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On July 30th of 1945, two torpedoes launched by the Japanese struck and sank the USS Indianapolis. Along with the ship, 880 of the 1016 men would be forever lost in the depths of the ocean. The remaining 316 survivors had to battle through sharks, hunger, and perhaps worst of all, the lack of water… drinkable water.

Now, imagine if these brave men had access to a portable water bottle capable of desalination through nanofiltration technology. Even better, imagine if the ship was made of advanced nanomaterials and never sunk in the first place!

But before I dive deeper into the nanoworld and its relation to the US Navy and Marine Corps, let me first explain the origins of my passion for nanomaterials, which began from a TED-Ed video on the LifeSaver bottle. As an avid environmentalist, I always had an interest in water treatment and the LifeSaver bottle's use of ultrafiltration membranes and activated carbon caught my attention, especially its ability or at least its claims of having the ability to filter out 99.9% of contaminants. I am sure many would be impressed by this technology, but I am a little different. Rather than focusing on the 99.9%, I was more curious about that 0.1% that couldn't be filtered out.

Thus, in an effort to chase after that elusive 0.01% and to satisfy my own curiosity, I chose to ignore the obvious legal liability explanation to why companies never claim 100% decontamination, and decided to go beyond the realm of ultrafiltration by researching into the even smaller realm of nanofiltration and nanomaterials. Yes. I'm not joking. What inspired me to learn more about nanoscience was a percentage that was advertised for a water bottle from a TED-Ed video on Youtube.

Now, let me circle back to how nanomaterials, specifically graphene, can improve the Navy and Marine Corps. Due to my prior interest in water treatment, when I first learned about graphene from the video "Nanomaterials with Dr. Richard Ordonez," I was immediately drawn to its usage for desalination. With its unique nanopore structure, durability, and high surface area, graphene would be perfect for selective capturing of salt ions and in my opinion, essentially an upgraded version of the activated carbon used in the LifeSaver bottle.

One might ask, why should the Navy or Marine Corps care about water supplies? Isn't water the most abundant resource the Navy and Marine Corps would have? After all, they literally live on the ocean. Although that is true, the abundant water is in the form of saltwater and with operations that can last for years out, desalination of ocean water is vital for the Navy and Marine Corps. Not to mention, the Navy and Marine Corps current use of the Light Weight Purification System for desalination still requires insanely high pressure and lots of energy to operate. Due to its properties, a graphene membrane based desalination system would be more efficient and cheaper to operate.

Another aspect of graphene worthy of the Navy and Marine Corps attention is its hydrophilic and hydrophobic properties. Wait what? When I first learned about its hydrophobicity I was extremely confused as well, especially since I had just learned about graphene-oxides use in water treatment which easily confirmed its hydrophilic property. But according to research done by the Naval Research Laboratory, its hydrophobic and hydrophilic properties actually depend on the thickness of the layers with single layered graphene showing hydrophilic tendencies and double layered graphene showing hydrophobic properties. How is this relevant? Well, in recent years, the Navy has been experimenting with superhydrophobic coatings of ships and submarines to decrease drag in the ocean, so I believe the potential hydrophobic property of graphene is an area of interest. In addition, graphene is also a strong, durable, and light material so it would definitely be of interest to use in metal matrix composites which are regularly used to build the current battleships.

In the past the high production cost of graphene would make it not unaffordable on large scales, but the recent advancements in the use of graphene-oxide changes everything. It is a much cheaper method of production that essentially only requires the oxidation of graphite. Furthermore, Rice University has also developed a process known as flash graphene which can produce graphene from almost any carbon based waste. Through the use of two electrodes that sends short and intense high energy electrical pulses, carbon based waste like food scraps, rubber tires, plastic, and others will instantly heat up to 3000 degrees Kelvin, causing all the bonds to break and later reform as turbostratic graphene which is a structure of graphene that allows for easier separation of layers when compared to the AB stacked form of graphene. Thus, allowing the production of graphene to not only be cheaper but more environmentally friendly.

Now enough of this talk about graphene, let us transition to Dr. Richard Ordonez who not only got me interested in graphene, but even convinced me to change my future career and dream job.

In case you have not realized, I am what many would call an environmentalist. From global issues like water pollution and climate change to my friends who still do not know what belongs in the recycling bins, I care about all these crises and have always wanted to become an environmental engineer. But after watching and learning from Dr. Richard Ordonez I realized that all the issues I care about have a hidden connection—material science. Plastic pollution? Find an alternative material that is biodegradable. Climate change? Find a material that can capture carbon dioxide such as activated carbon or… graphene. I never realized that my real passion is not just in the environment but also in materials engineering and that is the field of engineering in which I want to major in college.

Dr. Richard Ordonez also inspired me to change my dream job. As a scientist that works for the Navy and Marine Corps, he made me reconsider what it actually means to be a part of the military. Up until a week ago, I was actually very much against working for the military because I had believed that as a military engineer or scientist I would be forced to design and build weapons of mass destruction. Perhaps it was due to watching too many war movies, but in my mind I thought all those military scientists would be cold hearted humans. Dr. Richard Ordonez was nothing like what I had imagined a typical military worker would be like and in fact was quite a humorous man himself, but more importantly he was doing work that would help others and that is also my lifelong goal as an engineer and as a human being.

Thus, in honor of Dr. Richard Ordonez and his crazy story about how he stumbled upon the idea of using honey as a biodegradable transistor because he just so happened to have gotten honey that day for his stomach ache issues, I will also announce one of my crazy ideas, which is using the flash graphene process or something similar to what was developed by Rice University to convert carbon dioxide into graphene or at least a non environmentally harming material. Rice University claims that the flash graphene process can be used for almost any material containing carbon so why not carbon dioxide? Many of the current carbon capture methods, like the use of amine, are expensive and also use chemical reactions. The flash graphene process is much simpler and does not use any chemical reaction. Ideally, if we are able to find a way to use carbon dioxide as a source for the flash graphene process we would be separating the carbon dioxide into carbon (in the form of graphene) and oxygen which is also an invaluable resource.

20 years from now, I envision nanomaterials to be a core technology in the Navy and Marine Corps. Remember the incident with the USS Indianapolis I told you about in the beginning? In 2040, I believe a crisis like that would never happen again because the warships would be constructed with metal matrix composites that include nanomaterials like graphene. I also expect the water purification system aboard the warships to be using nanomaterials like graphene-oxide membranes and nanofiltration technology to reduce costs and energy usage. I also envision marines equipped with portable water bottles that have nanofiltration technology implemented within to achieve that elusive 100% decontamination rate. I expect that warships will have self-sustaining water supplies from desalinating ocean water and never need to waste time resupplying on land. I expect that our soldiers will never again have to experience what the survivors of the USS Indianapolis did.

But most important of all, 20 years from now, I expect to see myself working in a government laboratory leading the research and development of these nanomaterials that will forever change the world.