and cost-effective monitoring are in great demand. Chemical sensors embedded with nanomaterials are effective in all stages of the development process, including drug purity, manufactured drug chemical nature, and detection of the targeted drug.

Moreover, there are many pharmaceuticals experiments that include electrochemical sensors. For example, the antibacterial medication olaquindox was successfully identified via an electrochemical sensor in one

research. Graphene was utilized to increase the sensitivity and conductivity. Then, for effective distribution and adherence of graphene on the surface of the electrode, they added dopamine. As a result, the electrochemical sensor was successfully used to detect olaquindox in feed ingredients and fish specimens.

In other research, Bagheri has utilized an electrochemical sensor that identifies ephedrine, a powerful medicine used to treat breathing issues. The researchers started by creating a magnetic composite and the magnetic composite was produced on the carbon paste electrode surface. Then, they observed that an electrochemical sensor was successfully used to identify ephedrine in serum, urine, and pharmaceutical samples having great sensitivity.

By considering the research and experiments done in pharmaceuticals, the importance of electrochemical sensors is clear. In experimental and real-world studies such as drug delivery studies, metabolic investigations, drug excretion research, and drug identification, electrochemical sensors effectively meet the essential need for precise, sensitive, and cost-effective methods. The electrochemical sensors are an excellent opportunity for scientists to extend their discoveries in the pharmaceutical field.

Alp Baran Erkul / 11

USING NANOPARTICLES FOR DRUG DELIVERY

Ever since the introduction of nanotechnology by the American physicist and Nobel Prize Laureate Richard Feynman, nanotechnology has progressed significantly and made its way into many industries and fields including fashion, cosmetics, medicine, and engineering. Nanoparticles, which are particles that range between 1 to 100 nanometres in size are usually made up of a few hundred atoms.

Why Nanoparticles?

You might be wondering how something that is one-billionth of a meter is so important in medicine, aerospace engineering, cosmetics, and more. However, the small size gives rise to enormous potential. Owing to the large surface area to volume ratio of nanoparticles, chemical processes are significantly facilitated, as more atoms are chemically active at the surface of a nanoparticle. Other reasons, include their high mobility in a free state (no external or other additional influence), and their potential to exhibit quantum effects. In medicine, which will be the focus of this article, nanoparticles are developed for diagnostic purposes or delivery of therapeutic agents to specifically targeted sites in a controlled manner for treating chronic human diseases, atherosclerosis, and cancer. They can act as a bridge to overcome the problems often faced with the traditional drug intake methods such as vaccinations, oral intake, and finally non-specific intake methods such as chemotherapy.

Barriers of Drug Delivery Mechanisms that Could Be Tackled by Nanoparticles

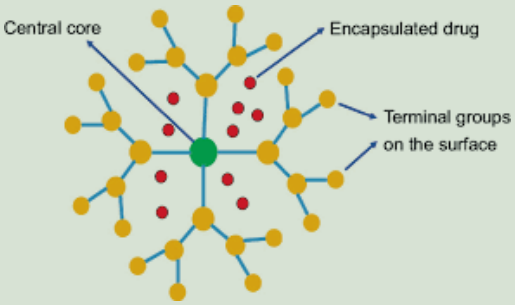
Many natural products are favorable due to their vast chemical diversity, chemical and biological properties however problems regarding their biocompatibility and toxicity levels may arise. Additionally, large-sized materials in the delivery of drugs are problematic; challenges include poor bioavailability, solubility, and absorption levels in the body, issues with target-specific delivery, and probable unwanted side effects of drugs. However, using nanoparticles for delivery could easily diminish these problems as they can alter a drug's solubility, drug release profiles, diffusivity, bioavailability, and immunogenicity by easily penetrating the tissue system and ensuring action at a targeted location through.

Most Used Nanoparticles in Medicine for Drug Delivery

Here is a list of the most notable nanoparticles for delivery purposes:

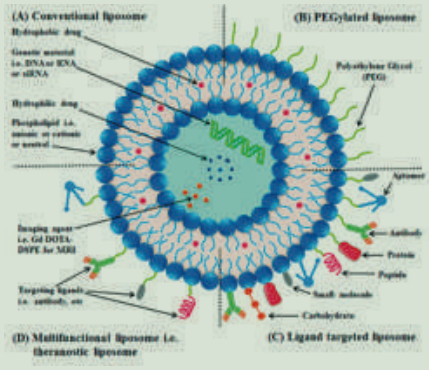
• Nanotubes –compounds that are devised into single or multi-walled structures composed of

self-assembled sheets of atoms arranged into tubes. Carbon nanotubes (CNTs) are substantial, cylindrical molecules that are formed by hexagonally set carbon atoms. Their wall consists of one or more layers of graphene. Their enormous SA:V ratio enables them to have a considerable loading capacity for chemotherapeutics.



Structure of dendrimers

• Dendrimers – Dendrimers are nanostructures that are branched, tridimensional polymers that resemble a sphere. They have a multifunctional core and dendrons that branch out from the core. Pharmacologically active molecules could be placed within the cavities of dendrimers or connected to the surface groups.



Structure of a liposome

• Liposomes – Liposomes are spherical organic nanostructures with the size ranging from 30nm to several micrometers. Liposomes, as the name suggests, are composed of one or more lipid bilayers located outside the aqueous units with polar heads facing the exterior and interior aqueous phases. Liposomes may carry both hydrophobic (water-fearing/hating) or hydrophilic (water-loving) substances, prevent the degradation of their contents and release them for a set purpose. Liposomes are already commonly used for the delivery of some drugs such as analgesics, anticancer and anti-fungal drugs.

Types of Delivery

Nanomaterials could deliver drugs through two major ways – passive and self-delivery. Passive delivery is when a small amount of a drug is encapsulated in the core of a structure, and is released when the structure reached the targeted site. Via the second way, drugs are directly placed on the carrier nanomaterial for facilitated delivery. In this method, timing plays a crucial part as if the drug does not meet with the target site quickly enough after dissociating from the carrier, the drugs' bioactivity and efficacy will decrease. Another important classification of delivery is active delivery and passive delivery regarding the targeting of drugs. In active delivery, antibodies and peptides play a role in the delivery system for anchoring to receptor sites. In passive targeting, factors such as pH, temperature, molecular site, and shape play an important role in initiating binding and determining affinity.

Alya Kaynak / 10

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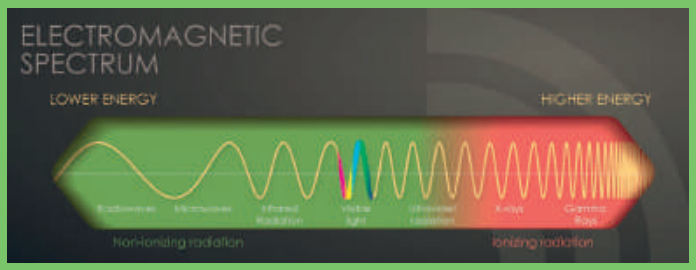
Is Cell Phone Radiation Dangerous?

You may have heard that cell phones emit harmful radiation that could increase the chance of cancer. But is this fact true? Are these gadgets harming us?

Before we answer this question, we need to take a closer look at radiation, and understand what it really is.



When we think of radiation, nuclear power plants, cancer, nuclear bombs, and mutations. Come into mind which genuinely are effects of radiation. Nevertheless, radiation is much more than that. What is radiation? Radiation is the transfer or spread of energy in the form of waves or particles. For instance, the light that helps us to see is a form of radiation or the heat emitted by the radiators is also a kind of radiation. We could say that wherever there is energy, there is radiation. We classify radiation in two main groups: Ionizing radiation and non-ionizing radiation. Non-ionizing radiation does not carry enough energy per quantum (photon energy) to ionize atoms or molecules such as: visible light, microwaves, and radio waves. This type of radiation is harmless if you are not directly exposed in intense levels. The type of radiation that we need to be concerned about is ionizing radiation because it has high energy levels, and this high energy could strip the bonds between atoms or deteriorate molecules such as our DNA. Ionizing radiation could be found both in wave and particle models. Alpha, Beta, Gamma, and X-rays are in the scope of ionizing radiation

Now we know a little more about radiation we can focus on our main question. Can cell phones harm us? To answer this question, we need to know which type of radiation cell phones emit. Cell phones emit radiation in the radiofrequency region of the electromagnetic spectrum. Second, third, and fourth-generation cell phones (2G, 3G, 4G) emit radiofrequency in the frequency range of 0.7–2.7 GHz. Fifth-generation (5G) cell phones are anticipated to use the frequency spectrum up to 80 GHz.

These frequencies all fall in the nonionizing range of the spectrum, which is low frequency and low energy. The energy is too low to damage DNA.

As stated by the National Cancer Institute, "there is currently no consistent evidence that non-ionizing radiation increases cancer risk in humans." The human body does absorb energy from devices that emit radiofrequency radiation. The only consistently recognized biological effect of radiofrequency radiation

absorption in humans that the general public might encounter is heating to the area of the body where a cell phone is held (for example the ear and head). Just like the microwaves that we use to heat our food. These waves vibrate the molecules and produce heat. However, that heating is not sufficient to measurably increase body temperature. There are no other clearly established dangerous health effects on the human body from radiofrequency radiation.

So why are we concerned about it? We have tens of thousands of studies that prove that cell phones are safe. There are two primary reasons why individuals are concerned that portable phones might have the potential to cause certain sorts of cancer or other wellbeing issues: The first is the misconception about radiation and electromagnetic waves. And the second reason is that some research made by organizations such as WHO (World Health Organization) states that there "could be a risk" of cancer when the user is exposed to radiation in excessive amounts.

Cell phone radiation is not associated with an increased risk of cancer formation but still, one cannot conclude that cell phones are harmless. More research must be done since cell phone technology is new and developing pretty fast, to get a precise answer.

Aral Efe Mermer / 9

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Water Scarcity and Pollution in the 21st Century

All biochemical reactions take place in the medium of water. All life as we know it today can, hence, only exist in the presence of liquid water. The stability of Earth's climate depends on ocean currents, rivers, and polar ice, as 71% of the planet's surface is covered with water. Water is the precursor of all life and the foundation of our Earth.

That is why the 6th goal of United Nations Sustainable Development, Clean Water and Sanitation, aims to preserve water reserves and increase the accessibility of water. According to a United Nations estimation, more than 446,000 children lose their lives every year because of diseases related to water contamination. However, numerous international organizations are actively working on this issue and considerable progress is achieved in increasing the accessibility of clean water.

Nevertheless, the issue is far from resolved, as the threat of water scarcity is becoming more imminent each day. A region is considered water-distressed when it withdraws 25% or more of its renewable freshwater resources. Currently, approximately 2.2 billion people lack access to clean water, while 884 million cannot find drinking water. As climate change worsens –with increasing greenhouse gas emissions–, the situation will only deteriorate further. If action is not taken, refugees, who flee their country in search of water, and global conflicts over ownership of water sources will leave a mark in the 21st century. But, if 71% of the planet's surface is covered with water, why is water scarcity a problem?

Even though the majority of Earth's surface is covered by water, the percentage is by surface area. In terms of volume, less than 1.4×10^(-7)% of Earth's volume is held by water. In addition, 97% of that water is in oceans and, thus, cannot be used for consumption or agriculture, due to high levels of salt. The remaining 3% are the only freshwater reserves of Earth and 2.5% of those reserves are inaccessible to humans, as they are either in the form of polar ice or inaccessible groundwater. The remaining 0.5% of clean, drinkable water is all humanity has and will ever have.

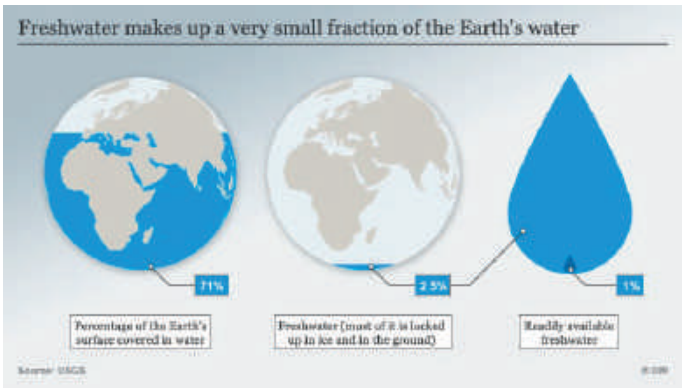

Figure 1: An illustration of Earth's water reserves

The risk posed by water scarcity does not only threaten humanity's access to water, but rather the entirety of humanity's activities upon Earth. This is considering the fact, that 72% of all water withdrawals are used by agriculture, 16% by municipalities for households and services, and 12% by industries. Henceforth, food safety, all industrial production, and access to electricity are all directly affected by water shortages.

Sadly, the accessible freshwater reserves of Earth are getting more and more polluted by the day. Research shows that 13% of freshwater located in the Arctic Sea ice is lost every decade, considering that the resulting freshwater is mixed in with the ocean's salty waters. This not only decreases the availability of fresh water on Earth but also worsens the climate crisis. The resulting decrease in ocean water saltiness alters major ocean currents like the Gulf Stream –an ocean current originating from the Caribbeans that balances the temperature of the European Continent; hence, allowing for efficient agriculture to take place. This in turn decreases temperatures, reduces precipitation (rainfall/snow), and creates more water-related natural disasters.

Moreover, there are types of water pollution directly caused by human activity. Water pollution from nitrogenous and phosphorus-based compounds, as well as industrial waste that is often toxic, destroys ecosystems and reduces the availability of

clean water. The agriculture industry has the highest water consumption out of all industries and is also responsible for water degradation.

Extreme use of underground reserves increases the saltiness of the water, which is damaging both agricultural crop yield and the ecosystem. The widespread use of artificial manure and pesticides/herbicides not only pollutes water but also damages marine life. The nitrogenous and phosphorus-based compounds within such waste promote the growth of certain microorganisms that consume the dissolved oxygen in the water, which is damaging to fish and other marine creatures. Additionally, nitrogenous compounds in industrial waste can also lead to mucilage, which covers and suffocates immobile shelled creatures and reefs. A similar case is being observed in the Sea of Marmara.

Perhaps most crucially, the United Nations predicts that more than 80% of the world's wastewater flows back into the environment –without filtration, reuse, or treatment. In less economically developed countries, this figure is higher than 95%. With this rate, access to clean water will significantly be reduced in the following decades. However, there are various solutions that can end the water crisis.

One of these solutions is recycling water, which has the potential to slow down the water crisis. Water recycling works by reclaiming water from a variety of sources, before treating and reusing it. The treated water can be used in agricultural irrigation and industrial production. It can also be utilized to replenish groundwater supplies or degraded water sources like rivers/lakes. Water recycling enhances water security, by offering a sustainable method of reusing water. Whereas recycling water is often costly and is not sufficient to eliminate water scarcity. Even though developments in technology and science may allow recycling to be more efficient, the process must be accompanied by drastic changes in how we treat water as a society.

Major movements, like the 25-liter challenge (where people are challenged to spend a day with only 25 liters of water), have previously demonstrated that we are not aware of the colossal amount of water we consume per day. Public awareness campaigns and water education are vital tools that can create a more water-responsible society. Until then, the issue will persist and worsen by the day.

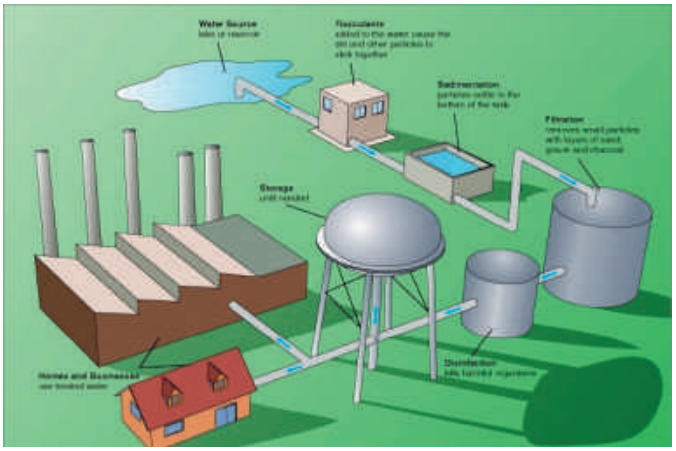

Figure 2: An illustration of a water recycling plant

Overall, according to the UN today, 2.3 billion people live in water-stressed countries, of which 733 million live in high and critically water-stressed countries. 1.42 billion people, including 450 million children, live in areas of high or extremely high-water vulnerability. According to FAO, 3.2 billion people live in agricultural areas with high to very high-water shortages or scarcity, of whom 1.2 billion people – roughly one-sixth of the world's population – live in severely water-constrained agricultural areas. It is also estimated that as many as 700 million people may be forced to migrate by 2030 because of water supply risks. These people are already called "water refugees". UNICEF defines the situation as "a water crisis", as children's lives and futures are at risk. Thus, we are nearing the end of modern society. Unless actions to preserve water, and reserves are taken, soon that end will come.

Arda Deniz Altınok / 10

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Duyguların Kimyası

Duygular, doğduğumuz andan varlığımızın son bulduğu ana kadar tüm yaşamımız boyunca bize eşlik eden ruhumuzun en özel yanı. Duygular yaşama keder, aşk, öfke, mutluluk veya acı olarak sirayet ederler. Aslında bütün bu duygular beyinde bulunan 'limbik beyin' adı verilen, hipotalamus ve küçük sinirsel bölgelerden oluşan bölümün ürettiği kimyasal bileşenlerin bizlere yansımasıdır. Böyle söyleyince kulağa pek de şiirsel gelmiyor değil mi? Hatta bu bileşenlerin isimleri pek de romantik sayılmaz; en temel halleriyle bu bileşenler dopamin ($C_8H_{11}NO_2$), serotonin ($C_{10}H_{12}N_2O$), noradrenalin ($C_8H_{11}NO_3$), asetilkolin ($C_7NH_{16}O_2+$), histamin ($C_5H_9N_3$), GABA ($C_4H_9NO_2$) ve glutamik asit ($C_5H_9NO_4$) şeklinde sıralanabilir. Kerem'i Aslı'ya; Mecnun'u Leyla'ya; Romeo'yu Juliet'e bağlayan o mükemmel duygu, aşk...

Adına destanlar yazılan aşk ne yüce duygu. Ruhların bağlanması olarak nitelendirilen bu eşsiz duygunun aslında sadece ve sadece beynimizin oksitosin ve vazopressin hormonlarının fazla salgılamasından kaynaklı olması ufak da olsa bir hayal kırıklığı yaratmıyor değil insanda… Ya da bir duygunun insan bedeninde de bir acı olarak hissedilebileceğinin en net kanıtı olan o duygu, keder… Bir yumru, bir düğüm ya da ağır bir yük gibi göğsümüzün üstünde, kalbimizin en derinlerinde hissettiğimiz o tarifsiz acının sadece stres hormonu olarak da adlandırılan kortizol hormonunun fazla üretilmesinden kaynaklı olduğunu öğrendiğimizde ve buna karşılık o kusursuz beynimizin endorfin hormonu üretmesini sağladığımız anda tüm bu kedere son verebileceğimizi biliyor olmak insanın garibine gitmiyor değil. Ya da mutluluk veren ve ağrıları azaltan endorfin hormonunun aşırı üretimi sonucunda mutluluktan çok öfke duygusunun açığa çıkması da bir o kadar ironik, gerçekten her şeyin fazlası zarardır belki de. İşte kimya bir kez daha bize bir kapı aralıyor.

O bitmez sandığımız aşk acısını, içerisinde yüksek miktarda dopamin bulunduran badem yiyerek bitirebilmek; en büyük kederlerimizi vanilya çekirdekleri ile atlatabilmek oldukça tuhaf aslına bakılırsa. Duygular böyle bakıldığında oldukça sıradan ve basit gelse de, bizlere yaptıkları etkilere bakıldığında ne kadar mucizevi ve komplike oldukları aşikar. Bizlerin tarif edemediği duygular aslında basit birer hormon fazlalığı veya eksikliğinden ibaret. Vücut ne kadar da ilginç bir yapı, değil mi?

Ayşe Lal Dokumacı / 9

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These Microorganisms Eat Plastics!

Plastic wastes, which take thousands and thousands of years to recycle, or dispose, have been a huge problem recently. This causes many environmental problems such as but not limited to water, air, and earth pollution. The excess amount of plastic waste caused by unconscious consumption and difficulties in the recycling process makes the problem even worse. The increasing amount of plastic waste in the last 70 years is a crucial indicator of inevitable consequences. As it is shown in the graph, the prediction for the next 30 years draws a disaster scenario.

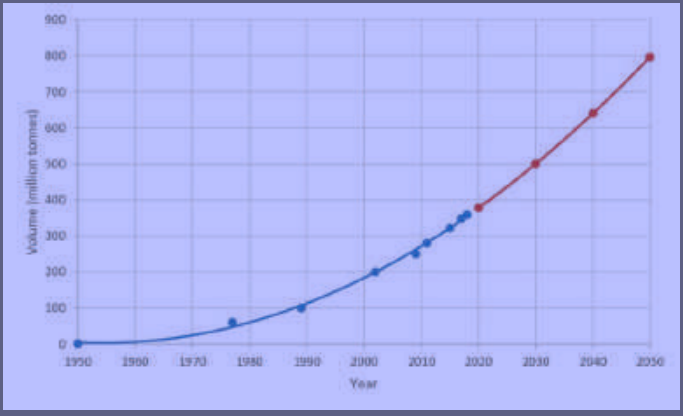


Figure 1: Global production volume of plastics. Blue line, production 1950 to 2018; orange line, forecast production 2020 to 2050. Data; 1950 to 2016 (Plastics Europe 2016); 2017-2018 (Plastics Europe (2019). Forecast 2020 to 2050, this study.

The common recycling process is not enough to reduce the amount of plastic waste. There are two important points why this is not possible. First, every plastic has a different melting point that requires a differentiation trend, which leads them to be differentiated before the recycling process. Since classifying requires a lot of time and a conscious approach, it makes the process difficult.

Moreover, the plastic wastes should be removed from the food residues, which makes the process again difficult and expensive.

Figure 2: Plastic pollution

Can microorganisms be the solution to this huge problem?

In 2016, Japanese scientists discovered an extraordinary microorganism, which is called "Ideonella sakaiensis" bacteria. These small creatures have the ability to digest polyethylene terephthalate (PET) which is usually used in plastic bottles and packaging. According to their findings, these bacteria can decompose PET into monomers but not enough fast to consume millions of tons of plastic bottles. This research was a breakthrough and a strike point for other research in the next years.

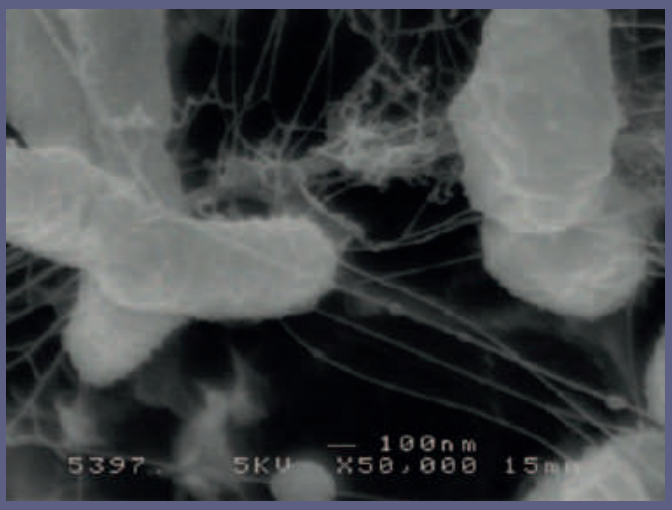
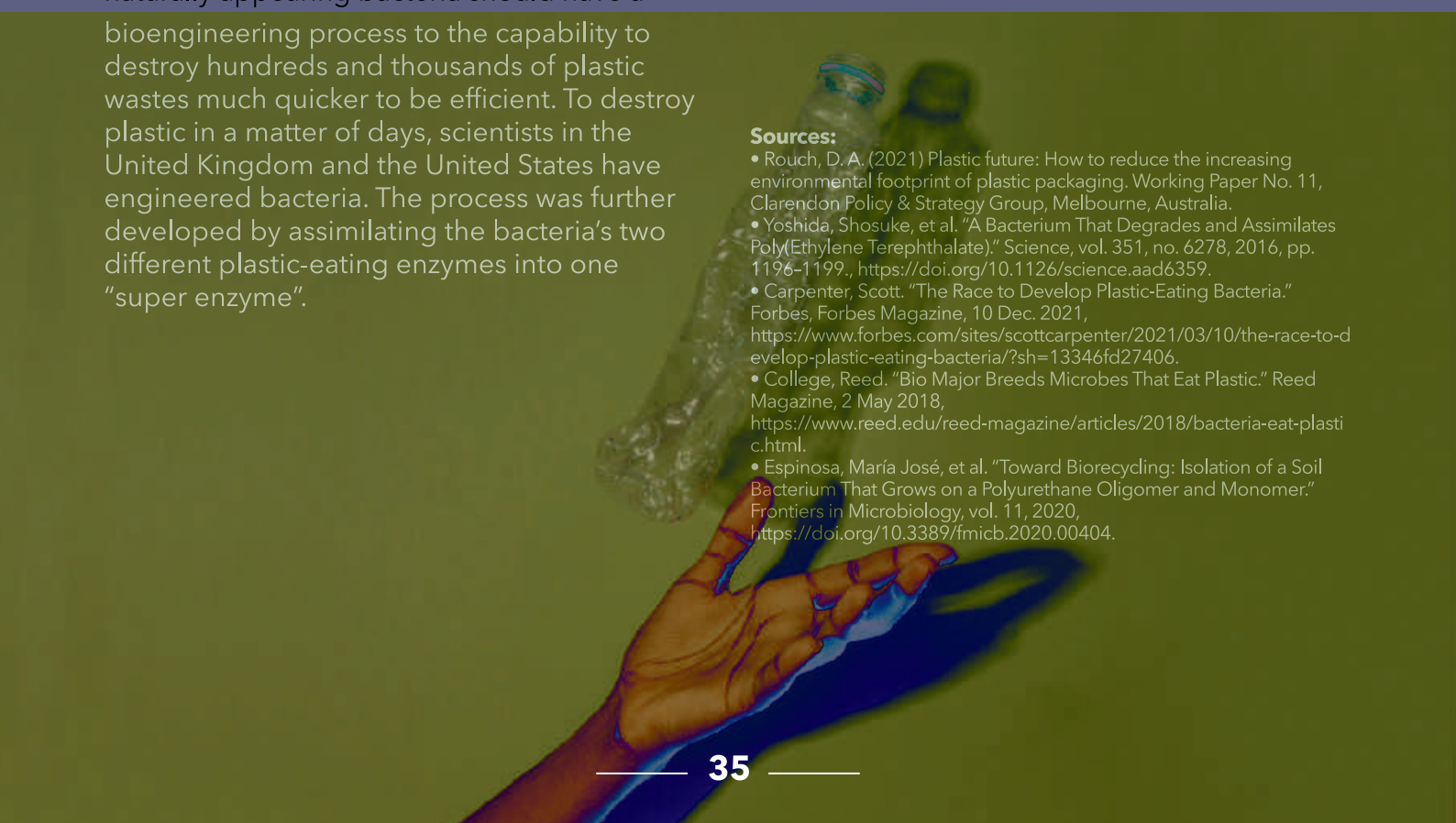


Figure 3: The SEM picture of "Ideonella sakaiensis" in the PET medium.

Scientists announced that a fungus was also able to reduce the amount of plastic waste in Islamabad, Pakistan a year after discovering "Ideonella sakaiensis" in Osaka. The plastic-eating bacteria was discovered in the samples taken from an oil site near her home in Houston, Texas, in 2017 by a biology student at Reed College in Oregon. After a frail plastic waste was collected from a site near Leipzig, Scientists from German reported the bacteria strains were appropriate for breaking up polyurethane plastic in March 2020. All these naturally appearing bacteria should have a bioengineering process to the capability to destroy hundreds and thousands of plastic wastes much quicker to be efficient. To destroy plastic in a matter of days, scientists in the United Kingdom and the United States have engineered bacteria. The process was further developed by assimilating the bacteria's two different plastic-eating enzymes into one "super enzyme".

The first big financial appliance is still years away but within sight. A demonstration plant may be launched in the following months by a French firm, Carbios, which will be able to enzymatically biodegrade PET plastic. The development in this area is great news but unfortunately, they are not yet useful enough to decrease the amount of plastic waste. That's why decreasing plastic production, using natural materials in packaging, and encouraging recyclable products have still crucial importance to protecting the environment and resources.

Ece Nur Bayraktar / 9



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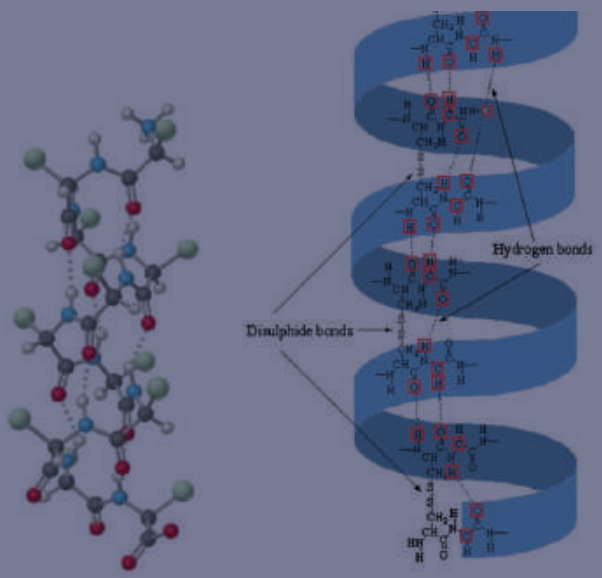
The Chemistry Behind Hair Straightening

Hair straightening is a frequently encountered procedure among millions of people around the world, in which many intricate biological and chemical transformations take place.

Keratin is a protein located on the human skin's exterior, and various kinds of this protein contribute to the structure and development of body parts such as hair and nails by shielding them from fracture and offering strength. Moreover, other functions of keratin include the control of important cellular events like protein synthesis and cell growth. The concentration of keratin is correlated with the condition of the body parts. Animals also have keratin in their corresponding organs such as feathers, hooves, and wool. The keratin inside these is taken with the aim of treating and supplementing the body with it. Overall, 54 kinds of different keratin proteins were discovered in humans.

There are two kinds of keratin proteins are alpha and beta keratin which differ in structure. Alpha keratin contains a fibrous and helical structure found in skin, mammalian wool, and human hair. Beta keratin, on the other hand, is formed by parallel sheets and is commonly seen in organisms such as reptiles and birds.



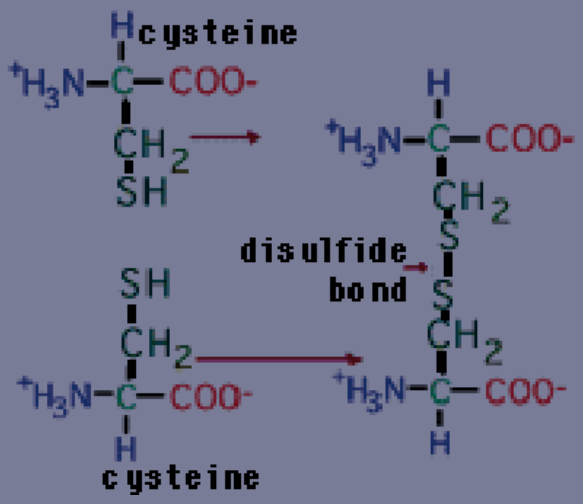
Stable Molecule – Free Radical molecular comparison
https://osumex.co.uk/strategic-health-markers/free-radicals/

Keratin is made up of the remnants of cysteine, an amino acid, later on making cystines with the help of disulfide bonds, which are created when the sulfur atoms from keratin chains neighboring each other interact.

As for the properties of keratin, it is insoluble in both acids, bases, and water. This is an advantage since keratin stays stable and

unchanged after encountering bodily chemicals. The reason for this steadiness is the cystines mentioned above. This steadiness is aimed to be overcome to obtain straight hair, and thus, disulfide bonds are sought to be broken.

A device used to straighten hair is a hair straightener or a flat iron. The logic behind these devices is simple: as they apply heat to the hair, the disulfide bonds shatter, causing the chains of keratin to wander and ultimately leading to straight hair. The hair remains in its desired straight state due to the disorganized placement of keratin molecules although, the disulfide bonds mend after the exposure to high heat is over. This is a reversible process, as the hair returns to its previous state when it encounters water and moisture.



If a more enduring treatment is desired, procedures with chemicals can be used. Chemically, basic solutions are used to shatter the disulfide bonds in the hair. This stems from the fact that disulfide bonds can be shattered by sturdy reducing agents, also known as bases, whereas they cannot be shattered by oxidizing agents which are acids. Later, acidic solutions are used to hold the hair straight. The function of the acid is transforming the base into a neutral state, which helps the disulfide bonds to be created in different locations while the bonds are inhibited from undergoing what is known as a cleavage reaction - the destruction of covalent bonds which results in tinier novel molecules.

Basic hydroxides, including calcium and sodium hydroxide, are fast and rough in shattering disulfide bonds, and they cause hair to swell. The hair reaches its desired state when these substances are washed off from the hair, as this puts an end to the reaction while disulfide bonds are created. These substances should be washed off from the in maximum ten minutes to eliminate the risk of damage to hair and scalp.

There are safer options including substances with thioglycolate and bisulfate. Thioglycolate's thiolate ions, emerging when the sulfur and hydrogen atom separate from the thiol group, could shatter disulfide bonds. The reaction must be stopped by using powerful oxidizers such as hydrogen peroxide to let bond formations take place.

As it can be clearly seen, a process we regard as being basic has a scientific basis far from being "basic". Don't forget that this is only a single example from the huge and mesmerizing scientific world around us!

Eda Sarıtaş / 11

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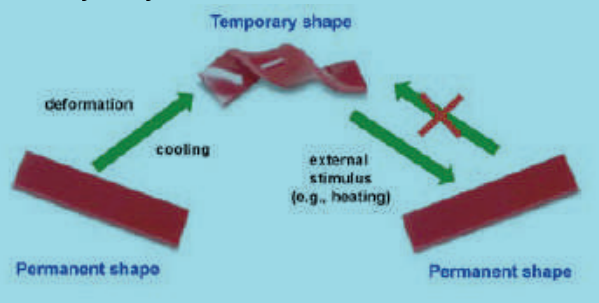
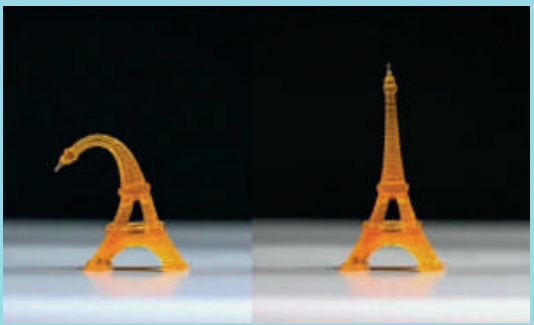
Shape-Memory Polymers and Their Impact in Medical Devices

Shape memory materials are a group of smart materials that can switch **between a temporary and original shape.** Simply, we can define them as magical materials! They can change their shape by variety of stimulus such as temperature change, light or pH change. They can be classified as "Shape Memory Metals", "Shape Memory Ceramics" and "Shape Memory Polymers".

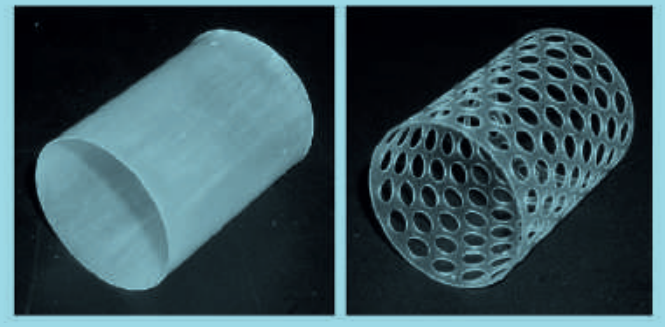


Shape Memory Polymers (SMP) is a class that has just started to attract attention compared to other types, and it continues to make a big impact, especially in research subjects. They are used in many areas in industry especially in biomedical applications. They have many advantages compared to ordinary materials and other shape memory materials. SMPs are lightweight, low cost, easily tailorable, biocompatible and have adjustable mechanical and thermal properties as well as easy programmability and controllability of recovery behavior for biomedical applications.



Biomedical Applications of SMPs

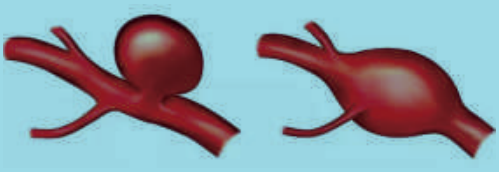
Stents:



Stents are commonly used to **treat blocked or damaged blood vessels.** Traditional stents are made up of mostly stainless steel and shape memory alloys (SMAs) that are widely used after coronary, carotid, and iliac angioplasty to prevent **acute vessel occlusion and late restenosis.** Unfortunately, SMAs have disadvantages like limited amount of drug loading can be achieved in the thin polymer coating on a metallic stent and stiff to be delivered to the small and highly tortuous vessels of the neurovasculature.

Replacement SMAs by SMPs provides many advantages by enhancing deployment rate and decreasing mismatching via rapid shape change.

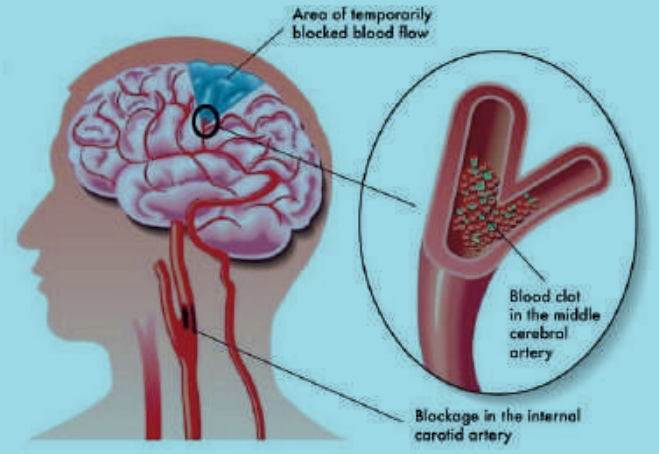
Aneurysm Treatment:



Aneurysm is focalized dilations of an arterial wall, simply put, we can call it a balloon formed in artery or vein. The most common aneurysm treatment is **embolization via placement of soft platinum coils.** This traditional method has many disadvantages such as residual lesions, deficient healing at the neck, repetition of disease, incomplete occlusion, or coil migration. SMP foams have many favorable characteristics as an aneurysm filling material,

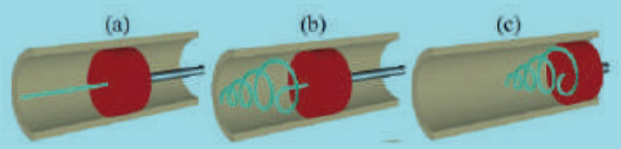
such **as tunable pore size for optimal cellular infiltration, excellent biocompatibility, radio-opacity, low circumferential recovery stress, exceptional volume occlusion, and device flexibility.**

Stroke Treatment:



A stroke is a life-threatening medical illness that occurs when part of the brain's blood supply is cut off. Strokes are a medical emergency that requires immediate attention. The sooner a stroke patient receives care, the less damage is likely to occur. Current treatment modalities for stroke are **mechanical intervention and thrombolytic drug therapy** to disrupt or dissolve thrombi. Fast deployment rate of SMPs makes them the most valuable candidate for mechanical approaches.

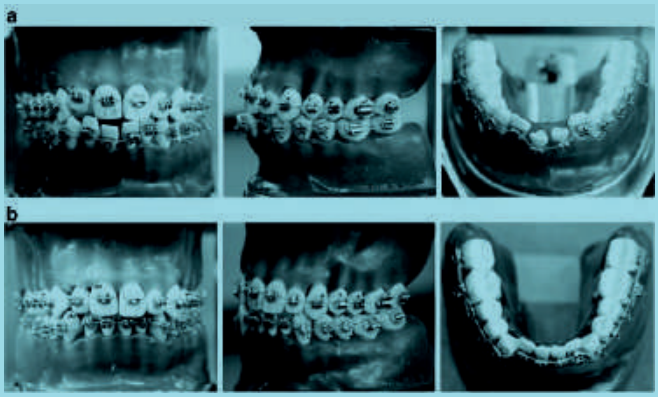
a. Secondary straight rod form, the micro-actuator is delivered through a catheter distal to the thrombotic vascular occlusion.



b. Micro-actuator is then transformed into its primary corkscrew form by laser heating.
c. Deployed micro-actuator is retracted to capture the thrombus.

Orthodontic Wires:

SMPs are also used in braces. The thin line that is visible between the brackets. It is used in braces because the wire in the braces starts to remember its original shape and starts moving over time. The movement of the wire also moves the tooth and straightens them.



There are many other biomedical applications of SMPs in the literature, there are just a few well-known examples above. These smart materials have been gained a huge potential to be used in biomedical applications to change the traditional perspective in the medical industry.

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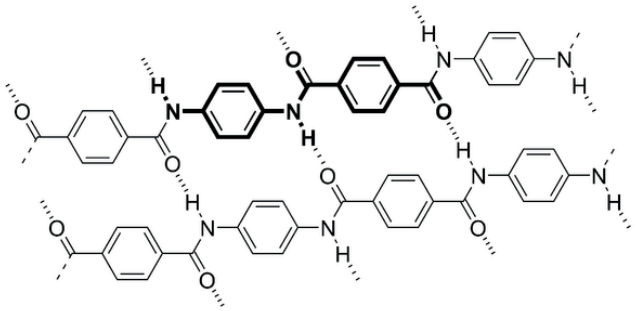
A LIFE-SAVING FIBER: KEVLAR

Throughout its history, humanity was in search for the most efficient material for a variety of purposes. We even named our historic periods for sake of our search: Stone Age, Bronze Age, and Iron Age. Stone was the most abundant one, so we decided to craft our tools with it. Then we found that it was not that sharp, and it wore out quickly. Therefore, we mixed copper and tin to make bronze, yet again it was smooth and blunt. This time, we utilized iron—a strong and sharp ore that can pierce through nearly anything available at those times—, yet it rusted quickly. Now that in the contemporary era with our significant development in science, we can produce material optimized for efficiency and durability.

HISTORY AND INFORMATION ABOUT KEVLAR

In 1965, Polish American chemist Stephanie Kwolek has invented the first type of exceptionally strong and stiff chemical fibers. Her most famous invention in the DuPont company was the Kevlar. As a material, Kevlar has an outstanding ability to cut, puncture, and ballistic resistance. These features make Kevlar an ideal material for protective clothing purposes. Moreover, Kevlar has an impressive tensile strength which is about 3620 MPa (525.000 psi approx.) while regular steel has only about 350-550 MPa tensile strength. Kevlar could resist up to 426 °C, which is spectacular in account of its chemical composition. Even though Kevlar is a strong and stiff material, it is surprisingly flexible as well. Due to its flexibility, it is ideal for cutting and shaping material. Thus, Kevlar had broad utilization in clothing and high-performance appliances also for its lightweight.

CHEMICAL PROPERTIES OF KEVLAR



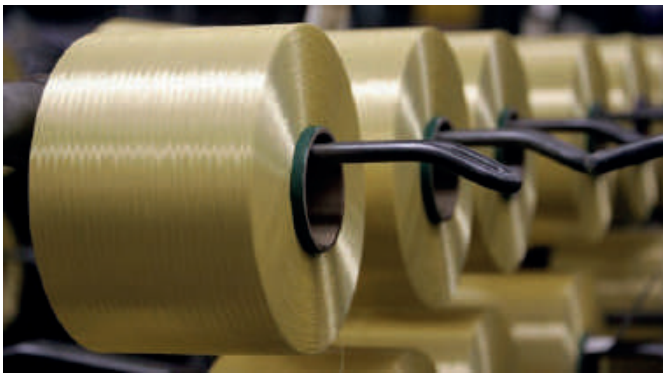
Universally identified as Poly(azanediyl-1,4-phenyleneazanediylterephthaloyl) in IUPAC classification, Kevlar is an organic fiber belonging to the aromatic polyamide family. First developed by DuPont company in the 1960s, aramids are simply polymers with repeating units of amides. The foundation of aramids, thus Kevlar's, is called amides which are functional groups containing a generally a nitrogen atom or any other compound that is connected to a carbonyl group. Specifically, during the synthesis of Kevlar, the amid 1,4-dicarbonyl chloride is connected to 1,4-diamino benzene. During the reaction, the chlorine on the oxalyl group of the 1,4-dicarbonyl chloride and the hydrogen of the amino group in. 1,4-diamino benzene are separated and form hydrochloric acid. Thus, the carbon of the oxalyl and nitrogen of the amino group form a covalent bond. The structure formed between the oxalyl, and the amino group is called a polyamide. When the chain is formed, the oxygen of the oxalyl forms a negative dipole moment and the hydrogen on the amino group forms a positive dipole moment.

Since the hydrogen is bonded to nitrogen, a hydrogen bond is formed between these two chains. The formation of this intermolecular force is one of the main reasons behind Kevlar's immense tensile strength. Despite Kevlar's impressive strength and performance, like every other molecule, it has a weakness. If Kevlar is introduced to an acid, the protons(H^+) in the acids will be attracted to the oxygen in the oxalyl and nitrogen in the amino group. This will disrupt the hydrogen bonding and it

will cause the chains to move further apart making them more vulnerable to ballistic or puncture damage. Thus, strong acids such as hydrochloric acid (HCl), sulfuric acid ($H2SO_4$), or nitric acid (HNO_3) will severely damage Kevlar. If it is completely exposed to any of these acids, not only the hydrogen bonds but also the amide bonds are also broken, leaving the Kevlar dysfunctional. Apart from its chemical nature, Kevlar's main purpose is not simply to resist to damage. When a body hits the Kevlar, the kinetic energy of the body is transmitted to the intermolecular bonds. The intermolecular bonds absorb this kinetic energy and shatter as a result. In other words, the Kevlar sacrifices itself when used on a bullet-proof vest to prevent the bullet from reaching the person wearing the vest. Moreover, Kevlar isn't simply absorbing the damage but reflecting a significant amount of it to the body that it is on. If a Kevlar vest stops a bullet, the vest will cause severe bruises on the body because of that high transmission of energy.

APPLICATIONS OF KEVLAR

The Kevlar was originally designed for stronger tire production. Its initial purpose was to produce enhanced tires for performance and to prevent the possible negative outcomes of the gasoline shortage in 1964. However, after its outstanding performance, it was evident that Kevlar's applications would reach beyond tires. There are 10 industrial variations of Kevlar now. The most widely known Kevlar is KM2, which is mainly used for personal protection purposes. Used by the military, police, and law enforcement, Kevlar KM2 is also used in aerospace applications due to its high tensile strength and toughness. Rather than for solely protection purposes, Kevlar is also used in the field of fiberoptics. The Kevlar 49 is designed to have a greater modulus compared to its variants and is mainly used in fiberoptic cables, plastic reinforcements, other cables, and textiles. The flexibility of this type of Kevlar enables the cables to be more resistant towards bending and ruptures.



Moreover, the Kevlar is utilized in countless many fields such as automotive, oil and gas transportation, sports, marine sports, biking, mining protection, labor safety, ropes and cables, emergency, and nuclear protection. Such an innovative fiber has altered whole fields of labor and ensured the safety of thousands of people. In the search for a cleaner and sustainable world, high-performance materials like Kevlar harbors the potential for achievement.

Furkan Baylav / 11

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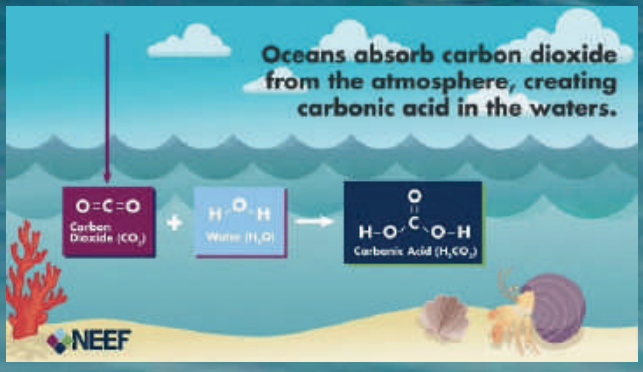
HOW CARBON DIOXIDE AFFECTS OCEAN ACIDIFICATION

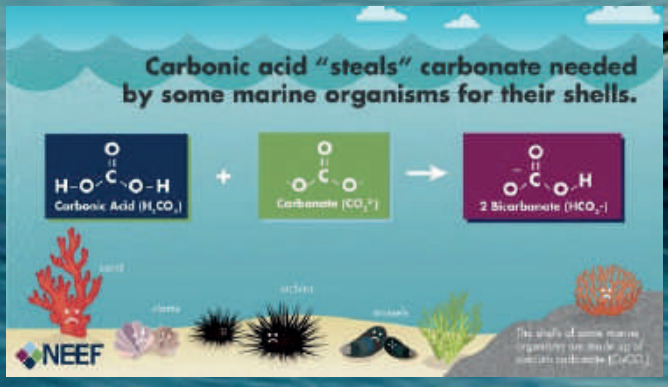
Ocean acidification is the term given to chemical changes in the ocean because of carbon dioxide emissions. Approximately 25% of the steadily increasing amount of atmospheric CO_2 emission is absorbed by the oceans and seawater.

When CO_2 is absorbed by seawater, chemical changes occur that reduce seawater pH and the concentration of carbonate ions. The pH (the measure of acidity) of ocean surface waters has already decreased by about 0.1 units, from an average of about 8.2 to 8.1 since the beginning of the industrial revolution. (0.1 pH unit is acidification of about 26% percent.)



Evidence from experiments and observations over the last decades increases concerns about ocean acidification and possible negative effects on marine life. This is mainly due to the rapid rate at which ocean carbonate chemistry is changing. This change may cause marine organisms to migrate to alternate habitats, or maybe adjust to changes in their environment. However, some may not adjust, and they will not survive these rapid changes to ocean chemistry. These different scenarios will, unfortunately have wider implications on food webs and ecosystem function.

Ocean acidification is already impacting many ocean species, especially organisms like oysters and corals that make hard shells and skeletons by combining calcium and carbonate from seawater. However, as ocean acidification increases, available carbonate ions (CO_3^{-2}) bond with excess hydrogen, resulting in fewer carbonate ions available for calcifying organisms to build and maintain their shells, skeletons, and other calcium carbonate structures. If the pH gets too low, shells and skeletons can even start to dissolve.



In the coming decades ocean acidification could have harmful impacts for some species. Scientists didn't worry about this process before as they always assumed that rivers carried enough dissolved chemicals from rocks to the ocean to keep the ocean's pH stable. However, so much carbon dioxide is dissolving into the ocean rapidly that this natural buffer system hasn't been able to keep up, with the resulting pH level decreases in surface waters. As those surface layers gradually mix into deep water, the entire ocean is affected. Overall, it's expected to have dramatic and mostly negative impacts on ocean ecosystems. Beyond lost

biodiversity, acidification will affect fisheries and aquaculture, threatening food security for millions of people, as well as tourism and other sea-related economies.

The most realistic way to lower this number would be to reduce our carbon emissions by burning less fossil fuels and finding more carbon sinks, such as regrowing mangroves, seagrass beds, and marshes, known as blue carbon. If we did, over hundreds of thousands of years, carbon dioxide in the atmosphere and ocean would stabilize again. However, even if we stopped emitting all carbon dioxide right now, ocean acidification wouldn't end immediately, since time is required to see the effect of decreasing carbon dioxide emissions Even though the ocean may seem far away from your front door, there are things you can do in your life and in your home that can help to slow ocean acidification and carbon dioxide emissions. The best thing you can do is to try and lower how much carbon dioxide you use every day. Try to reduce your energy use at home by recycling, turning off unused lights, walking or biking short distances instead of driving, using public transportation, and supporting clean energy, such as solar, wind, and geothermal power. Even the simple act of checking the tire pressure of your family car can lower gas consumption and reduce your carbon footprint. Finally, one of the most important things you can do is to create awareness by telling your friends and family about ocean acidification. That is the main reason of this article here.

Hakancan Süel / 10

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Ultrathin films for strong and flexible bioelectronic membranes

Researchers at UCLA have developed a revolutionary design of ultrathin films for highly elastic yet mechanically robust bioelectronic membranes that could open the way for diagnostic on-skin sensors that fit precisely over the body's contours and adapt to its movements. Science recently published an article describing the research co-led by Xiangfeng Duan, professor of chemistry and biochemistry; and Yu Huang, professor, and chair of the Materials Science and Engineering Department at the UCLA Samueli School of Engineering.

Held together by van der Waals forces, intermolecular interactions that can only take place at extremely close distances between atoms or molecules, the membrane is flexible and adaptable to continuously changing biological substrates while being breathable and permeable to water and air. The development of durable electronic materials could also lead to the development of benign electronics for medicine, health care, biology, agriculture, and horticulture. The researchers named the material van der Waals thin film, VDWTF, in short, which could serve as a foundation for living beings to adopt electronic capabilities.

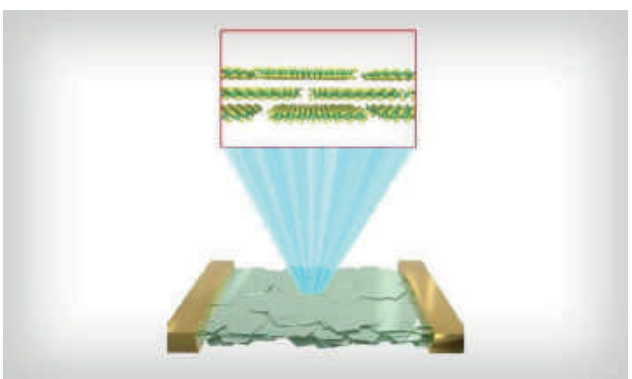
"Conceptually, the membrane is like a much-thinner version of kitchen cling film, with amazing semiconducting electronic functionality and extraordinary stretchability that naturally adapts to biological tissues with highly conformal interfaces," Duan said. "It could open up a diverse range of sensing and signaling implementations. For example, wearable health-monitoring devices built with this material can accurately track electrophysiological signals at the organism level or even down to the level of individual cells." The researchers created several illustrations using the thin films, including a transistor that sat on top of a leaf, whose electrolytes were used to make the electronic circuit. They also created a similar version of the transistor but for human skin that used electrolytes-present skin cells to complete the circuit.

Moreover, the team developed an electrocardiogram that uses small circles of the film placed on a person's forearms and could detect their eye movements during meditation. "Our proof-of-concept demonstrations using the van der Waals thin film really just hint at the priceless possibilities for this new material," Huang said. "The membrane could serve as the connection for human-machine interfaces, enhanced robotics, and artificial intelligence-enabled technologies that connect directly. This could open a way to synthetic electronic-cellular hybrids—living organisms with electronic enhancements."

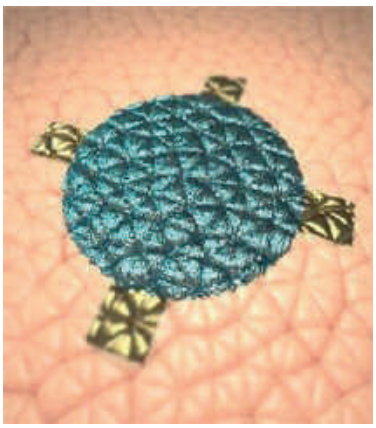
The ultrathin, approximately 10-nanometer -thick electronic membranes are made of several layers of inorganic compound molybdenum disulfide. Each sheet is only a couple nanometers thick which means it is more than 10,000 times thinner than the diameter of a piece of human hair.

The key point to maintaining the membrane's structural integrity while not compromising its thinness lies in its unique layered patchwork structure. The layers are an assemblage of smaller pieces, rather than a single continuous sheet.

Instead of being held tightly in place by non-flexible covalent bonds, the layers are loosely connected by nonbonding Van der Waals forces. This allows the sheets to independently slide and rotate over one another, creating extraordinary bendability while keeping their electronic functionality. The design also enables the membranes to stretch and flex over irregular geometries, such as skin. The thin films can adhere to unrigid biological tissues with a perfect fit over their micrometer-scale structures, actively adapting to dynamically changing biological substrates, without tearing or restraining the membranes' functionality.



The layered patchwork creates a network of nanochannels, large enough for air and water molecules to go through, giving the material its permeable and breathable qualities.



With its unusual combination of high electronic performance and malleability, the van der Waals film beat many challenges presented by other bioelectronic thin film alternatives, such as inorganic membranes or organic thin films. However, those alternatives have been limited by either their thickness, lack of stretchability, incompatibility to merge with irregular geometries of biological surface, or by their disappointing efficiency rates in wet biological environments.

Hayat Karabulut / 11

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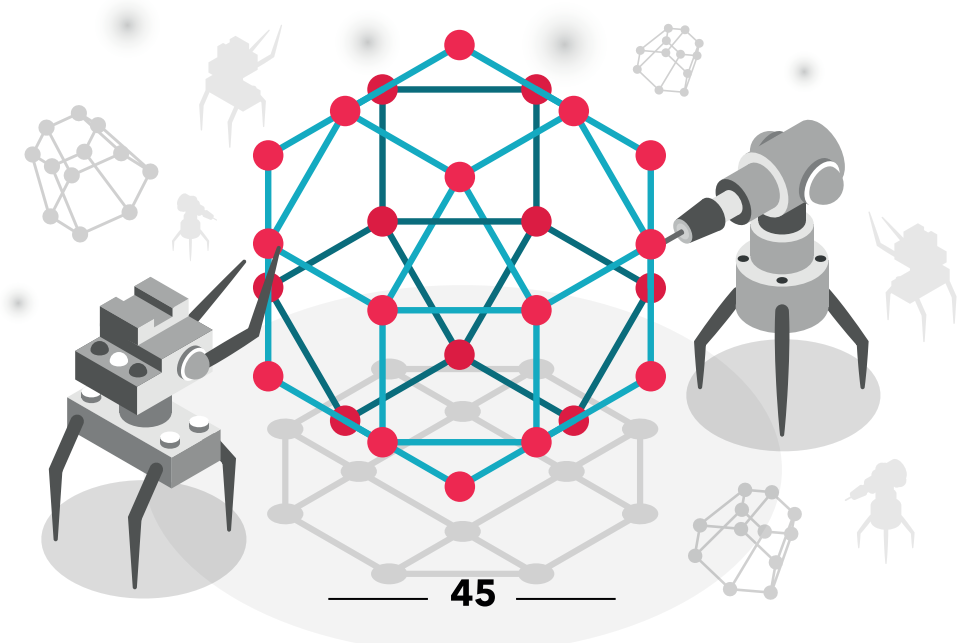

The James Webb Space Telescope

Basics of the James Webb Space Telescope

The James Webb Space Telescope is the largest, most powerful, and most complex telescope ever built. The Webb Telescope is a hundred times more powerful than the Hubble Telescope and was mainly developed by NASA, with major contributions from other agencies and private parties. It made the headlines in global news, following its launch on the 25th of December 2021. The ground-breaking technological advancements concerning the Webb Telescope are engineering miracles that will allow researchers across the world to revolutionize our current understanding of the universe.

The telescope needs to orbit the Sun while maintaining contact with the Earth. Hence, it will be located in a Lagrange point, a region where gravitational forces balance each other out to create a stable orbital trajectory, as

Figure 1: The orbital trajectory of the James Webb Telescope
https://www.scientificamerican.com/article/what-is-a-lagrange-point/

demonstrated in figure one. However, potentially the most interesting aspect of the journey is the fact that the telescope is too large to be pre-assembled. The James Webb Space Telescope will be performing numerous mechanical maneuvers in its journey to orbit, in order to unfold and assemble itself. NASA has identified more than 300 potential sources of failure that could significantly damage the telescope in this process. Additionally, repair missions are almost impossible, as the 10-billion-dollar worth telescope will be located more than 1.6 million kilometers away from Earth. So why is the mission worth the risks?

The Webb Telescope is much more well-developed than previous telescopes. Thus, it is able to visualize longer distances more clearly and isolate background noise, which refers to factors diminishing the quality of observation. The mission of the James Webb Telescope includes searching for signs of life in distant solar systems, conducting various scientific research regarding far-away planets, and perhaps most importantly observing the first stars and galaxies of the universe, that formed soon after the big bang. The data collected by the telescope will allow generations of scientists to come to form theories about the universe and our role within it.

The Hubble vs James Webb

The James Webb Space Telescope set to succeed the Hubble Space Telescope has numerous differences and improved features. However, before starting the comparison, let's briefly mention Hubble's greatest contributions to science and technology.

Figure 2: The Pillars of Creation observed by the Hubble Telescope https://www.vox.com/science-and-health/22664709/james-webb-space-telescope-launch-date-december-science-hubble.

The Hubble Space Telescope was launched on April 24, 1990. Named after famous astronomer Edwin Hubble, whose research, later on, proved that the universe is expanding, the Hubble Telescope led to major developments in the field of astronomy. By being the first optical telescope to be launched into space, the Hubble Telescope was able to observe the universe with minor disruptions from the Earth's atmospheric conditions. It allowed researchers across the world to guess the universe's age, discover the results of supernovas, and understand black holes. The Hubble Space Telescope also presented numerous magnificent sites in the universe with great clarity, such as the picture named Pillars of Creation (illustrated in figure two) which pertains to a section of the Eagle Nebula.

There are a couple of key differences between the Hubble and James Webb space telescopes, which are: the size, mirror, and the equipment attached to the telescopes. The size of the Hubble telescope is close to a school bus, whereas, the Webb telescope is as big as a tennis court when it is completely unfolded.

Another key difference is the curved mirror. The curved mirror of Hubble was nearly 2.4 meters in diameter, while the JWST's curved mirror (the gold-plated mirror shown in figure three) has a diameter of 6.5 meters. This simple increase in size allows the mirror to catch more

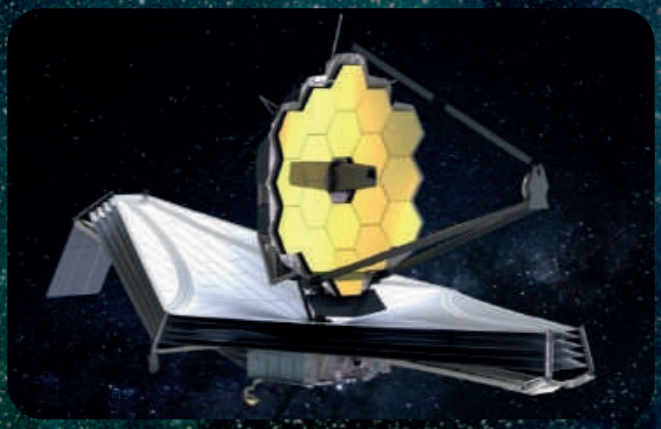

Figure 3: The deployed form of the James Webb Space Telescope https://www.sciencefocus.com/space/james-webb-space-telescope/.

light, hence increasing the clarity of distant objects. Moreover, unlike Hubble's mirrors which are made of glass, the curved mirror of the James Webb Telescope is made of beryllium that is covered in a very thin layer of gold. Beryllium's heat and corrosion-resistant properties, as well as its strength and ease of casting, make beryllium alloys perfect materials for space telescopes. Additionally, the conductive properties of metal allow gold to reflect light (especially infrared and red light) very well. This improvement in the materials used for the mirror is also a key difference between the Hubble and Webb, as it makes the Webb telescope's bigger mirror lighter and more effective.

Last, the James Webb Space Telescope hosts a variety of new and improved equipment. The Webb telescope has four main instruments, which are as follows: the Near Infrared Camera, the Near-Infrared Spectrograph, the

Mid-Infrared Instrument, and the Fine Guidance Sensor/ Near InfraRed Imager and Slitless Spectrograph. The first instrument can detect the light from the earliest galaxies and has the technology to observe a faint light that is located near a very strong light source. The second instrument can determine the physical properties, like temperature, mass, and composition, of a given far-away object, by methods of spectroscopy. The third instrument can provide images of wide regions in the universe, similar to, but with even better clarity than, famous pictures taken by the Hubble telescope. The fourth instrument can take very high-quality images of exoplanets, for various scientific research.

An Engineering Miracle

Scientists and engineers faced a major challenge when developing the James Webb telescope. The James Webb Space Telescope could barely fit in a rectangular box with a volume of roughly 19300-meter cubes (21.2, 14.2, 8 meters). Even then, the numerous extremely fragile and sensitive instruments within it would be at risk of degrading or breaking completely in a rough journey of 1.6 million kilometres through Earth's atmosphere and outer space (with temperatures ranging from 58 to -212 degrees Celsius). The challenge gets even more complicated when the fact that even the most powerful spacecraft, like Ariane 5, has a very limited payload capacity in terms of volume and mass. Henceforth, objects that occupy too much space are much more expensive, challenging, and sometimes impossible to launch, with current technology. In order to solve all of these issues at once, scientists and engineers came up with the solution of folding the James Webb Space telescope, hence making it occupy less volume in a regular prism. The folded version of the JWST can be seen in figure four.

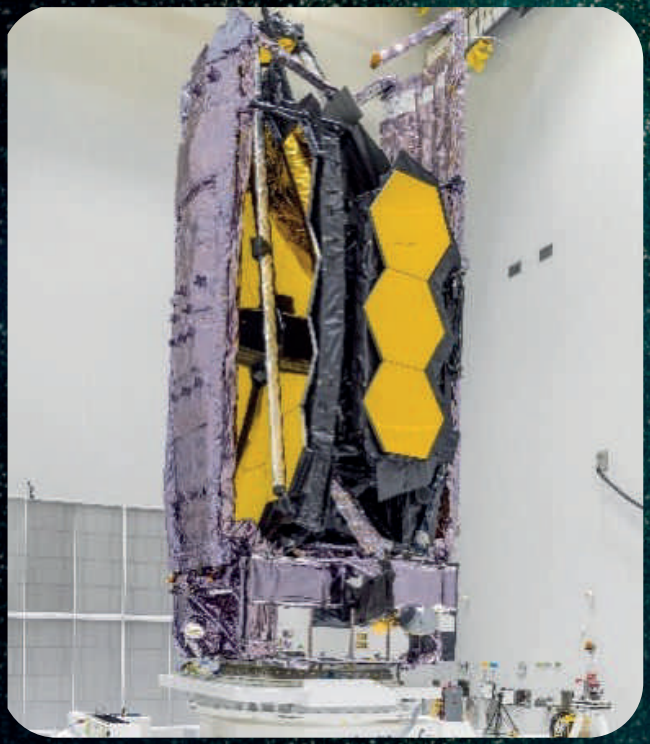

Figure 4: A folded image of the James Webb Space Telescope https://www.spaceupclose.com/2021/12/nasa-webb-telescope-fueled-for-late-december-launch-on-ariane-5-rocket/.

The telescope includes two major sections that are large in size: the sun shield and the mirror. The sun shield is a component that occupies a surface area of nearly 220 meters squared (22, 10 meters). By separating the mirror and the front side of the telescope from sunlight, the shield creates two sections, the hot and cold side, in the telescope. The cold side is where the mirror and all instruments are located, and remains very cold (around -233 degrees Celsius) in order to allow instruments to function properly. The sun shield is made of a polymer named Kapton and is also covered in aluminium. Both of these materials are very flexible, allowing the sun shield component to be directly folded to fit the spacecraft. The other major section is the primary mirror, which as previously mentioned is 6.5 meters in diameter and made of beryllium. Since beryllium is a hard metal, it lacks elastic properties in solid form and, hence, will break if sufficient force is applied to bend it. That is why scientists and engineers had to use various segmented sections of beryllium mirrors in hexagonal (the most efficient shape to occupy an area effectively) structures, that work

together to form the mirror. This almost origami-like folding technique allowed the primary mirror to be safely folded and loaded into the spacecraft.

Nevertheless, there was still a vital problem that scientists and engineers had to overcome. This now-folded telescope would need to automatically unpack itself, deploy the sun shield, unfold the remaining components, while still journeying through space. This issue was solved with mechanical structures built into the main body of the telescope, a lot of electric circuitries, and algorithms to allow the telescope to manage the process on its own. The James Webb Space Telescope began deploying the sun shield three days, the secondary mirror eleven days, and the primary mirror twelve days after launch. As of the 28th of January 2022, the telescope has completed unfolding and is waiting to cool down before starting its mission.

A New Age of Discoveries

The James Webb Space Telescope has four main scientific instruments attached to it, each with its own purpose and specific properties. These instruments observe different spectrums of light under distinct conditions, thus allowing scientists to procure data that revolutionize our current understanding of the universe. However, how can being able to observe different spectrums of light in space lead to new discoveries?

Electromagnetic radiation is a form of energy that includes many forms such as visible light, microwaves, and X-rays. Electromagnetic radiation, or more simply light, is photons traveling in space. Light behaves both as particles and waves of different lengths (where the wavelength is derived), the latter behaviour of which is defined by the Electromagnetic Theory developed by physicist Clerk Maxwell. Additionally, different elements absorb/emit different frequencies of electromagnetic radiation. This allows scientists to study emission/absorption spectrums of materials to understand the physical and chemical properties of the relevant object.

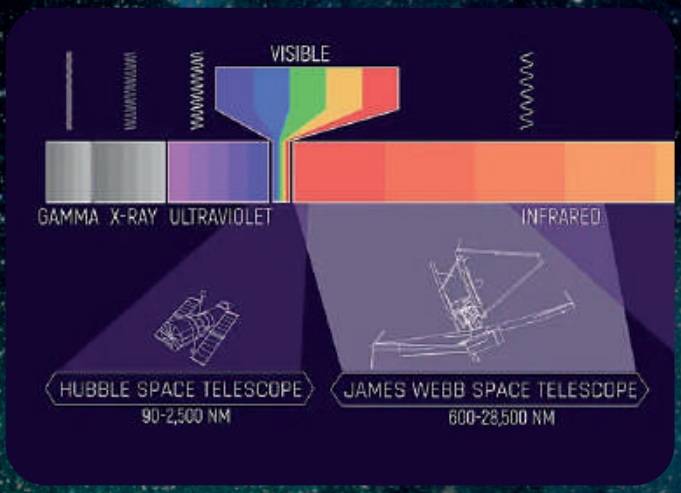

Figure 5: A comparison of the Hubble and James Webb space telescopes regarding the range of the electromagnetic spectrum that can be observed.
https://www.nasa.gov/content/goddard/hubble-vs-web-b-on-the-shoulders-of-a-giant.

Furthermore, the electromagnetic spectrum (illustrated in figure five) is the spectrum in which the different forms of electromagnetic radiation are sorted by frequency (the number of waves in a given amount of time). When frequency increases, the energy carried by the radiation will increase and the wavelength will decrease. In contrast, when frequency decreases, the energy carried will decrease, as wavelength (the distance between waves) increases. In order to observe the first stars and galaxies of the universe, the telescope needs to visualize deep into space. Considering the enormous size of the universe, it takes a lot of time for light from a distant part of the universe to reach the telescope, even at the speed of light. Hence, the farther away the telescope observes, the earlier in time the telescope will be able to observe. However, since the universe is constantly expanding, the farther objects will move away faster from the telescope. This event redshifts the light available to the telescope.

The term red shifting is a concept in astronomy where light, traveling from an object moving

away from the observer, will shift to become longer in wavelength and, hence have a lower frequency. This functions similarly to the Doppler Effect, where approaching objects appear to have higher frequency and objects that are moving away from each other appear to create lower frequency. Henceforth, together with red shifting, the electromagnetic radiation from these distant sources becomes infrared, requiring instruments that can detect specific nanometres of frequency. Some of the previously listed four instruments have technology that allows them to detect specific ranges of infrared light, thus, enabling the James Webb Space Telescope to observe a wider range of galaxies, stars, and planets across the universe.

In summary, the James Webb Space Telescope is a miracle of human ingenuity, and is far more well-developed than any other space telescope humans have engineered to this date. JWST's curved mirror, that is almost three times the diameter of Hubble's mirror, will allow it to take extremely high-resolution pictures of planets, stars, and blackholes. Last, the four instruments attached to the JWST will collect data, revolutionizing our understanding of the universe and our past.

Arda Deniz Altınok / 10

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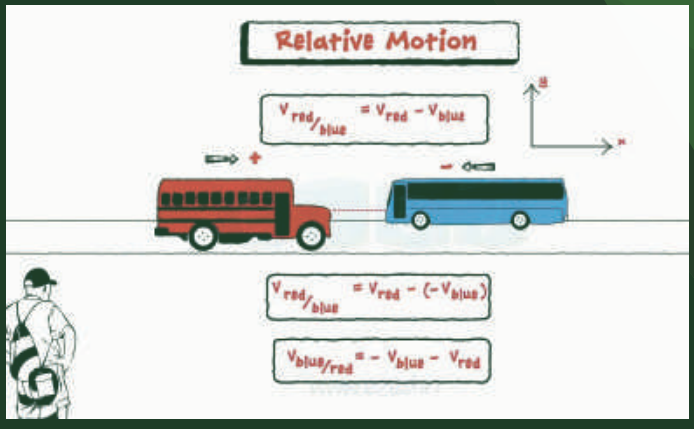
A Spectacular illusion: MOTION

Just think for a moment! Two people in different trucks are placed side by side. Let's call them person A and person B, and person A is in truck A, person B is in truck B. Trucks aren't moving; they are at rest. You are outside the trucks, and you can see the trucks and the people inside. For you, they are not moving. For example, for person A, person B is at rest and vice versa. The question is: What will happen if trucks start moving at the same velocity? How will their motion be? Will they be at rest, in motion? We'll come back to this question, but first, let's explain a key concept and grasp the situation thoroughly.

We have to talk about the reference point. What's that? It's significant because that will enlighten the question we asked initially. It's the point used to define an object's motion. For example, for me standing on earth, the moon moves because we take the earth for reference. Also, for me, the earth is at rest. However, for a person standing on the sun, the earth revolves, and that's why it moves because that person's reference point is the sun. Thus, it depends on your reference point to determine whether objects are moving or not. That's why the objects' motions are different for different observers.

Let's get back to the question: What will happen if trucks start moving at the same velocity? Remember what we said at the beginning. When trucks are at rest, A and B are at rest because they have the same velocity, 0. When trucks are moving, they have the same velocity too. It'll be the situation at the beginning. When they look at each other from the window, they'll see each other at rest. For themselves, they aren't moving because they are inside the truck. However, they are moving according to your reference point. How can this happen? How can an object be at rest for one observer and in motion for another? The answer is simple: Motion is relative. Both observers' observations are correct; however, they have different reference points to define motion differently. We have mentioned the reference points because it changes the whole idea and perspective we are looking from.

Let's do another thought experiment. Try to visualize this: In [Figure 1], there are two busses moving towards each other. Think that you're in the blue car heading left, and you see the other bus heading right. Wouldn't you see the car moving twice your speed? How can that work? First, we should note that both cars actually have the same speed. In this image, the cars will meet after some point and afterwards let's assume that the blue bus moves with 10 m/s velocity due left and the red bus moves with 10 m/s velocity due right. The reason why you observe the red car moving twice your speed is that the distance between the vehicles will decrease 20 m every second. Thus, even though you move at the same speed, you feel as the red buses' speed is twice that of yours.



Let's apply this to persons A and B. Assume that the trucks start moving from the same point in different directions with the same speed. Person A will see person B twice its speed even though they are moving simultaneously and vice versa. You're still standing on the road watching the trucks. According to you, both of them move at the same speed. It's indeed an illusion, isn't it? It's mind-blowing to perceive how different observers define motion differently and their reference points. The importance of the reference points is again recognized. Just because you are outside the trucks causes you to evaluate the trucks' motion differently.

Consequently, neither observer's statement will be incorrect because their definition of motion and direction depends on their reference point. Hence, this relativeness shows why physics is essential and omnipresent in daily life. Even Albert Einstein's experiment with trains to examine the relativity of simultaneity is related to relativity of motion. Thus, motion is everywhere, knowing its concept and factors affecting it is also critical to question everything by physical rules and terminology. Although physical terms and their mathematical proofs are not easy to comprehend, it's understandable when visualized. To conclude, motion is relative and depends on the observer's reference point.

Can Sinan Canpolat / 9

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https://voices.shortpedia.com/narmada/everything-about-fermi-paradox/

We exist in a universe that is 14 billion years old and observably 93 billion light-years wide (Gohd, 2021). Take a moment for numbers of that magnitude to sink in. Just the fact that there exists approximately 100 billion galaxies, each with around 100 billion to 1 trillion stars and an innumerable amount of planets revolving around those stars leads us to the conclusion that there must be lots of opportunities for extraterrestrial life to develop and exist within our universe. It appears beyond possible for us to be all alone inside all of this space, all of this presence. If it's this likely, we simply cannot be the only ones out there; there must be radio signals or visual clues reaching our telescopes already. However, scientists have yet to encounter any sign or scientific evidence that suggests the presence of any form of life of civilization within the observable universe. So then, where is everybody?

In 1950, at the Los Alamos National Laboratory, Enrico Fermi famously proposed this question, "where is everybody?", to his colleagues (Boeree, 2018). His question led way to the Fermi Paradox, which is a paradox that refers to the duality between the high probability that extraterrestrial intelligence exists and the fact that we possess no evidence for such aliens. There is a myriad of solutions and explanations proposed to this paradox, therefore it's a matter that is nearly impossible to be wrapped up in a single text within a school magazine. Nearly every single person must have taken a look at the celestial night sky and wondered if

https://pxhere.com/de/photo/28994

there was someone else out there, looking right back at us. This paradox can also be interpreted alongside various different beliefs; thus, it is very subjective. Nevertheless, this doesn't mean that it is unworthy of being addressed and mentioned and still remains one of the biggest and oldest mysteries that have ever been proposed by humankind.

One of the most obvious suggestions to this paradox is that we simply do not have the required level of technology to find extraterrestrial life, and have not looked hard enough. Sure, we do have an estimated guess of the number of earth-like habitable planets within our galaxy, but we still haven't been able to identify many. The first planets beyond our solar systems have been confirmed only 30 years ago (Wenz, 2019). Thus, we have barely started to scratch the surface of studying the universe and extraterrestrial life. Even if we did have the required highly-advanced level of space equipment that would allow us to travel between stars, we can't ignore the fact that even the closest star system, Alpha Centauri, is four light-years away. That would take tens and thousands of years to reach with our current fastest speed. Therefore, the distances between star systems are enormous, making journeys between them difficult- even impossible.

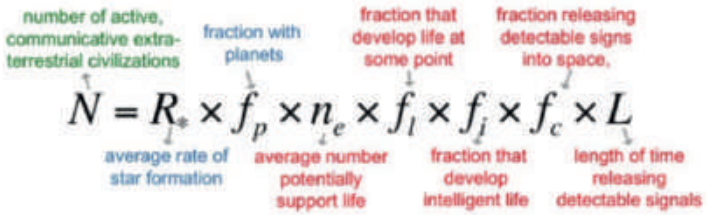
Another term that comes up to mind when this paradox is brought up is the Great Filter. As aforementioned, we know that there are at least 10 billion Earth-like planets in the Milky Way, many having been around for billions of years (McFall-Johnsen, 2019). The fact that we are observing a total of zero interstellar lifeforms may mean that something, a critical step, is https://pxhere.com/de/photo/28994 preventing living species from developing their civilizations beyond the step we're on right now. Something that makes being a galactic civilization (a civilization that has possession of energy at the scale of its own galaxy,) extremely difficult and maybe even impossible. This would be identified as a Great Filter, a challenge or danger so hard to overcome that almost none of the species can clear it and move on to the next. It's a step that eliminates almost every species that encounters it. Considering this theory, there are 2 possible scenarios. The first one suggests that the filter

is behind us and that humankind is possibly the only civilization (if not, one of the rare civilizations) that has successfully cleared up the step and passed the filter. We may never surely know what this filter is in this specific scenario. Maybe, the filter is life itself, since life itself is extremely rare to emerge from dead things, just like how it did on our planet. We might have beaten the odds by just being here. Another possibility is that the step of complex animal cells may be the Great Filter. According to the evolution theory, a primitive hunter cell swallowed another cell and instead of swallowing it, the two formed a union. These eukaryotic cells make up every single animal on the planet. Maybe, such creation of eukaryotic cells was extremely unlikely, and though there are millions of bacteria-covered planets out there, not even one, apart from humankind, has been able to reach our level of complexity. Or maybe, reaching a certain level of intelligence is a great filter, and we are the only lifeform that has been able to use its level of intelligence in a way that allows it to develop into a growing civilization.

Scenario 1 allows us to interpret our apparent loneliness in the universe as a good sign as it shows that we have safely made it through the one insuperable great filter. We might be the only or one of the rare species that has overcome this step, therefore are practically lonely in the universe. Scenario 2 suggests that the filter is ahead of us. If we were to detect a signal from an advanced technological species, this may imply that the Great Filter still lies ahead. If so, many interstellar civilizations might have reached our current level of development but have not been successful to develop much further. This would imply that the point of extinction, a.k.a. the great filter, lies somewhere close ahead in our development scale. One hypothesis suggests that once a species takes full control over its planet's sources, it automatically leads itself to the path of destruction. Therefore, becoming a civilization with control over all of its planet's sources is a filter itself.

Other theories suggest that this filter could be an experiment that blows up the whole planet, a large-scale nuclear war, an intelligent AI that destroys its home planet, or maybe, something so big that we cannot possibly comprehend with our current level of understanding of the universe. Therefore, finding life outside of earth would be a bad sign for us, as the more complex interstellar civilizations are, the more likely it becomes a filter awaiting us. Nick Bostrom, a philosopher with a background in theoretical physics at the University of Oxford summarized; "You start with billions and billions of potential germination points for life, and you end up with a total of zero extraterrestrial civilizations that we can observe. The Great Filter must therefore be powerful enough — which is to say, the critical steps must be improbable enough — that even with many billions of rolls of the dice, one ends up with nothing: no aliens, no spacecraft, no signals, at least none that we can detect in our neck of the woods." (Williams, 2022)

In 1961, astronomer Frank Drake proposed the Drake Equation, which is an equation that is used to estimate the number of active, communicative extraterrestrial intelligence in the milky way galaxy (Sierra, 2021). It remains astronomers' only method of calculating the probability of alien life. The equation is as below:



http://faculty.haas.berkeley.edu/mhsu/blog/files/drake_equation.html

Some parameters, such as R* (rate of star formation per year) is certainly known while many other factors such as fi and fl remain uncertain. Although the Drake equation helps us to estimate the number of communicating civilizations in the cosmos, it still does come with enormous uncertainty, and this shows itself through how various scientific papers give N results that vary on a scale of 10 to many billions.

Another big possibility is that we are in no way capable of communicating with and comprehending other life forms- their existence is beyond our senses in ways we cannot understand. The only life form we know of is carbon-based, which is a life form made of complex molecules that are based around carbon atoms. Carbon-based life is common for all life ever observed, and it is believed that there exists only a little chance that any planet anywhere in the Universe has life not based on carbon, as carbon forms, four bonds and is very abundant. But there still exists a chance that there are other life forms, those beyond our intelligence.

There is no reliable way to exactly predict the likelihood of intelligent life. We sure do have some ideas, and in this text, I have summed a couple of important ones up, yet this still doesn't mean that the paradox does not have more layers to it. Regardless of whichever side you take whether we are alone or not, as Arthur C. Clarke mentioned in his quote, 'Two possibilities exist: either we are alone in the Universe or we are not. Both are equally terrifying.' Apart from how terrifying being alone, which is what numeric data show us is highly possible, might be; we should still consider the serious meaning that this would have for humankind. For the first time in human history, we have reached a point in technological development where we are avariciously wasting environmental resources, building enough nuclear weapons to wipe out all the human species, and destroying ourselves out of pure greed and individualism.

If we are the only civilization out there, our responsibility doesn't only concern one planet but a rather astronomical scale. As Carl Sagan said in his 'Pale Blue Dot' speech in 1994, *"Our posturings, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves. The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand."*

İrem Eroğlu / 9

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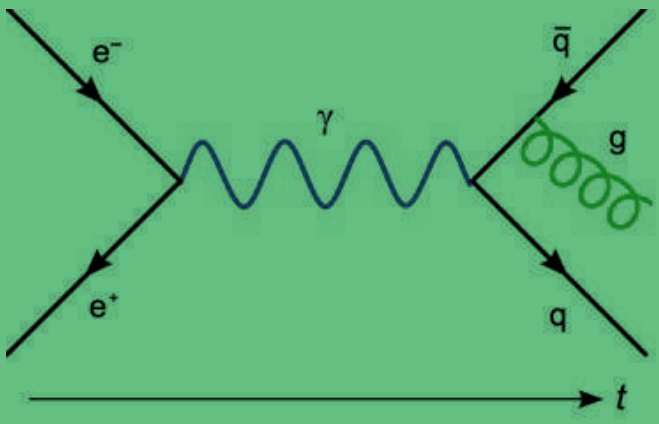
Antimatter

When we understand the true philosophy behind physics, we will not be terrified. Physics and science are real daily life. As we comprehend science, especially physics, we will have a better understanding of our life and a great chance to shape the world.

We might need a simple explanation of antimatter since it is a very deep concept in particle physics. Antimatter is a substance made up of antiparticles. These have the same mass as regular matter particles but have the opposite charge and characteristics, such as the number of leptons and baryons. When a particle collides with an antiparticle, both are annihilated. High-energy photons (gamma rays), neutrinos, and lower-mass particle–antiparticle pairs are produced as a result.

All primary particles, or the general structure of objects we can touch, are found in pairs in physics. There is an antiparticle for every particle. Except for one fundamental change, this particle may appear and behave exactly like the conventional one. The electron and the positron are two examples. Antimatter particles are like ordinary particles in that they have the same weight, appearance, and behavior, but their electrical charge is the polar opposite of regular particles. Antihydrogen, for example, has a positively charged positron orbiting around a negatively charged antiproton, which is the opposite of ordinary hydrogen, which has an oppositely charged electron orbiting around a proton (positive charge). Humans have created antimatter particles through ultra-high-speed collisions at massive particle accelerators like the CERN-operated (the European Organization for Nuclear Research) Large Hadron Collider outside Geneva. Antihelium, the antimatter equivalent to helium, is the most complicated antimatter element yet created (By Adam Mann published December 13, 2021).

When the particles and the antiparticles collide, they annihilate each other; they make each other disappear and at the end of this event lots of energy appears. In particle physics, annihilation results when a subatomic particle clashes with its antiparticle to form



other particles, such as two photons when an electron clashes with a positron. The original pair's total energy and momentum are maintained throughout the process and distributed among a group of other particles in the end state. As a result, any set of particles with total subatomic particles of zero can be created if energy and momentum conservation laws are followed.

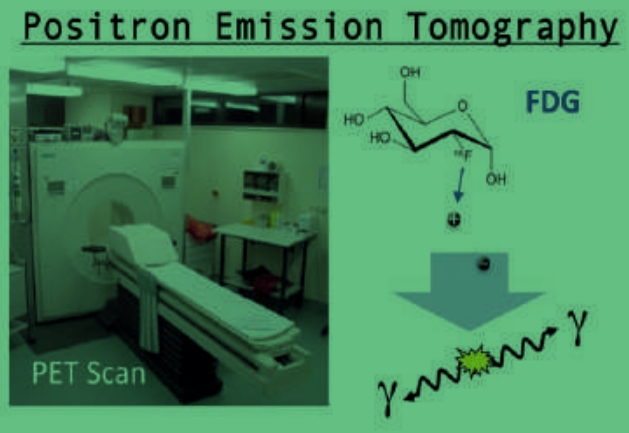
Photon generation is favored during a low-energy annihilation because photons have very little mass. An annihilation in a high-energy particle collider produces a wide array of unusual granules. Informally, the term "annihilation" refers to the interaction of two particles that are not mutual antiparticles – that is, they are not charge conjugate. Certain quantum variables may not sum to zero in the

initial state, but they may conserve in the final state with the same sums. Paul Dirac, a physicist, was seeking an equation to explain how very fast particles should behave in 1928. The Schrödinger equation could already be used to describe slow-moving particles, but Einstein's theory of special relativity said that fast and slow particles may be extremely different. Dirac was well aware that particles such as electrons move very quickly. He understood that the old equation wouldn't be accurate enough for rapid particles. So, he came up with a new equation that may describe particles traveling near to the speed of light (by Roger Jones, Lancaster University, The Conversation, January 16, 2016). It's no longer accurate that now the energy is "E = mc2" for rapid particles. Dirac's new equation, on the other hand, worked for particles whose energy was supplied by "E^2= m^2 c^4+p ⊠^2 ⊠ c⊠^2". The sign "p ⊠" in the new energy equation stands for momentum, which represents how rapidly the particle is moving and how difficult it is to stop. This equation states that very fast particles have more energy than slow particles, indicating that they are different.

Antiparticles are also created spontaneously and intermittently throughout the cosmos. When matter and antimatter collide, they annihilate one other and release energy, therefore antimatter doesn't last long in a matter-dominated universe like ours. Antimatter is also important to the puzzle of why the cosmos exists at all. Just energy emerged in the early minutes after the Big Bang, particles of both matter and antimatter were created when the cosmos cooled and grew. Scientists have precisely examined the properties of particles and antiparticles and discovered that they behave alike. If matter and antimatter were generated in equal quantities and behaved alike, all matter and antimatter formed at the beginning of time should have been destroyed on contact, leaving nothing behind. It's a big mystery why matter won out over antimatter. According to one idea, the cosmos began with some more matter than antimatter, so that even after mutual annihilation, there was enough matter left to form stars, galaxies, and, presumably, everything on Earth.

The difference would have been insignificant. Less than one in a billion ordinary particles would have survived the pandemonium and proceeded on to generate all the matter we see around us today (Space.com, n.d.). If the neutrino — a tiny, ghostly particle that scarcely interacts with the other matter — is, in fact, its very own antiparticle, that could be the key to unlocking the mystery. According to this theory, a small number of neutrinos could have transitioned from antimatter to matter at the beginning of time, perhaps causing a modest matter imbalance. Tests have been carried out to see if the neutrino is its own antiparticle, but the results have been unconvincing up to this point. Since antimatter has such a high energy density, it can be used for a variety of applications, including space fuel and automobiles. The issue is that antimatter is extremely costly to manufacture and almost as pricey to store due to its inability to interact with conventional matter. Making less than one-millionth of a gram of antimatter costs hundreds of millions of dollars. It is, in reality, the most expensive and most precious substance on the planet. Because antimatter is so costly, it is not viable to utilize in weaponry or a source of energy because there is so little of it.

Antimatter is used in medicine too. PET (positron emission tomography) creates high-resolution images of the human body by utilizing positrons. Positron-emitting radioactive isotopes (such as those found in bananas) are connected to naturally occurring chemical compounds like glucose (sugar) (By Roger Highfield, May 12, 2009). These are put into the bloodstream and naturally degrade, generating positrons that collide with electrons in the body and annihilate them. The annihilations create gamma radiation, which are then employed to create images.



Engineers have suggested that baryonic matter aircraft, satellites that rotate in unison, such as those observed around the Milky Way and Andromeda, could be an effective way to discover the cosmos since combining matter and antimatter produces energy. NASA has investigated the prospect of flying to Mars using antimatter-driven spacecraft, but the concept has certain drawbacks; for starters, it's extremely costly. In a 2006 article for NASA, Gerald Smith of Positronics Research LLC in Santa Fe, New Mexico, stated, "A rough estimate to manufacture the 10 milligrams of positrons needed for a human Mars journey is roughly $250 million dollars using technology that is now under development."

Although the price may appear exorbitant, sending something into space still costs roughly $10,000 per pound, so launching a huge spaceship with a human crew would be costly (NASA, April 14, 2006). As we've all seen, when we open our eyes and start looking from a wider perspective, we can understand how fascinating science can be. Nothing is holding us back from enjoying it.

Mert Kozanoğlu / 10

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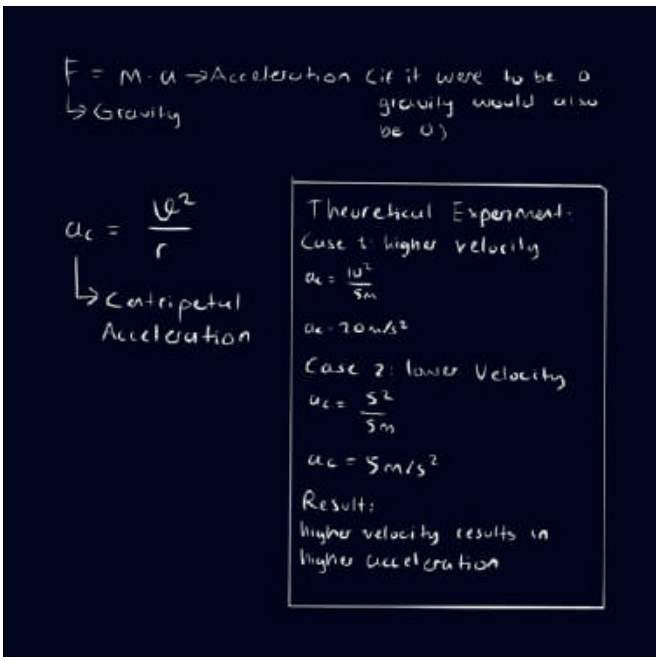
ROTATING SPACESHIPS AND ARTIFICIAL GRAVITY

Rotating Spaceships are often seen in science fiction movies such as Passengers, Avengers Infinity War and Interstellar however, apart from the general concept of them, viewers don't know a lot about these types of spaceships. By simple definition Rotating Spaceships are spaceships that travel in space by turning around their own axis. They rotate around their center axis in order to, in theory, generate artificial gravity inside the spaceship. However, the production of artificial gravity is more complicated than just the result of the spaceship's motion.

A spinning spaceship should be able to mimic the gravity on earth and create artificial gravity since its rotation produces a force that gives the same effect as gravity; however, it is yet to be confirmed. The particular force produced is called "The Centripetal Force" which is by simple definition: a force that acts on a body moving in a circular path and is directed toward the center around which the body is moving. (Nast)



My own explanation for the formula of centripetal acceleration

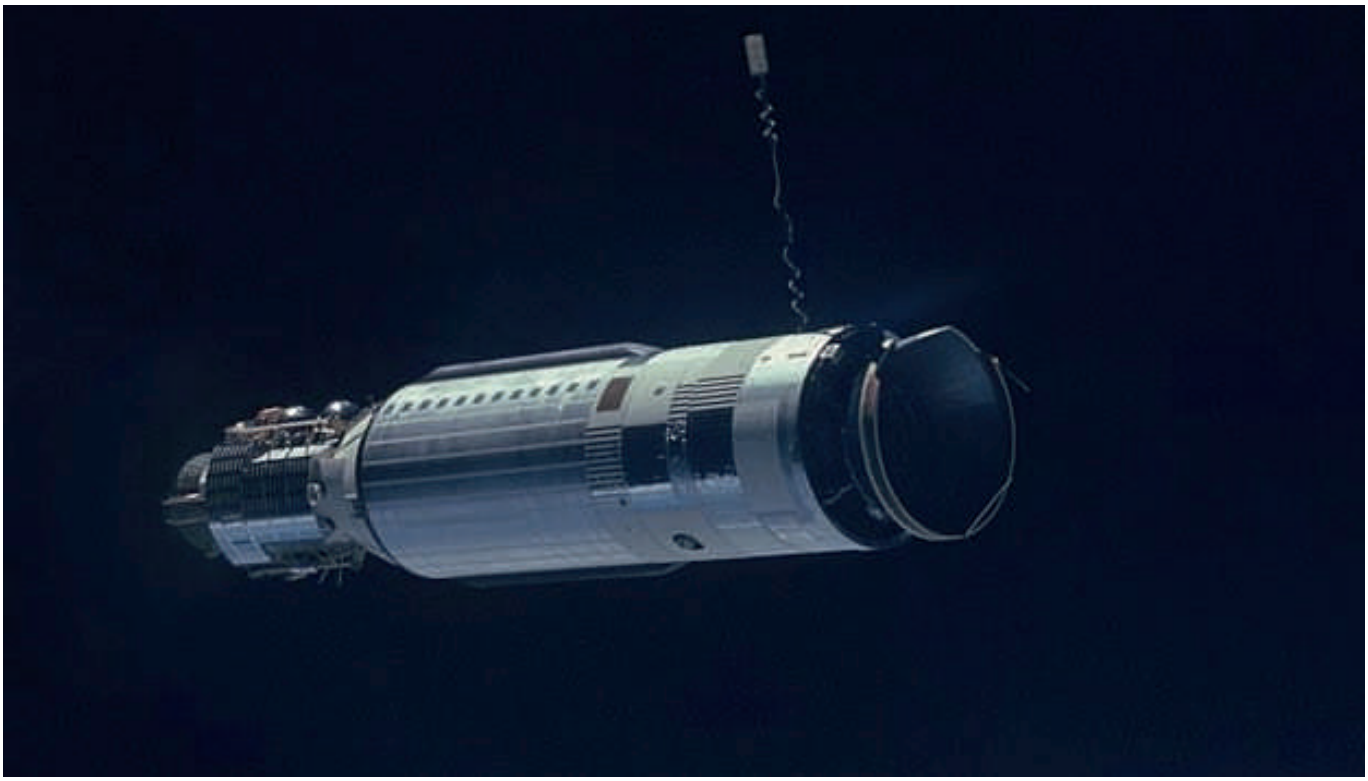
Exactly how fast would the spaceship have to spin in order to generate artificial gravity? As we all probably know, gravity is a kind of force. Judging by this fact we can use the equation net force equals mass multiplied by acceleration. Which basically means that the spacecraft would have to be constantly speeding up to create acceleration and as a result, gravity. If this acceleration is in the direction from the feet to head of the astronaut the astronaut would feel a kind of weight on them. Humans would have to stand on the inside with their heads facing the center to feel the weight. Although it would be hard to keep the spacecraft accelerating for a long period of time it wouldn't be impossible.

The formula used to calculate how fast a rotating ship would have to accelerate would be dependent on the formula of centripetal force. Centripetal force is in basic terms: "the force that is necessary to keep an object moving in a curved path and that is directed inward toward the center of rotation" In simpler terms centripetal is the force needed to make something move in a circle. The formula for centripetal acceleration is A= v^2/r. ("Centripetal Acceleration | Physics") This indicates that a smaller radius and a larger velocity would result in a larger acceleration. For instance, let's make a theoretical experiment with the independent variable being the velocity, the radius being the constant variable that is 5 meters and the acceleration being the dependent variable. If we were to make the velocity 10 and take its square, 100 divided by 5 would equal 20 m/s^2. However, if we were to make the velocity 5 and take its square, 25 divided by 5 would equal 5 m/s^2which brings us back to the fact "a larger velocity would result in a larger acceleration".

Picture o Gemini 11 from https://bit.ly/37RTNDo

Artificial gravity is extremely beneficial to space travel and exploration. In a spaceship or situation without gravity, the calcium comes out of your bones making them thinner however, due to the artificial gravity generated in rotating spaceships this event does not occur. Yet despite the advantages of artificial gravity, rotating spaceships also have several disadvantages. One of the disadvantages is the fact that a rotating spaceship would have to be bigger than a football field in order to give the effect of gravity. If it were to be small, the gravitational difference between a person's feet and head would be too much resulting in their blood accumulating to their feet and causing light headedness. However, as we previously mentioned while talking about centripetal acceleration, a smaller spacecraft would mean faster rotation, a larger one would mean slower. Which isn't exactly a benefit seeing that space travel already takes a large amount of time depending on the destination.

Now it has come to the question of whether or not a rotating spaceship has ever been attempted to be created before. By rotating the capsule around the Agena Target Vehicle, to which it was linked by a 36-meter tether, the Gemini 11 mission, which was the spaceflight mission of NASA's Project Gemini, sought to create artificial gravity. The mission was actually successful in generating artificial gravity by using their side thrusters to rotate the combined craft like a pair of bolas in slow motion. However, the number was very insignificant as it was only about 0.00015 g. Due to the rather smaller resultant gravity while



Picture of Agena Target Vehicle from https://bit.ly/37RTNDo

astronauts were not able to feel it but objects had been seen drifting towards the capsule's surface. In addition to the Gemini 11 Mission other few proposals that incorporated artificial gravity in their designs were made. These included; Discovery II, Multi-Mission Space Exploration Vehicle (MMSEV), ISS Centrifuge Demo, Mars direct and Tempo3. Unfortunately to this day, despite the many attempts artificial gravity remains unused. This is due to several factors starting with what the size requirements would be for an aircraft or spaceship that would have the ability to generate artificial gravity. A smaller spacecraft would require faster rotation as the radius would also be shorter in a smaller spacecraft. As a result, it would be preferable to use a larger spaceship that rotates slowly to simulate gravity. The size requirements for rotation are related to the varying forces acting on portions of the body at different distances from the rotation axis. If sections of the body closest to the rotational axis are subjected to a force that differs greatly from those farther away, this could have negative consequences. In addition, a bigger spaceship would require a lot of material and a very large space which translates to the requirement for a lot of resources that we are not exactly in possession of. ("Why Don't We Build Spinning Spaceships That Create Artificial Gravity? › Ask An Expert (ABC Science)") In the future however, the benefits of a rotating spacecraft could outweigh the disadvantages.

Pırıl Zadil / 10

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The Red Planet: Earth 2.0?

"Humans will absolutely be on Mars in the future," said NASA chief scientist Jim Green (USA TODAY, May, 2018). For years now, people have been awaiting an advancement great enough to ensure possible life and habitability on Mars and many researchers argue that time is close to come. Mars, also known as the Red Planet, is the fourth planet from the Sun as well as the most Earth-like planet in our Solar System. Since the first time the idea came up in the early 2000s, Mars has been considered viable for the migration and potential relocation for a fraction of the human population. So, what is stopping us from actually getting and inhabiting the Red Planet?

The first obstacle is a technical and logistical one. When the Earth is closest to Mars, it takes about 260 days to arrive at the destination. Technology isn't that advanced yet to find a way to shorten that time period. The trip to Mars is a long one, therefore the fuel the rockets used, should be nuclear thermal or electric propulsion, as opposed to the majority of the rockets that have been sent to outer space using rocket fuel. This way, it would decrease the time it takes to arrive to the planet as well as the fuel amount needed. These are, however, considering the fact that the ship would be much more compact (Nichols, 2017). Nuclear electric propulsion systems use propellants far more effectively than chemical rockets, but they produce little thrust. They create energy in a reactor that positively charges gas propellants like xenon or krypton, then push the ions out through a thruster that propels the spaceship forward (Learn, 2021). This system effectively uses low thrust to drive spacecraft for long periods of time and can push a Mars trip for a fraction of the cost of high thrust systems. Nuclear thermal energy is created by transferring heat energy from a reactor to a liquid propeller. The heat would eventually turn the liquid into gas, which would expand to propel and provide thrust for the spacecraft to then move forward. Though this has not been done yet, several scientists are working on experimental procedures to accomplish this by using various nuclear fission technologies. The first test drive is being planned to be demonstrated on the Moon (Skelly, 2021).

Next, before even attempting to conduct experiments on Mars's surface, researchers have to find a way to successfully land an

aircraft carrying people. Currently, NASA is capable of landing a 1-ton vehicle, the Curiosity rover, on Mars' surface. To land, humans would have to park around at least 10 tons on the ground. Considering the supersonic retro-propulsion technology will be used, the spacecraft will need to be able to deliver around 20 tons. That spacecraft would also have to land precisely and smoothly, avoiding mountains, hills, and rocks. Aside from the landing, scientists also need to find a way to return to Earth. Right now, it seems to be a one-way trip, but returning still must be an option (Nichols, 2017).

Let's say that the trip and landing were successful, what happens then? Aside from technology, we need to discover more about how humans—creatures that evolved to survive in the Earth's atmosphere with the Earth's gravity—will manage being in a low gravity, close proximity, near environment condition for several months on spaceships. Studying how astronauts living on the International Space Station cope with the solitude and low gravity up there, as well as how they cope when returning to Earth, has been ongoing for some time. The numerous lunar missions also revealed how the astronauts handled the low-gravity environment there. So, researchers are searching for psychological and biological implications that humans are ready to experiment habitation on Mars. So far, scientists are planning on sending humans on the Moon to get a better understanding of what it is like to live away from Earth (Learn, 2021).

Okay, now we have established how humans play into all of this, but why is Mars considered to be fit in the first place? 4.2 billion years ago, Mars's magnetic field disappeared due to its iron core's current shutting down; causing the magnetic field to vanish, resulting in the solar winds with charged particles to destroy the atmosphere. Normally, the charged particles would repel each other, but since the magnetic field disappeared, the solar winds started to invade into the planet through its atmosphere; leading Mars to become a planet without an atmosphere. The lack of an atmosphere is what currently differentiates Earth from Mars. The atmosphere protects planets from external factors and keeps the pressure constant, making it habitable. Back in 2017, NASA had a plan to place a giant magnet in between the Sun and Mars to help Mars evade the Sun's once destructive particles, and regain its magnetosphere. This would give Mars a chance to reestablish its atmosphere. Mars's climate would become 4 degrees Celsius warmer, which would be enough to melt the carbon dioxide ice on its polar cap (Williams, 2017). The carbon dioxide in the atmosphere would trap heat, creating a greenhouse effect and would potentially help Mars get its liquid water back. If this were the case, Mars would be considered habitable for humans. Right now, Mars is not fully habitable for humans, but it does have traces of life/potential life on it.

If humans were able to travel to, land and inhabit the Red Planet, the habitats would likely have a few characteristics in common: they must be self-sustaining, sealed against the thin atmosphere, and capable of supporting life for long periods of time without assistance from Earth. To exemplify, consider the International Space Station (ISS) to get a sense of what to expect. During the first manned voyage to Mars, anticipate large, durable equipment to travel across the stars, whatever the astronauts use must be able to withstand the extended flight. Therefore, habitats will need to be considerably large (Nichols, 2017).

The easiest approach to make a habitat self-sustaining on Mars is to keep food and medicinal supplies stocked, but with a thin atmosphere and limited sunlight, growing anything can be challenging. Artificial leaves, which are engineered to perform in adverse situations, could provide a solution for first aid, as availability to medicine will be a key aspect in habitability. These silicone rubber leaves can convert a small amount of sunlight into enough energy to drive the chemical reactions required to create medication and other substances (Nichols, 2017).

Farming and establishing a food source would be necessary for the first colonists on Mars.

Beans, asparagus, and potatoes, according to scientists, are suitable crops for the soil. Unlike popular belief, it is not really possible or necessary to create a greenhouse, which is similar to the ones on Earth, to grow plants. While the plants will require more pressure to grow, it isn't necessary to be at an Earth-like pressure. Indeed, the greenhouse can be pressurized with carbon dioxide, which is the primary component of Mars's atmosphere (Nichols, 2017).

To conclude, even though we have a long way to go to make Mars inhabitable, there is one thing that is clear: life on Mars, is a definitive maybe. It seems, as technology improves, the likelihood of reaching and living on Mars increases exponentially. But one of the most important things to acknowledge is that the planet does not need to actually evolve into Earth 2.0. Perhaps one day it may, but for now, it must suffice as a place for NASA scientists to live and experiment on.

Zeynep Atabek / 10

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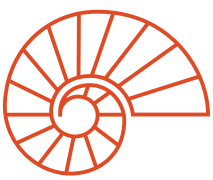

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