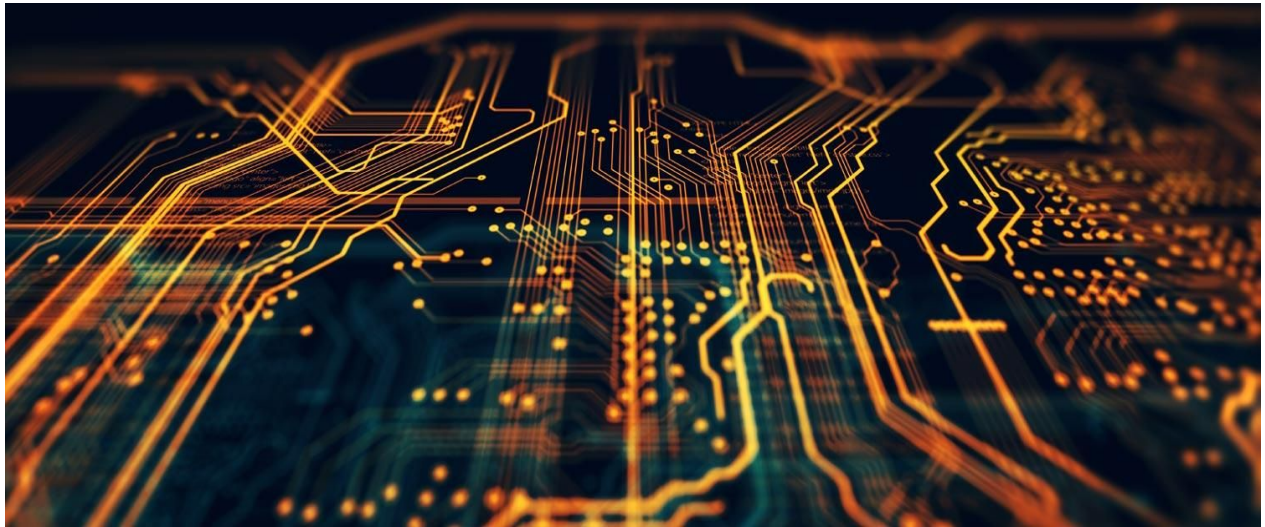


Physics Newsletter

December 2020



Hi guys welcome to another edition of the physics newsletter. So far we've been covering a lot about the cool and useful applications of physics, from maglev trains to quantum computers, we've learnt how integral physics is to our modern world. But who are the wonderful and creative people who apply all this physics to create something that is not just mind-boggling but also incredibly important. In this edition we'll be looking at some of the careers you can pursue as an aspiring physicist as well as other impressive engineering projects.

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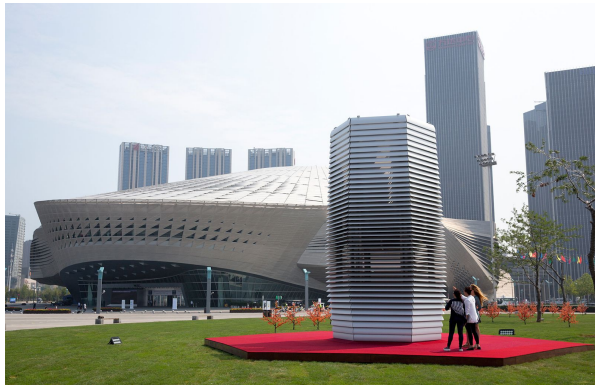
In this edition we will discuss:

- Environmental Engineering
- Aerospace Engineering

Environmental Engineering

We all agree on one thing. Global warming is one of the biggest and rapidly escalating problems we face today. Somehow under the exponential growth of humanity we must find a way to distribute the Earth's resources fairly and sustainably and environmental engineers may be the only ones that can find creative everyday solutions that could change the course of our planet. In this article I'll tell you about all the impressive gadgets engineers from around the world have innovated, and what these types of engineers do.

Smog Free Project



There are a few projects that jumped out at me but first we will talk about the 'smog free project'. Essentially, this 7 meter giant converts your everyday pollution to jewellery. 'How' you ask?

This machine is a giant air purifier, it simply sucks the air around it, passing it through its fins and filters. Then, pollutants (carbon) and fine dust in the air are trapped and collected, which are subsequently compressed to produce the ornament for the ring.

Clean air in the end of the collection is passed through the bottom of the device. The machine cleans a shocking 30,000m³ of air per hour and is powered by only a small amount of green electricity. It uses a 'patented ozone-free ion technology' and in simple terms this technology bombards the carbon particulates with positive ions so the smog becomes positively charged. Then it attracts the positively charged pollutants onto a negatively charged plate to collect it all. All of this in a nanoscale.



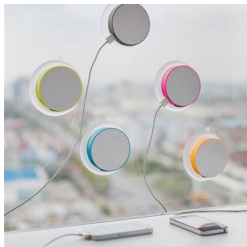
Port chargers

In comparison to the project above this device may sound more basic, but phone chargers that attach themselves onto the window and are charged using solar power may be a game changer. Can you even imagine the utility and efficiency of this object? Your phone can be sitting on the window ledge while it charges without the hassle of finding a socket or carrying a bulky portable

charger around. Your phone will harvest solar energy straight from the window and use this to power your phone.

How?

Here are the technicalities. The flow of electrons is electrical energy. To generate an electric current, electrons must be knocked out of orbit from their atoms. This is possible by giving them enough energy so that they fling out of orbit. Photons (packets of energy) carry enough energy to kick electrons off of atoms and specifically those from the sun have enough energy to pull electrons out of orbit from silicon atoms, the most used element for solar batteries. An



imbalance of positively charged particles and negatively charged particles creates an electric current from which you can charge your phone.

There you have a way to power your phone by the power of nature itself, independent of any sockets. Although this may not make a difference on its own, it is a stem to innovating technologies which are harmless to our planet.



B-Droid

Robotic bees. 75% of crop species require pollination from bees and because of many reasons (e.g pesticides, pollution, viruses etc) bee population has come to decrease. Now a group of engineers spent four years building an “autonomous device for mechanical plant pollination” AKA robotic bee. This B-droid isn't a carbon copy of an actual bee but it does its job quite well. Tests were done and the quality of

seeds its work produced were better than your average bees. This thing can fly too, but it can't for that long so instead it rolls around on the floor pollinating low lying flowers. The horse hair brush at this robot's end moves pollen from one plant to the other. The technology involved in this project is too intricate to explain in this article but as you can imagine, if a robot needs to pollinate flowers it must detect where flowers are, its own terrain and location, the movement of the brush and so much more.

The most important thing to remember though is that pollination is key for this race's survival and if a world without bees ever arises, this robot invented by engineers may come to the rescue.

What do environmental engineers do?

For the first part of the article I have been talking about environmental engineering projects, but what do they actually do day to day? Environmental engineers (which I will now abbreviate to “EEs”) have found fun and creative solutions to the problems that most of humanity does not know how to solve. They look at how to minimise pollution and waste given out by us so we can preserve the planet and potentially save it. As all engineers need to solve problems, the main causes of concern for these people are climate change, droughts, overpopulation, urbanisation, pollution, deforestation and the energy crisis.

Usually most EEs keep companies in check and give them advice on how to make their projects more eco-friendly or even make wacky inventions, the range is huge! You will most likely have to do an undergraduate degree in engineering/physics and major in environmental engineering/biological engineering. Personally, I think this job is for the creative people (as are all engineering jobs), and although the road may be tough your job can, quite literally, change the world for the better. This job is really sustainable as a career too because globally more countries are aiming to become more green. Therefore, job growth is suspected to be around 5% from this year to 2030 and environmental engineering is the 4th fastest growing engineering field.

Qualifications

- AAA - ABB including Maths and Sciences (usually Physics and Chemistry)
- Major in Environmental Engineering, Civil Engineering, Marine Engineering, Mechanical Engineering, Chemical Engineering and Process Engineering

Many universities such as Imperial, Manchester, Kingston University London and etc offer courses.

But of course, any type of engineer can find solutions to environmental problems, such as for the b-droid which aeronautical engineers created. You just need the passion.

Hopefully this article informed you about an engineering field you may not have known beforehand.

Thank you for reading up till here (and carry on too!)

Merry Christmas!! :)

- Vanshika Gupta 12P

Aerospace Engineering

While environmental engineers are focusing on ways to sustain the existence of the human race, we'll be flying high and looking at aerospace engineers... but what are they?

There is a slight difference between aerospace engineers and aeronautical engineers. Aeronautics is actually just one branch of aerospace engineering. This is because aerospace engineering is concerned with designing and building both air- and space-crafts. Aerospace engineering is divided into two areas: aeronautical engineers, who handle aircrafts such as planes, and astronautical engineers, who design shuttles and rockets and other forms of vehicle that travel in space. So in this article we'll be looking at what aerospace engineers do on a daily basis and how to become one, but let's start off with some really cool concepts and inventions within this sector.



The Solar Impulse 2:



Hawaii, United States of America, June 28, 2015.
Solar Impulse 2 lands in Hawaii with André Borschberg at the controls.

A lot of recent inventions have been based on the need to obtain and acquire sustainable and efficient energy resources, spurring on hundreds of concepts and ideas for the future. Within aerospace engineering, it has led to the development and creation of the "Solar Impulse". Solar impulse is a swiss, experimental, long-range and solar- powered aircraft project. That essentially means that a whole aircraft is being moved across the skies without any fuel- crazy, right? The Solar Impulse 2 completed a "round the world" journey without a modicum of fuel. How, you ask? Well, as it can be guessed by the name, the plane was powered by the Sun's energy. The Solar Impulse managed to cover 40,000 km while being piloted by Bertrand Piccard and André Borschberg.

Bertrand Piccard is a medical doctor who specialises in psychiatry but is also an explorer and aeronaut, making the first ever non-stop round the world balloon flight. He was the initiator of the project and is now the chairman. André Borschberg, who is an engineer, fighter pilot and a professional airplane and helicopter pilot, is the co-founder and CEO. Together, their work on this project has led to record- breaking achievements and a glimmer of hope for all, as they pave

the way to a sustainable future. The Solar Impulse 2 was not the first solar powered plane however, it was the first of its kind to fly day and night without carrying any excess fuel, by only using energy stored in its batteries, as well as being the first to cross oceans. Its weight is minimal being the equivalent to the mass of a family car, meaning that it needs little power despite its huge size. It has the power of “a small motorcycle”, which is jaw- dropping especially when seeing how big it is in size.

The details: Of course, many people contributed to this mind- boggling project, including technicians, engineers, mathematicians and meteorologists, so to find out the details, you can explore more by clicking this link: <https://aroundtheworld.solarimpulse.com/adventure>

VASIMR Plasma Based Propulsion System:

A not so recent but equally important project is the VASIMR project by NASA. VASIMR stands for Variable Specific Impulse Magnetoplasma Rocket and it basically means that the rocket has an engine that is powered by plasma (I'll explain how it works later). But why is this “plasma-powered” engine necessary, when we've used chemical fuels to power our journeys into the cosmos for the past 60 years? Well ever since John Glenn became the first American to orbit the Earth in 1962 rockets have still been going at the same speed. As we aim to delve further into our universe, it has become necessary to find a way to travel faster through space. VASIMR allows us to travel through space more quickly and has some other quirky benefits. The VASIMR engine has the potential to help protect astronauts from the dangerous effects of radiation in space and could even keep the International Space Station in orbit without requiring extra fuel to be brought up from Earth.

So how does it work? Well the engine is based on plasma providing propulsion for the spacecraft. In case you don't know plasma is a fourth state of matter, where electrons detach from the nucleus and atoms are split apart. An electric power source ionises fuel (this could be protium- hydrogen, deuterium another isotope of hydrogen and helium) into plasma. Then electric fields heat and accelerate the plasma, providing its velocity, while the magnetic fields move the plasma in a specific direction, which ejects it from the engine and creates thrust for the rocket and shuttle. The engine can vary the amount of thrust generated, allowing it to increase or decrease its acceleration.

There are many benefits of using hydrogen as a fuel for the VASIMR rockets, one of them includes the fact that since hydrogen is the most abundant element in the universe, the rocket would only have to carry the fuel needed to get to a destination and then could refuel upon arrival! Hydrogen is also one of the best known shields against radiation so the fuel could help the crew decrease their exposure to the dangerous effects.

What does the job entail on a daily basis?



Now, this doesn't mean you should be assuming that you'll suddenly be creating zero-fuel planes or setting off plasma-powered rockets on a daily basis, however, if you do like learning how things work, manufacturing and putting things together, aerospace engineering could be for you. Usually, an aerospace engineer designs, tests and manages the manufacturing of aircrafts, spacecrafts,

satellites, or missiles, depending on whether they work in aeronautics or astronautics. You can choose to specialise in a specific type of aerospace product, such as missiles and rockets, military fighter jets, helicopters, or commercial aircrafts like planes. Since you can deal with such large machines, you can also choose to be a specialist in certain areas such as communication, navigation, structural design, guidance/ consultancy or production methods, since we can also increase efficiency and sustainability during the manufacturing process by reducing waste products or toxic by-products.

What topics are studied as part of the degree?

Degree-wise, there is a specific aerospace engineering degree that you can study to become an engineer, however, you may also be able to become an aerospace engineer with a degree in: computer science/software engineering; electrical and electronic engineering; mechanical engineering; physics or applied physics; or other space-related courses.

For an aerospace engineering degree as an undergraduate, you usually learn the fundamentals of all the subsystems and major components (e.g. engines, aerodynamics, thermodynamics and propulsion) necessary to create an aircraft or spacecraft. Most modules are: aerodynamics, space mission analysis and design, mechanics of flight, heat transfer, airframe design, flight dynamics and space systems. You are also taught, in most cases, some aspects or details of the design process, manufacturing and testing. However, with most things, you learn how to apply your knowledge when you start working in that area. Although you can choose to do specialist degrees in certain areas of aerospace, typically as a graduate/ masters degree (these help with analytical areas), most skills are developed when participating in the engineering process.

Well that was certainly a lot of information to process, if you managed to read this far, well done and Merry Christmas!

-Siyma Chowdhury