DECEMBER 2024 | WINTER ISSUE

AUDREY HEPBURN
photographed with a microscope preparing for her role as a nun with a specialty in tropical medicine for The Nun's Story, 1958

GIRLS IN STEM

SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS

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ABOUT US

Launched in September 2024, *Girls in STEM* is a passion project born from a moment of self-reflection, a time when I felt torn between the path I had chosen in university and the realization that I was drawn to the world of STEM which had never been presented to me in the right way. I wanted to do something meaningful, but I didn't see how I could make that transition. That's when the idea for this magazine took shape: a place where young girls, who may feel the same way, can find motivation, inspiration and role models to encourage them to pursue STEM with confidence and passion. Through stories of real women in STEM fields, insightful interviews and informative content, this magazine is dedicated to sparking curiosity, breaking down barriers and inspiring future innovators. With every issue, we hope to bring a little more confidence, a little more curiosity and a whole lot of inspiration to the next generation of girls in STEM.

WITH SIX ARTICLES AND FOUR INTERVIEWS

FROM *THE* EDITOR

As the days get chilly, the air gets crisp and when it's dark and cold outside, prepare a hot chocolate, grab your blanket and settle on your sofa, you have my STEM magazine to read! (Actually while I was writing this I realized that in the other side of the globe it's summer... Umh anyway let's move on...).

Wow, this is incredible I would have never imagined someone would actually participate, I was already thinking I had to write all the articles under different names, but luckily someone took interest in my little project and here we are.
You need to know that I hate group projects and I tend to do everything on my own, which is why I was the editor, the writer, the graphic designer and the social media manager. However I wasn't alone, I couldn't have done it without everyone who decided to join me and most of all Aria and Vivi; so much love to my girls who helped me through the journey and supported this crazy idea since the beginning. I am also incredibly grateful for each of you who participated: Aria, Gwyneth, Christine, Kshiraja, Soso, Kristina, Grace and Alessandra

Well, I hope you all enjoy what we have created in these last months!

Arianna Moreo
Editor-in-Chief

enjoy...

girls in STEM, the magazine

HALLEY'S *COMET*

and its Beautiful Presence in Pop Culture

Bayeux Tapestry, scene 32, XI century

What is Halley's comet?
Halley's Comet, also known as 1P/Halley, is a short-period comet visible from Earth approximately every 75-76 years. It is one of the most famous comets in history, named after the English astronomer Edmond Halley who calculated its orbit. The comet's last appearance was in 1986, and it is expected to return to the inner Solar System in 2061.

Where can we find Halley Comet in pop culture?
Comets have been observed by humanity for thousands of years and because they disturbed the harmony of the starry sky, they were soon deemed to be a bad omen. Halley's Comet has been represented since the early ages, in particular, its appearance in 1066 won her a place in the famous Bayeux tapestry, a long, narrow strip of coarse linen (70 metres by 51 centimetres), which is displayed in a special museum in Normandy. It unfolds the tale of the 1066 conquest of England by the Duke of Normandy. In a segment depicting the incoronation of the Anglo-Saxon king, Harold, two men point at the sky where we can notice the comet, which is seen as a bad omen, as a matter of fact, the new king will soon be killed in the battle of Hastings by the Normans. Ever since, the comet has made appearances in many more masterpieces of literature, cinema, television and music and has even been featured in softwares. For example, regarding literature, Arthur C. Clarke's "2061: Odyssey Three" includes a detailed mission to the comet. Focusing on cinema, the Mexican film "Halley" is inspired by the passage of the comet, using it as a symbol of the cyclical nature of human life, even though Halley's Comet is never mentioned in any of the dialogues. When it comes to music, the first song that might come to your mind is Billie Eilish's "Halley's Comet," featured on her album "Happier Than Ever", which the singer herself describes as a "sweet, romantic song" and is about "falling in love and feeling a feeling of euphoria, like you're floating".

Why is Halley's comet so famous?
Halley's Comet has achieved its legendary status for several reasons. Firstly, it is one of the few comets visible to the naked eye from Earth, making it accessible to the general public. Secondly, its predictable 75-76 year

Halley’s comet, W. Liller, Easter Island, 1986

orbit allows for anticipation and planning of its appearances, creating a sense of cyclical wonder across generations. Lastly, its long history of recorded sightings, dating back to at least 240 BCE, has cemented its place in human culture and scientific understanding. However the comet's cultural significance extends beyond its scientific importance, its periodic appearance have often been interpreted as omens or harbingers of change throughout history. In conclusion, as we already mentioned this enduring fascination with Halley's Comet has inspired countless works of art, literature, and music, further solidifying its place in the collective human imagination.

MENSTRUAL HEALTH 101

Understanding Your Cycle and When to Seek *Help*

For those who menstruate, menstrual health plays a large factor in their overall health and mental well being. Menstrual health impacts the daily lives of about 26% of the global population. By taking the time to understand the not-so-complex world of the menstrual cycle, individuals can identify what is normal or abnormal about their periods, leading to a healthier life.

What is a menstrual cycle?

A basic menstrual cycle overview is divided into four phases: menstruation, the follicular phase, ovulation and the luteal phase. The menstruation phase, more popularly known as the period, is the part of your cycle when the uterus sheds its lining (endometrium) and allows the blood to exit the body through the vagina. This stage lasts about 4-7 days, depending on the person. The follicular phase begins on the first day of your menstruation phase, and lasts about 13-14 days. So, there's a bit of an overlap there. In this phase, your hormone level begins to change and that causes the lining of your uterus to thicken and follicles begin to grow on the surface of the ovaries. Typically, only one follicle will grow and mature into an egg. The ovulation phase is when the mature egg is released from the ovary. This phase occurs once a month, and usually two weeks before the next period begins. At this phase, an individual is more likely to become pregnant, so it's best to stay cautious around this time! Lastly, the luteal phase is when the egg travels through the fallopian tubes to your uterus. At this phase, the endometrium continues to thicken to prepare for a possible pregnancy. In the case that a sperm meets the egg, the individual falls pregnant, and won't have a period until after the pregnancy.

Common Menstrual Disorders

There are many menstrual disorders

Phases of menstrual cycle, Tom Organic

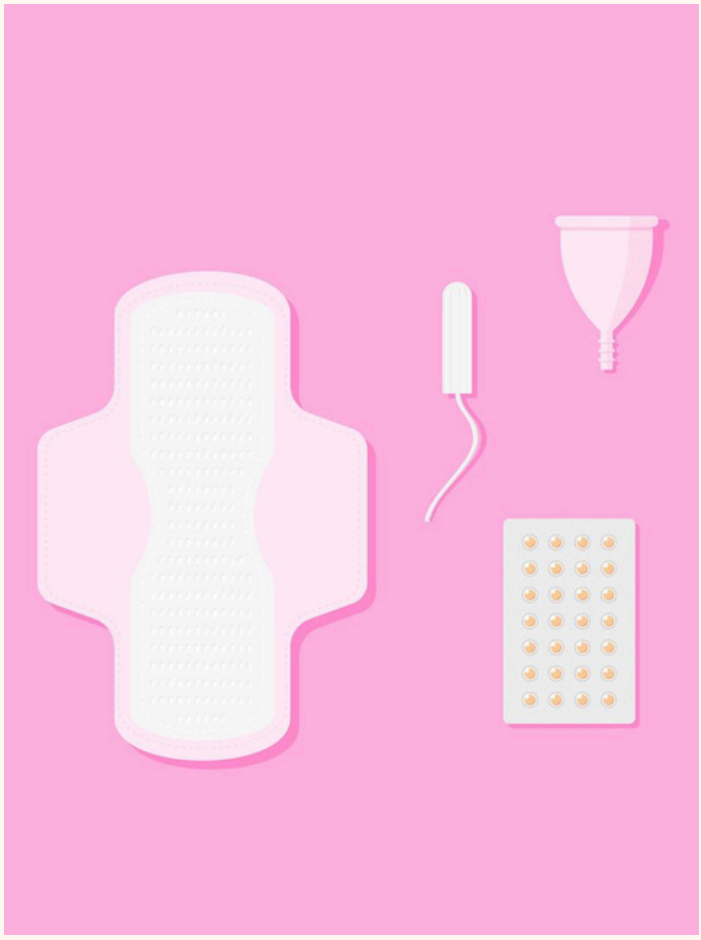
that affect the lives of thousands. Some of these disorders can affect not only the physical aspect of an individual's life, but also the mental aspect.

- Dysmenorrhea is a severe and frequent cramping during menstruation. Pain will occur in the lower abdomen, but it can spread to the lower back and thighs. Dysmenorrhea is divided into two sectors: primary and secondary. The primary one is diagnosed when the cramps occur from contractions in the uterus and become more severe during heavy bleeding. The secondary one is diagnosed when the cramping is associated with another menstrual disorder like endometriosis or uterine fibroids.
- Menorrhagia is when the uterus excretes an excessive amount of menstrual blood. Menstrual flow will last longer and is much heavier than the usual. The flow is able to soak through more than 5 sanitary products per day, and often requires more frequent changing.
- Amenorrhea is the absence of a menstrual cycle. Like Dysmenorrhea, it is divided into two sectors: primary and secondary. Primary Amenorrhea refers to when a girl does not start to menstruate by the age of 16. Secondary Amenorrhea is when in a girl who previously had a normal menstrual cycle it suddenly stops for at least 3 months.

Recognizing Symptoms and When to See a Doctor

If you recognize any of the following symptoms, it is best to book an appointment with your OB/ GYN or family doctor.

- Dysmenorrhea: Cramping in the lower abdomen, pain in the lower abdomen, low back pain, pain radiating down the legs, nausea, vomiting, and diarrhea.
- Menorrhagia: Soaking through one or more sanitary pads or tampons every hour for several hours in a row, needing double sanitary protection to control your menstrual flow, getting up at night to change sanitary pads or tampons, and bleeding for more than a week.
- Amenorrhea: Excess body hair (hirsutism), hair loss, headache, lack of breast development, milky discharge from the breasts, and vision changes.

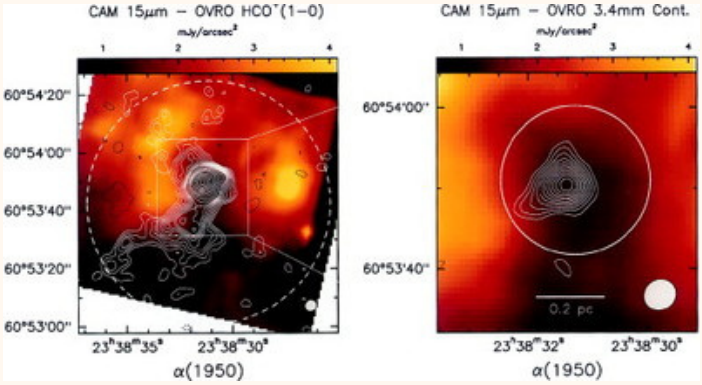


Sanitary goods, Parents

Menstrual health, UNFPA AsiaPacific

Managing Menstrual Health

Managing your menstrual health is important. It can help evaluate any pain, discomfort, or stress that comes with your menstrual cycle. The good thing about managing your menstrual health is that it comes down to you and how you know your body. Whatever works for you may not work for others, and that's okay! As long as you know how to manage it, that's what really matters. Studies have shown that getting regular exercise, changing your eating habits, and reducing your cortisol levels may help with menstrual symptoms, such as cramping and fatigue. It is also best to contact your family doctor or OB/GYN if you are eligible to take an over-the-counter medication to help relieve any symptoms of menstruation. Remember, taking charge of your menstrual health is a powerful step towards overall well-being, don't hesitate to seek the support and answers you deserve.



IRAS 23385+6053, The Astrophysical Journal Letters, 1998

HOT START

Protostar Chemistry

Our feeble minds cannot grasp the complex boundaries of galactic bodies. No likeness from beginning to end of a star's life. The tapestry of star formation starts from the abundances of gasses to form the young protostars; which in itself holds a fascinating niche. Studies that snapshot these moments provide valuable insight to existing research and prevent oversight. NASA is no different with studying protostar cluster IRAS 23385+6053 to better comprehend the various chemical processes and its composition; holding significant chemistry that is often overlooked.

Protostars are young stars that continue to develop under the masses of their parent interstellar clouds. Significantly, a representation of an early phase of a developing star that could become a much larger star. In cases such as IRAS 23385+6053, the mass is a furnace of chemical reactions catalyzed from high temperatures and densities. Under these conditions, it sets up the formation of a wide range of molecules, from diatomic species to complex organic compounds.

In the Cygnus X-1 region of the Milky Way, distinctive for the location of the swan constellation known as Cygnus; IRAS 23385+6053 is in a hotpot of tremendous amounts of gas.

There are many devices such as Atacama Large Millimeter/ submillimeter Array (ALMA) and NASA's Infrared Space Observatory (ISO) issuing an explicit spectra, indicating the variety of lights that are being emitted in a given sample. This sample can reveal wavelengths, elements, densities, magnetic fields, etc. Specifically in this chemical rich environment, the data reveals the presence of numerous molecules such as carbon monoxide (CO), formaldehyde (H2CO), methane (CH4), methanol (CH3OH), acetic acid (CH3COOH), and many others. Such complex organic molecules (COMs) are a stirring pot to star formation.

Many COMs hold a foundation in star development, creating structure, establishing temperatures and characteristics that apply to the protostar. Many of these familiar gasses are often overlooked for their great significance in star formation.

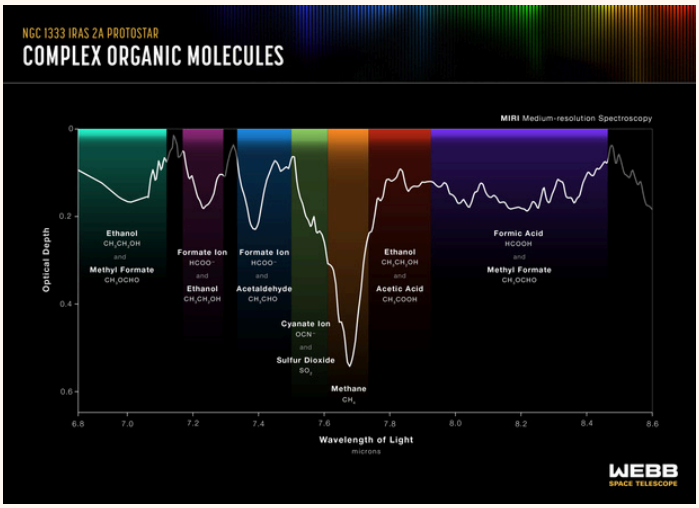
Methane (CH4) is a colorless and odorless gas used to fuel heat and light in everyday appliances. For a protostar like IRAS 23385+6053, methane is located in the warmer regions of the protostar cluster. It consists of a single saturated hydrocarbon that acts as a coolant for the collapse of interstellar

clouds because of its absorption of thermal energy from collision-induced emissions. Traces of methane equate to the protostar just being in its beginning stages. Essentially, methane is one of the most simple compounds that a gas can form into as being a precursor to more complex structures. This is the same gas that is released from cows' stomachs, yet it holds a significant value to the embryonic stages of a protostar.

Methanol (CH3OH) is another molecule that has uses in everyday materials such as synthetic fabrics and fibers for polyester, which later came to produce clothing. Under IRAS 23385+6053, methanol forms on icy surfaces of grainy dust then under thermal desorption, methanol can be released into a gas; essentially from solid ice into a gas. Although it is a relatively simple organic molecule, methanol is one of the largest molecules ever found in these developing stages. This is the same gas that could be found in fruits and vegetables in low quantities.

In IRAS 23385+6053, other complex organic molecules (COMs) such as dimethyl ether (CH3OCH3) and methyl formate (HCOOCH3) are prebiotic, indicating the potential foundation for life. Especially for the potential to create amino acids and sugars that could be synthesized before the birth of planets.

However, for such evolution, to create even more complex molecules from the other existing ones listed, chemical reactions are required: gas-phase reactions and grain-surface chemistry. The creation of methyl formate occurs with the reaction of methanol and formic acid on dust grains. Once these dust grains form, these molecules can be heated into its gas phase. Then this existing gas can react to other gasses to continue making more complex gasses in its timely manner.



organic molecules in the surroundings of two protostar, James Webb Space Telescope

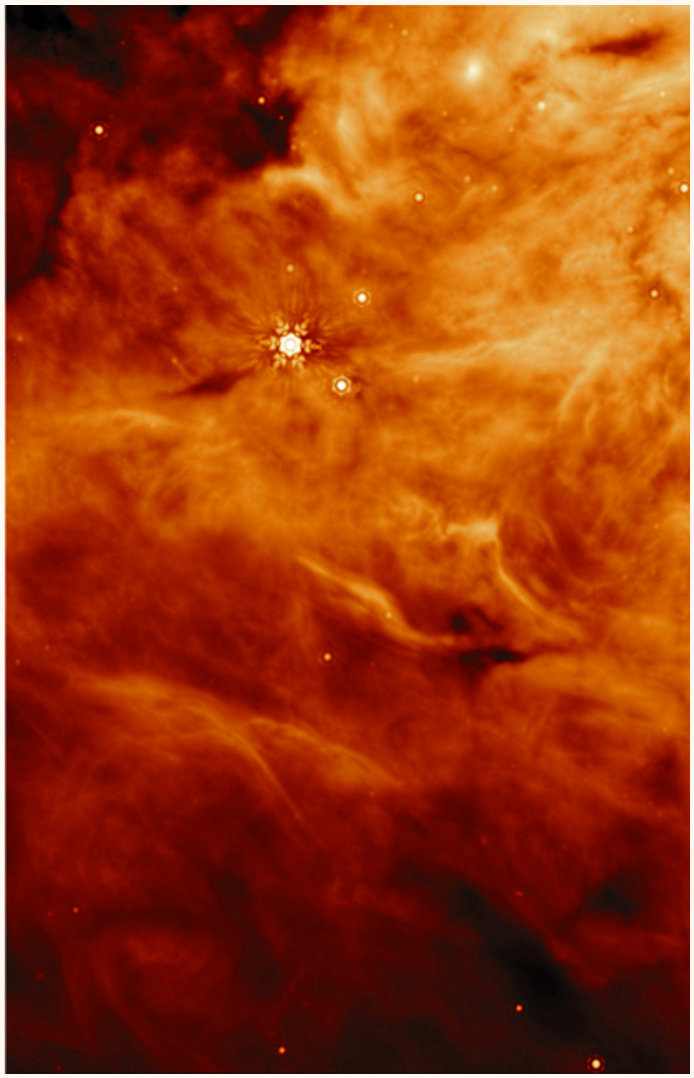
Astrochemists cannot observe these reactions first hand; comprehending the IRAS 23385+6053's chemistry requires specialists to observe through modeling and instrument usage. Models can simulate the physical consciousness in protostellar settings, and recognize factors: density, radiation fields, and temperatures. Through observational data, astrochemists can infer about these processes and create predictions in hopes to accurately depict the conditions in IRAS 23385+6053.

Modeling has assisted in elucidating the understanding of shocks and UV radiation in shaping its chemical landscape. Shocks are when fast-moving particles clash with another object (e.g. clouds of gas, magnetic fields) which abruptly decreases the

particles' speed and a shock wave occurs. A release of energy occurs in this collision. UV radiation influences from hot stellar objects can alter and accelerate reactions or lead to photodissociation, where compounds can degrade into photons. Models should be able to display such phenomena to show their understanding of overlooked chemistries.

The study of IRAS 23385+6053 is very significant in understanding a star's life. The chemical composition of protostellar environments creates the beginnings of forming bigger stellar systems, and eventually including other galaxy structures. Recognizing the presence of the existing molecules in protostars can relay patterns and conclusions that can be found upon other cases.

Insights of these given conditions lead to better comprehension of the development of massive stars. These massive stars display the evolution and age of galaxies and the various changes in chemistry that would lead to feedback processes: wind, radiation, and supernova explosions. The IRAS 23385+6053 study provides a fascinating case of chemical processes of a protostar's beginning life. Overlooked information leads to mishaps and broadness that shrinks understanding. Being able to take in the smaller details enhances mastery of a topic, especially as complex as astronomy. Astronomy continues to be a mystery but with careful speculation, these mysteries can be unraveled.



region near the IRAS 23385+6053, James Webb Space Telescope

THE CLOTTING CASCADE

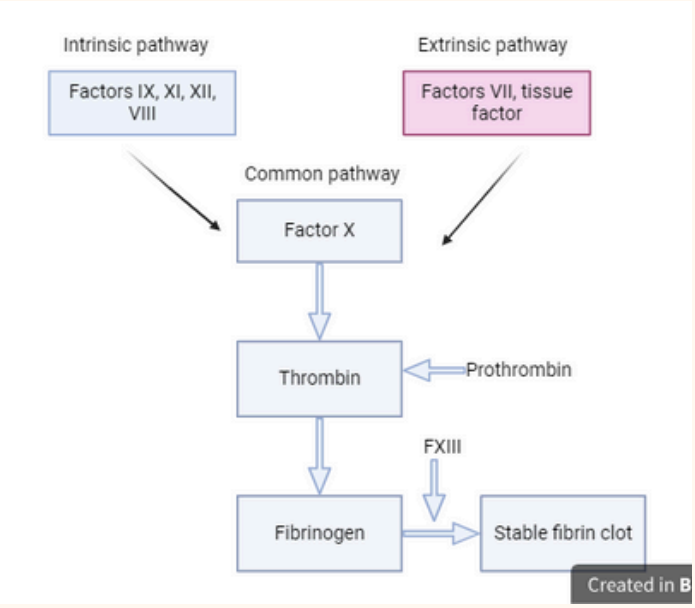
and *H*aemophilia A

Have you ever wondered how our body creates scabs? What about when it all goes wrong? If so, the clotting cascade is your answer! The clotting cascade is a sequence of proteins that activate one another to stop us from bleeding out and, eventually, they help us form a clot. However, when we lack certain proteins within this cascade, it can cause us to bleed out or produce unwanted clots. A prime example of a clotting disease is Haemophilia A which is a deficiency in factor VIII (8).

The clotting cascade

For some context, there are 3 pathways within the clotting cascade. The intrinsic, extrinsic and common pathway. The intrinsic and extrinsic pathways are activated in different instances. For example, when blood is exposed to collagen due to endothelial cell damage (the cells in the inner portion of a blood vessel), that's when the intrinsic pathway is activated. However, when tissue factor is released from the endothelial cells, the extrinsic pathway is activated. Both pathways lead to the common pathway which eventually causes a fibrin clot to form. This clot, when stabilised with factor XIII (13), stops the bleeding.

Factor VIII



simplified diagram of the clotting cascade, Kshiraja Dighe

Factor VIII (8) is a well-known factor within the intrinsic pathway which brings activated factor IX (9) and factor X (10) together to activate factor X and therefore, activate the common pathway. A decrease in this factor means the common pathway cannot be activated. This results in a fibrin clot that can't be formed and so a patient will keep bleeding.

Symptoms

Common symptoms of haemophilia A is internal bleeding, excessive bleeding post surgery, bruising, joint pain and many more upsetting symptoms.

Diagnostic test

In the lab, we test for factor VIII by centrifuging the blood sample (spinning the sample at a high speed to separate the contents). We take the plasma out and run a factor VIII assay on the plasma. This assay typically

measures the optical density of factor VIII by using a reagent that contains all factors but factor VIII. In this way, no other factor deficiencies can affect the test result. The optical density of the plasma is measured and using a standard curve, the approximate amount of factor VIII in the sample is calculated.

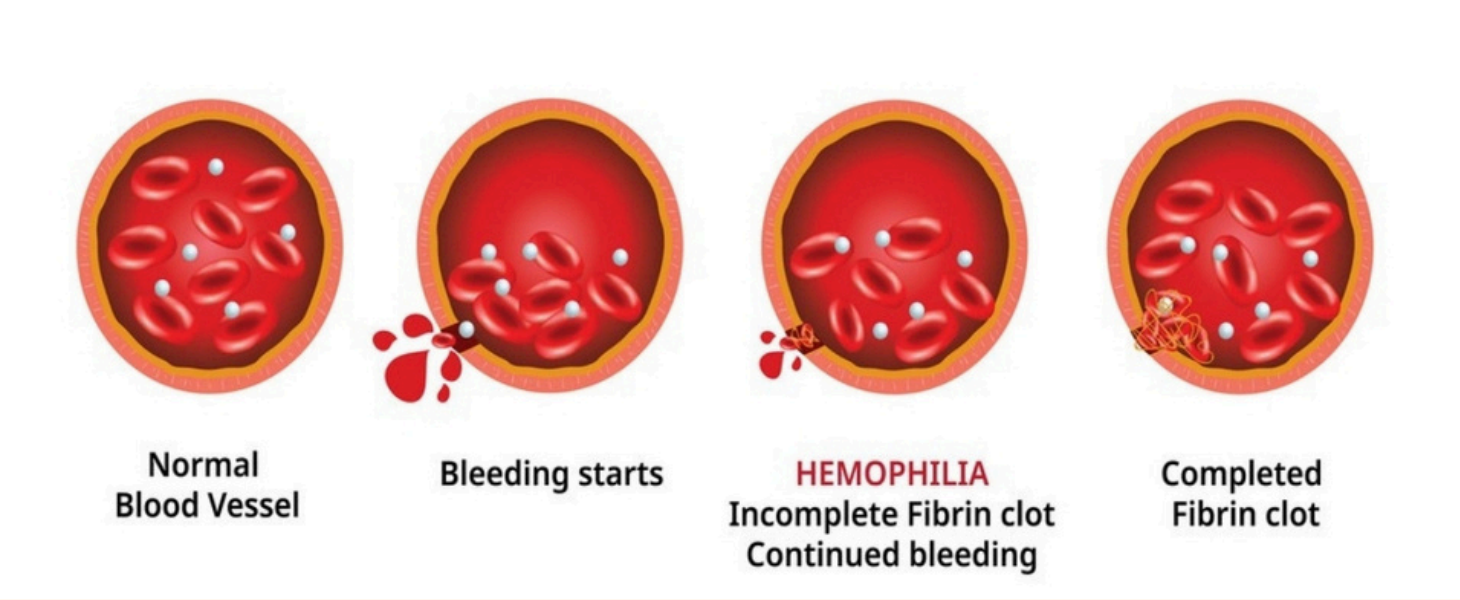
Treatment

One of the treatments for Haemophilia A includes Emicizumab which is a monoclonal antibody (lab-made antibodies that act like real antibodies in the body). This replaces the function of factor VIII by bringing activated factor IX and factor X together to mimic the natural reaction and induce activation of the common pathway. In this way, the clotting cascade is continued and patients don't bleed out!

Conclusion

Luckily, there is a lot of promising research being published for people with blood disorders and many new treatments who could help patients.

In conclusion, without the clotting cascade, our body would not be able to fix wounds for us. So next time your body patches up a wound, remember to say thank you to it!



haemophilia bleeding, HTI centers

Hedy Lamarr in The Heavenly Body, 1944

THE W IN *WIFI*

Stands for *W*oman

Hedy Lamarr: More Than Just a Pretty Face

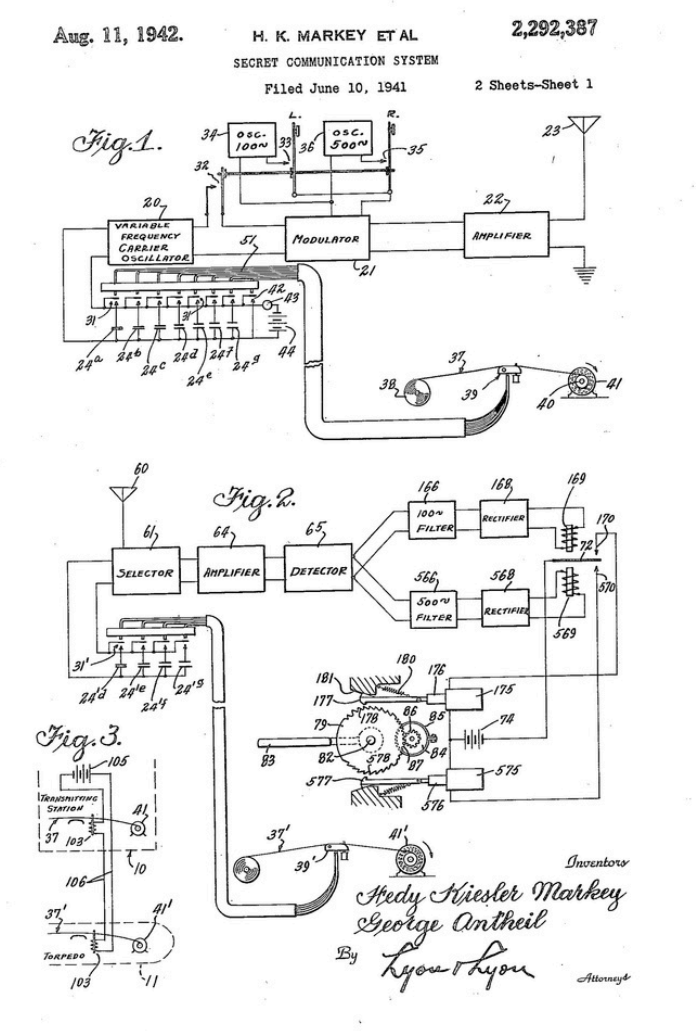
When we think about WiFi, we often take for granted the invisible waves that connect our devices to the world, but did you know that a Hollywood actress played a crucial role in developing the technology that paved the way for WiFi? This is the story of Hedy Lamarr, the woman behind the 'W' in WiFi.

Hedy Lamarr, born in 1914 in Vienna, Austria, was known for her stunning beauty and successful acting career. However, her contributions to technology have often been overlooked. During World War II, Lamarr and composer George Antheil developed a revolutionary frequency-hopping spread spectrum technology to use against the Nazis; this invention was designed to guide torpedoes in a way that was resistant to detection or jamming. Even if it wasn't directly implemented during the war, this technology later became the foundation for modern wireless communication systems, including WiFi, Bluetooth and GPS. Lamarr's invention was ahead of its time since it wasn't until the 1960s that engineers at Sylvania Electronic Systems Division recognized the importance of her work; her frequency-hopping idea was incorporated into a secure military communications system.

In 1997, she was honored with the Electronic Frontier Foundation Pioneer Award. Posthumously, she was inducted into the National Inventors Hall of Fame in 2014.

Hedy Lamarr's story serves as a powerful reminder of women's, often unacknowledged, contributions to technology; her work laid the groundwork for the wireless world we live in today, making her, in essence, the mother of WiFi.

Lamarr once said, "The world isn't getting any easier. With all these new inventions, I believe that people are hurried more and pushed more... The hurried way is not the right way; you



the top-secret patent, 1942

need time for everything: time to work, time to play, time to rest." Her words remind us to appreciate the technology that connects us, while also recognizing the need to catch a break.

The next time you connect to a WiFi network, remember Hedy Lamarr; her story is a testament to the power of innovation and the importance of recognizing diverse contributions in the field of technology.

The 'W' in WiFi may not officially stand for 'woman', but in spirit, it certainly does.

why a drunk *MAN* can always return home and a *BIRD* can't

I bet you can picture this situation: you are drunk, you left your college dorm and now you are randomly walking with no idea of where your dorm is. Above you a beautiful bird is also flying trying to find his nest. Mathematics demonstrates that you can return to your house, but the bird can't.

The walk of a drunk person can be modelled by what is called a Markov chain. Each step you take, you have a certain probability to go left, right, ahead or behind. And every time you take one step, it does not depend on the previous steps. We modelize the coordinates of our person by an element of $\mathbb{Z}^d$, where d here is either 2 (it is us, we walk on a 2D plane) or 3 (the bird can fly up and down, too, in a 3D space).

What we want is to determine when our Markov chain goes through the starting point. We are going to write X_n, the random variable who will represent our coordinates on the nth step. A very important theorem, named Polya's theorem, assures us that

Theorem 1 *$\Sigma\mathbb{P}(X_n = 0)$ diverges $\Leftrightarrow$ X_n goes through its starting point an infinite number of times*

With some combinatorics and analytics tricks, we can prove that the series diverge if and only if d=1 or d=2.

Therefore, it means that our bird, who can fly in a three-dimensional space, only goes back to its starting point in specific cases. Additionally, the higher d is, the smaller is the probability for the drunk guy, or the bird, to go back home. So the next time you wish people could have wings, you better think twice: if we could fly, we wouldn't go back home when we are drunk!

The variable d refers to the dimension of space in which the random walk occurs

- *d=1: the walk is in a one-dimensional line*
- *d=2: the walk is in a two-dimensional plane*
- *d=3: the walk is in three-dimensional space*

*A **Markov chain** is a mathematical system that undergoes transitions from one state to another within a finite or countable number of possible states. The key characteristic of a Markov chain is that the probability of transitioning to any particular state depends only on the current state and not on the sequence of states that preceded it*

LET'S CHAT LET'S CHAT LET'S CHAT

the interviews

meet the *girls* in STEM
and let yourself be
inspired by their stories

KRISTINA GATTO

“THIS IS WHAT I WANT TO STUDY FOR THE REST OF MY LIFE”

Kristina is only 23 years old but she seems to have had enough experience for 20 more years. She just completed her bachelors degree in Astrophysics and she is particularly interested in exoplanets and cosmology. She has conducted 4 research projects, she worked as a science policy intern at the American Physical Society and she connects with astronomers all around the world through a network on discord she created. Not only that, she also founded and was president of her college’s astronomy club and she was secretary for the physics club. Passionate about being able to connect with people in her field, she felt compelled to create an online environment to make that connection more accessible in order to inspire the next generation of scientists, especially young girls and women into the STEM field.

What first sparked your interest in science and what motivated you to pursue a career in STEM?

My grandfather definitely sparked an interest in science in me as a little kid. He was a fighter jet mechanic in the air force and I grew up watching the science channel with him regularly. My mom would also occasionally take me to our local observatory for stargazing nights and I fell in love with telescopes. I went again to the local observatory in high school before college applications

began and recall telling my mom “This is what I want to study for the rest of my life”, it just clicked for me that night. Having access to science media and experiences growing up absolutely helped that passion grow. When I got to college, the opportunity to study astrophysics presented itself and I saw it as a sign from the universe to take the chance, so I did and it was the best chance I ever took! I had the most incredible 4 years and had so many amazing experiences and opportunities that I’m so grateful for! After graduating with my astrophysics bachelor's degree I knew I wanted to pursue higher education because I fell in love with research and having the ability to share science with such diverse audiences, so I’m currently in the process of applying to graduate schools!

You have had lots of experience in the field and you’re focused on your career path, but do you ever wish you went a different path or is there something else you think about sometimes?
Honestly, not at all! I don’t regret my choice for a second and even though I’ve experienced challenges and setbacks along the journey, it’s all been worth it because I love what I’m studying and I love having the ability to share it with people! I couldn’t imagine doing anything else, truly!

Having worked on so many research projects, I’m sure you’re proud of each one of them, but is there a specific one which keeps you up at night because “oh my god, I did that”?
YES!! I did a research program (REU) at the University of Texas at Austin in the summer of 2023 and towards the end of the summer I ended up finding a black hole in the dataset I was working with and I was ecstatic! With that said, I also am extremely proud of the first project I ever did because I, not only conducted a full project on my own, but I also took the liberty to plan a trip to a conference to go present it, a major full circle moment for me!!

Space is a fascinating topic, I believe everyone loves to “solve” the mysteries of the universe, but most of us can only speculate. As an astrophysicist, what are some of the big questions that you hope to see solved in your lifetime?
After working on a cosmology research project, I found myself super interested and excited about the hubble constant! It’s essentially the rate at which the

universe is expanding and astronomers are super close to finding out the exact value of this constant so it would be awesome to see that “solved” in my lifetime.

Sci-Fi is among the most enjoyed genres and most of it is focused on space exploration. Do you like science fiction novels/movies and do they inspire you or, as a scientist, you find them absurd and improbable?
Personally I love space movies, with my favorite being (very cliche-ly) Interstellar and every time I watch it I definitely get reminded why I love studying astronomy. Additionally, I actually am not that into science fiction novels as much as I am into non-fiction! I have recently really taken a liking to the author Carlo Rovelli, who writes physics and astronomy books based on his own research! I don’t often have time to sit and read for leisure so when I do, I like being able to learn something new!

You clearly are an inspiration for young girls around the world with your impact online but also in school clubs. What would you say to those who wish to pursue STEM but feel like it’s too hard for them?
Challenge yourself, even when it’s hard, you might just prove yourself wrong! You’re capable of more than you can imagine. Embrace every opportunity, even if you feel scared or unprepared, because it’s better to take the risk than to live with the regret of wondering “what if”.

And one last question, you’re probably tired of this one because I think this is the most asked question to anyone who studies something space related… So, do you believe in aliens? I mean, not little grey men with big eyes, but extraterrestrial life forms.

YUPP. Ever since I started studying astronomy I’ve been WAITING for a scientific press release sharing the discovery of some kind of microbial life form found somewhere in our solar system! Plus, I don’t doubt the existence of intelligent life elsewhere in the universe!

Kristina

Thank you so much for joining me, I loved getting to know you. You were incredibly inspirational and sweet. I wish you all the best for your future, get to the stars for all of us!
Arianna

GWYNETH DE RAMOS

“HISTORY IS FULL OF WOMEN WHO BROKE BARRIERS AND CHANGED THE WORLD”

Gwyneth is a 16-year-old girl, she was born in the Philippines and at the age of 3 she moved to Canada. She is currently a junior student, in grade 11. Despite not having any job experience in STEM, she is very confident in what she wants to be: specifically interested in biology and chemistry, she is taking a grade 11 university path chemistry class, in order to fulfill her dream of becoming an OB/GYN. She strongly advocates for women’s rights and their reproductive freedom and feels even more strongly about creating the type of environment where women can feel comfortable and can thrive in.

Being in Canada, near the United States, are you worried about the election results and the impact it might have on women’s health? Would you say it could affect your country, too?

Being so close to the United States, I do feel a sense of worry after the recent U.S election results and what it could mean for the entirety of women’s health. My worry not only stands for the U.S women population, but for Canada as well. The changes and policies that have been made in the U.S, especially the overturning of Roe V. Wade had a tremendous impact for Canadian citizens. A recent document regarding the Canadian government was released and displayed a tally about each party and their respective MP’s stance on being pro-choice or anti-choice. The tally showed that each member in the conservative party who has a seat voted anti-choice. This is our fight, just as much as it is theirs. When a person in power, especially in a country like the United States of America, enforces restrictive policies related to reproductive freedom and women’s rights, it can fuel similar conversations across the border and pushes us further back on the protections we’ve worked so hard to achieve. I’m really hoping we can avoid those kinds of shifts, but there’s definitely an underlying worry about how much one election could shape women’s rights in North America.

Party	Total MPs	Anti-choice MPs	Pro-choice MPs***	Unknown or Indeterminate Stance
Liberal*	153	4 (2.5%)*	148 (97%)*	1
Conservative	119	119 (100%)**		
NDP	25		25	
Bloc Québécois	33		33	
Independent	4		4	
Green	2		2	
Total	**336** (2 vacant)	**123** (37%) (Excluding Libs: 35%)	**212** (63%)	**1** (0.3%)

You say you're interested in chemistry and you're also taking courses. With chemistry being one the most hated subjects, mainly because of its difficulty, how do you stay motivated in such a fascinating, yet hard, discipline?

I stay motivated in chemistry by focusing on the rewarding parts. What I mean by 'rewarding parts' is the small things, such as understanding how things work at a molecular level, or finally memorizing the polyatomic chart. It's true that chemistry can be challenging and there's definitely a lot to memorize. Concepts can also be extremely abstract and take a lot of studying to memorize, but what keeps me going is how often chemistry connects to the real world, whether it's understanding reactions in cooking or seeing its role in medicine, it's fascinating to see the connection between science and the world. Overall, I simply remind myself that every hard concept mastered is a step closer to achieving my dream career. Chemistry might be tough, but the payoff makes it worth it.

You're young, or at least younger than me, and you seem to be already very sure of your career path. Was there a turning point or event that made you want to pursue OB/GYN or was it something you've just always known? And how important is it to narrow down your interests early on?

I was the type of child who had to have everything planned out and organized. If I didn't, I would go into a spiral. I mean, at the age of 12, I already knew I wanted to be a doctor and I started searching for scholarships. But, the one thing that wasn't planned from the very beginning was my eagerness to pursue a career as an OB/GYN. At first, I wanted to be a pediatrician. I loved kids and found them fascinating. That all changed, however, when I had one conversation with my mother. She told me about her experience with giving birth to my younger brother in Canada. For context, she did not naturally birth me, instead she had to have a c-section due to complications. Anyways, when my mother gave birth to my brother, it was not a c-section and instead it was a natural birth. She was anxious, nervous, and had no idea the severe pain she would have to endure. For reasons I may never know, her doctors and nurses were unwelcoming and harsh. Keep in mind, my mother never had to push before. This was an entirely new experience for her. It was frustrating and eye-opening because her story highlighted gaps in women's healthcare and the need for attentive an empathetic professionals. That experience stuck with me. It made me want to be someone who could provide that missing care for others, someone who could make sure patients feel heard, supported, and

well taken care of. It's a huge motivator in why I want to pursue this field, knowing firsthand the impact compassionate and high-quality care can have. As for narrowing down interests early, I think it depends. Knowing what you're passionate about can definitely help you set goals and find learning opportunities, but it's also okay to explore and change paths. Sometimes, discovering what you don't like is as important as finding what you do like.

Working in healthcare requires a strong personality, having to interact with sick people, so which personality traits should a doctor have in order to be a "good doctor"?

A good doctor needs a combination of empathy, communication skills, patience, resilience, and a strong work ethic. Empathy allows them to connect with patients on a deeper level, while clear communication ensures patients are informed and heard. Patience is also important when navigating complex or emotional situations and resilience is key when facing challenges. Lastly, a strong work ethic ensures ongoing learning and the best possible care for every patient. These traits are essential for building trust and providing compassionate, effective care, which is what all patients deserve.

Do you believe gender and cultural differences influence how women receive healthcare and education about reproductive rights?

100%. I believe gender and cultural differences significantly influence how women receive healthcare and education about their reproductive rights. In many cultures, women are expected to prioritize family and caregiving roles over their own health and well-being. This can lead to women neglecting their own health or avoiding seeking medical help, especially for issues like reproductive health. In some cultures, there's still a stigma around discussing topics like reproductive health, which can lead to misinformation or a lack of education, leaving women without the tools and resources they need to make informed decisions about their bodies. Additionally, the level of education and awareness around reproductive rights varies greatly depending on where a woman lives, her socioeconomic status and the resources available to her. This can limit a woman's ability to advocate for themselves or access the care they need.

What would you say to inspire more young women to pursue careers in STEM, especially in fields like medicine, where they are still underrepresented?

To the young women who are currently considering careers in STEM, especially in medicine, I would advise you: your potential is limitless. Medicine and other STEM fields need your diverse perspectives, and you are a vital part of that change. The world is evolving, and women have so much to offer in shaping the future of science, healthcare and technology. Don't let the idea that STEM is a field dominated by men discourage you. History is full of women who broke barriers and changed the world. You can do the exact same, and more.

One last question, this might seem like a joke, but many women have issues with male OB/GYNs claiming it's weird. What do you think about that? Is it weird for them to pursue this kind of career or is it just work?

I can understand why some women might feel uncomfortable or have issues with seeing male OB/GYNs, especially given the deeply personal nature of the field. However, I don't think it's inherently "weird" for men to pursue a career in OB/GYN. Just like any other medical specialty, OB/GYNs are driven by a desire to help people and make a positive impact on their patients' lives. Gender should not be a barrier to anyone's ability to provide quality care. What matters the most is the doctor's professionalism, expertise, and ability to create a comfortable, respectful environment for their patients. A good OB/GYN, whether male or female, should prioritize patient comfort, empathy, and communication. For some women, having a male OB/GYN may not be ideal, and that's perfectly valid. I would support their decision to switch doctors if that is the case. There's no shame in preferring a female doctor for certain types of care. The key is for patients to feel comfortable and respected, and for doctors to understand and acknowledge those concerns.

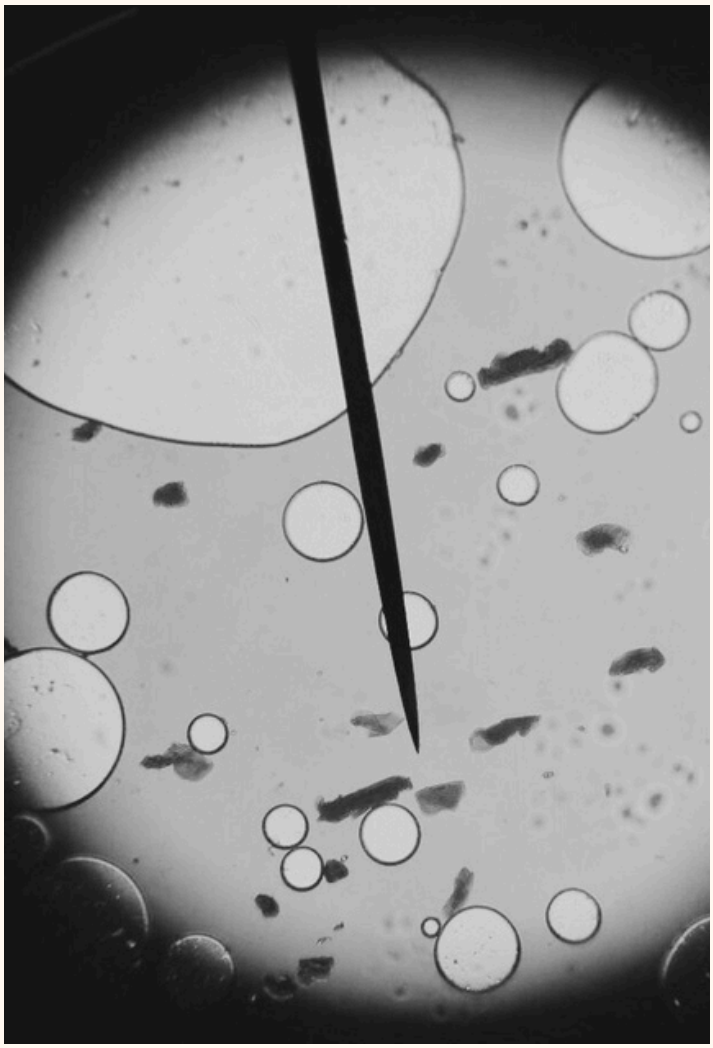
Gwyneth

Thank you so much for joining me, I loved getting to know you. Your insights were incredibly interesting to read and I wish you can achieve your dreams!
Arianna

“IT IS TERRIFYING, FASCINATING AND ABSOLUTELY WORTH SPENDING A LIFETIME STUDYING”

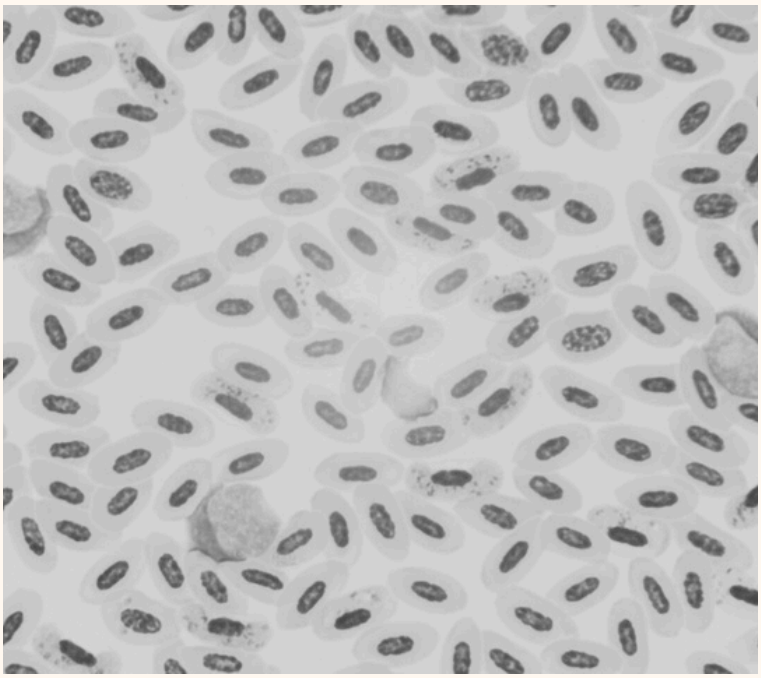
GRACE

Grace is 18 years old and she is in her first year working towards a BS in Molecular, Cellular, and Developmental Biology. Right now, she is working through her general chemistry courses, but she is really interested in molecular pathology, driven by her need to fully understand how disease messes with us at the smallest scale. At the larger scale, she wants to show younger girls how complex and interesting life is when you ask questions. She has hands-on experience through basic high school labs, but most of her knowledge comes from Science Olympiad. Claiming her favorite part about it was teaching younger students about biology, her proudest moment in STEM is definitely when one of her middle schoolers said to their friend that microbiology was "hard but pretty cool" after a challenging lesson she led. She said that seeing a kid engaged in the difficult subject made her day!



What drives your passion for science? Was there a specific moment or experience that made you want to pursue a career in biology?

I’ve always been interested in science. I blame my parents for that. My father was especially supportive, entertaining his toddler’s ‘why’ game to a ridiculous extent, giving different demonstrations and explanations to the same simple question each time. Books, children’s museums, and hiking trails were staples of my childhood, all of which I recommend for parents looking to promote curiosity in their children. One moment I’ll never forget is looking through an old textbook and seeing an actual photograph of malaria in the blood. It was horrifying. I could see the little worms (or as I later learned, protists) growing in each sick cell, growing and growing until it bursts, just to infect the next one. The caption explained that in the past, malaria could only be cured by a poison so strong that the person taking it might just die from fever, instead of their blood cells bursting one-by-one. Was sickness really that tangible? At that moment I decided to learn everything that could go wrong in the body at the most basic level, in hopes of finding a cure.



Molecular pathology is such an interesting discipline. Are there any specific diseases or conditions that you're particularly interested in studying?

I can't honestly say yet, there are still so many things I don't know. What I can say is that I've always had a particular interest in neurodegenerative diseases, illness of the brain. The brain is already such a mystery, and when one tiny thing goes wrong it's devastating. I hope I can contribute a little to what we do know, in hopes of making life easier for someone. A specific disease that led me to the study of molecular pathology in the first place was something called Creutzfeldt-Jakob Disease. CJD is caused by a protein, called a prion, that's folded into the wrong shape. It could be just one tiny change, but it causes the brain to die within a matter of months, and there's no medicine that can help. The fact that such a simple thing, just one protein, could stump the scientific community for so long while causing such brutal symptoms is absolutely terrifying, fascinating and absolutely worth spending a lifetime studying.

You mentioned your experience teaching younger students in the Science Olympiad and it seems like you're good at making complex topics more accessible to others. Are you planning to go into research, work in a laboratory or down the path of teaching?

My plans are mostly about research, but the ideal scenario would be to work at a university where I could teach some adjacent classes as well. I enjoyed teaching little kids for an hour a week, but it requires a different kind of mental fortitude to do that full-time. I'm still incredibly invested in science communication and accessibility, though. One of the subjects I taught to those middle schoolers was epidemiology, or public health. It's a difficult subject, with lots of numbers and fancy-looking graphs. I found that when it was presented as just data and practice problems, the lessons were a bore. But, when it was presented in a way that resonated, hands-on, engaging, relevant, it sparked curiosity, and that's where the real learning happens. This approach to teaching became all the more relevant in 2020. I saw how the lack of scientific literacy caused an astounding amount of misinformation about the pandemic to circulate. Many people at that time dismissed scientific findings outright. It was at those moments that I realized how much work it takes to make science feel real. Science communication helps people realize that science has an impact, outside of the isolated laboratory. These complex discoveries, grand additions to the whole of human knowledge, don't do any good if they can't be communicated clearly and effectively. Building a community that

fosters the kind of curiosity necessary to learn about science is essential, and it starts outside of the classroom. As a non-teacher, directly supporting local museums, natural areas where kids can play and learn and schools are all great ways to contribute to building that environment, long before the lecture halls.

As you continue your studies, how do you plan to stay motivated during difficult or frustrating times in your coursework?
Allowing myself to have a break when I need it is the best way to keep burnout away, whether it's for five minutes or the whole weekend. Study strategies like the Pomodoro technique help start tedious tasks, but for myself, I find the best way to stay motivated is to study a wide variety of things that I'm interested in. For example, when I'm stuck on a difficult and boring math problem, I might take a break by working on a writing assignment instead. I try to have fun with it, not just doing the assignment but playing with the topic, and exploring it until I find something that interests me personally. The other way I keep myself motivated is by reminding myself what I'm working towards. For me, grand reasons like "the advancement of all human knowledge" are usually enough, but if that doesn't work I can also be easily bribed with the promise of chocolate!

Growing up I have noticed that many young students aren't interested in science, may it be because it's hard or because they don't believe it's useful. What do you think is the most effective way to show them the value of science?
There are three main things that I think lead to students valuing science. First, hands-on activities help kids see how interesting science can be. If their only exposure to the subject is in school with a teacher giving them facts to memorize, it becomes boring, fast. Even with adequate context, the concepts don't feel real. Giving hands-on demonstrations allows it to be real. The first lesson I ever gave my middle schoolers was how to start a Bunsen burner. Allowing them to operate the equipment (in a safe, supervised manner) piqued their interest right through the rest of the lesson. The other most important thing, more accessible without equipment, is allowing space for all questions. Students following their natural curiosity, instead of going by the book, will be infinitely more interested. Entertaining their silly but enlightening questions is the most reliable way to garner interest in an otherwise boring subject. As you said, many kids aren't interested in science because they think it's too hard, or that they're not smart enough. Making students feel smart during the lessons is essential but incredibly difficult. We've all had a teacher who has rambled on completely oblivious to the fact that the class is lost or felt patronized when someone didn't have faith in our ability to understand a topic. Being able to speak at the student's exact level and avoid these pitfalls is a rare skill that I certainly haven't mastered, but I do think its rarity is part of the reason why so many students feel like science is so hard. Just one teacher who can make them feel good about learning can show kids that it isn't too hard and that any subject can be valuable and interesting.

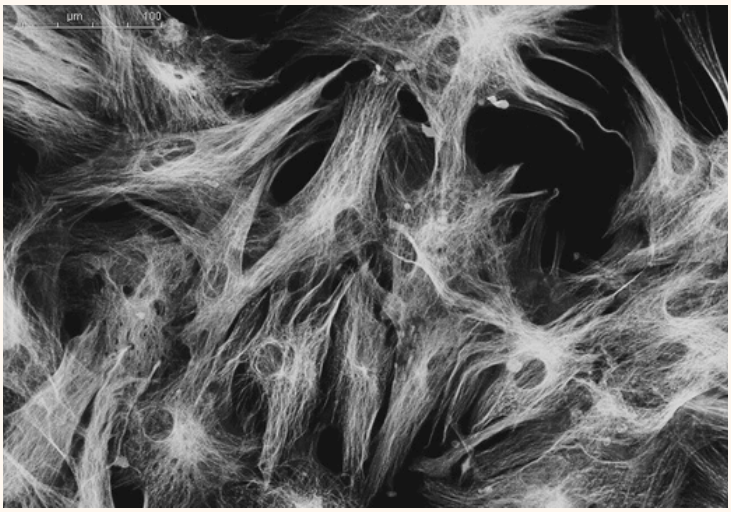
As advances in molecular biology and genomics continue to grow, concerns regarding genetic editing have arisen. What are your thoughts on genome

editing in humans? Given your interest in molecular pathology, would you say these technologies could prevent the development of some diseases and if so, is it ethical to try it this way?

Interesting question! I do think we have at least some responsibility to try and cure diseases that can be life-threatening, but we're still a long way out from the technology being commonplace. Genetic engineering on humans should be treated with caution, especially due to its long history of misuse. As a culture, I don't think we can be trusted to use gene editing technology responsibly, but I'm not sure it matters. The technology will continue to develop, and it would be a downright waste not to fulfill that potential to alleviate suffering. When this happens though, it will be the responsibility of everybody impacted by the technology, from scientists to lawmakers and laypeople to make clear that improper use will not be accepted. A recent development that I think is largely positive, on the other hand, is technologies like prenatal screening. They can be wonderful in preventing complications during childbirth and letting the parents know what to expect, but many companies can produce false promises about how reliable the technology is. We now know that the environment and other external factors have a large impact on what traits are presented and nothing is simple, so it's important to be wary of any company trying to tell people they can prenatally screen for complex traits.

What advice would you give to other young women who are interested in pursuing careers in science but feel like it's too much for them?

Imposter syndrome runs rampant in this field, especially for women. It's normal to feel like you're out of your element, just remember that most people around you probably feel it too. When I first applied to start teaching other students for the Science Olympiad, I was terrified that I wasn't qualified. I had been with the club for longer than most, but I was still younger than the other applicants. What if someone older was more suited for the job? What if I didn't know anything about science at all? It took talking to my own teachers, most of them just a year older, to remind me that I wasn't alone, it is possible to learn, and it's impossible to know everything that might crop up. So stop judging yourself by that metric. Look, science is difficult to learn, but most of my tips on engaging kids are the same that I use for myself. Don't just memorize the facts from the book, that's boring. Follow your curiosity. Find a reason to make the material feel real. You'll gain confidence with experience, just remember why you're doing it. Many people do a STEM degree purely for the money and if you're genuinely interested you're already one step ahead. Of course, you'll have to work. Of course, it will be hard. Following your interests helps. Don't feel afraid to ask questions, or share ideas, your perspectives are valuable.



Grace

Thank you so much for joining me, I loved getting to know you. Such a noble pursuit, I'm sure you will make a change!
Arianna

ALESSANDRA

Alessandra is a 20-year-old Physics student with a strong background from her scientific high school education. She has a clear passion for astrophysics, particularly in the areas of cosmology and energy. Although she is deeply interested in theoretical physics, she is also strongly oriented towards experimental research, aiming to merge theoretical knowledge with practical experimentation. Having experience in various laboratory courses, including Thermodynamics, Computational Physics, Computer Science, and Mechanics she developed a practical approach to scientific challenges, preparing her to tackle complex problems with both theoretical and experimental tools. Particularly interested in research she is interested in focusing on experimental investigations within cosmology and energy.

“IT’S LIKE GOING ON A REAL JOURNEY INTO THE MATHEMATICS OF THINGS”

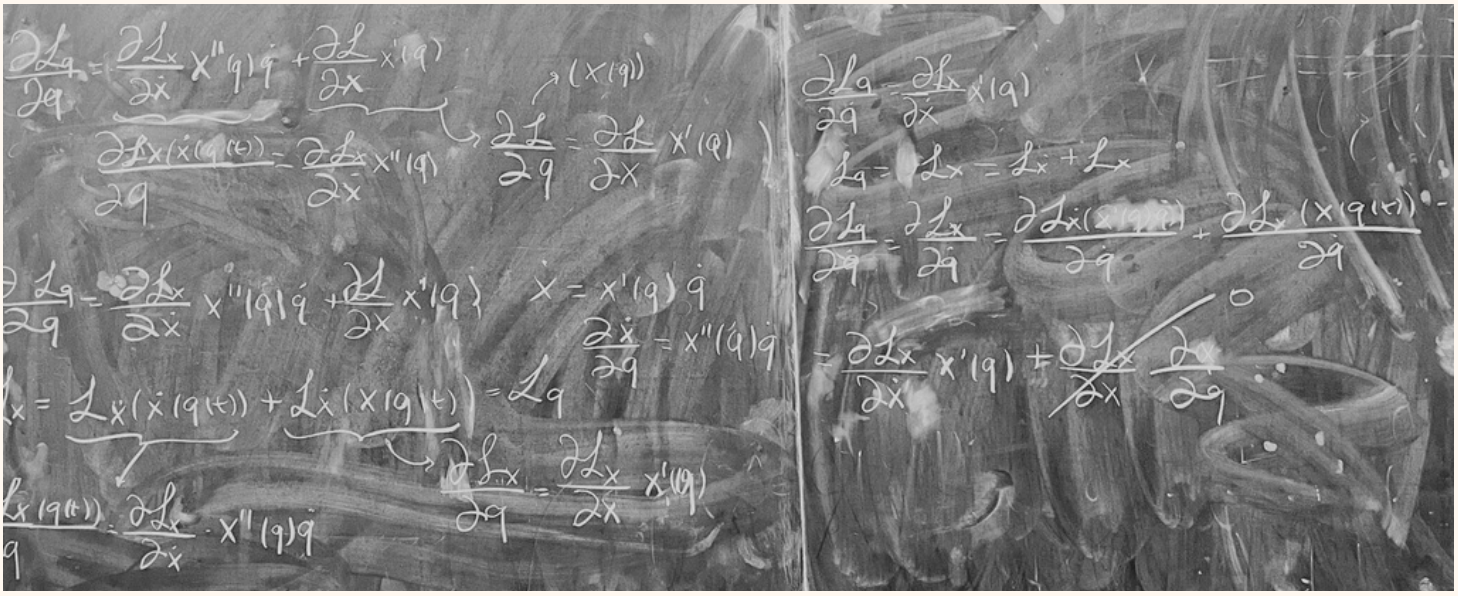
What made you want to pursue astrophysics? Have you always been sure it was the right choice?

I’ve always been sure I wanted to study this, I mean ALWAYS. More generally, physics, but specifically I already know I will end up in astrophysics and I particularly like cosmology. I’m not sure yet if I’ll be an experimental or theoretical physicist, but I think it will be kind of a mix, doing things like high energy physics, which is quite in between. Actually, in experimental physics, you also do a bit of theoretical work. I'm not interested in particles and things like that, but I’m very interested in the big things, space-time, large distances. The thing that I think will really excite me is statistical mechanics, which is also behind much of cosmology, probability, entropy, those kinds of topics, to give you an idea. Even at a particle level, it’s still very macroscopic things, like the concept of entropy, which in the end is a macroscopic concept. I don’t know how to explain it, because it’s not strictly macroscopic, but it has to do with the diffusion and dispersion of microscopic objects and you can also talk about entropy in the context of the universe.

You said you were uncertain whether to follow the experimental path or the theoretical one, even if you feel drawn towards experimental physics the most. What could the pros and cons about those different specializations be?

Certainly, the most obvious advantage of experimental physics is that it’s really a

mix of both, in fact physics is exactly what connects theory to experiment, there are experiments in the search for a mathematical truth behind it. The beauty of being an experimental physicist is that you find pragmatic solutions; you find them on a practical level, but that always happens with a theoretical analysis, because if you're doing experiments, it's because you want to test a model, and in doing so, you might find problems with that model and that's when you also need theory. So, in my opinion, the experimental aspect is fascinating because you get to ask questions based on what you observe. Theory might be very interesting because there's a lot of mathematics, and above all, theory is fundamental in opening up many areas of thought, meaning that mathematics has already made progress on many things. To give you an example, mathematics already had answers for a physics that didn't even exist in the last century, and when certain theories were developed, there was already some maths theorems available to explain them. However the downside of theory is that you can get a bit too absorbed in the mathematics if you're too closed off. And regarding experimental physics, the disadvantage is that you might lose some interesting theory. So, in the end, I believe that the beauty of physics lies in the middle.



If you could choose a different study path and career, what would it be? Or maybe there is nothing else you'd want to do.

Oh my, well, I think in another life... Actually, I wouldn't do anything else because nothing would satisfy me the way physics does, but perhaps as a hobby... I mean, if there's a documentary, I watch it, if there's a film, I watch it. I also really like history, especially the Middle Ages (I'm obsessed with the Middle Ages) and I also like contemporary history, like Italian history, the mafia, things like that. I also enjoy literature, so maybe in another universe, I would have done something related to literature, books, maybe publishing, or something like that. But I'm not really sure, honestly, it wouldn't have fulfilled me as much. Maybe I would have found it easier, but it wouldn't have been what I really wanted. I think it's nice to engage with these things on a superficial level, kind of like we do in high school, but I wouldn't be able to study them at university. You really have to sit down and study the language.

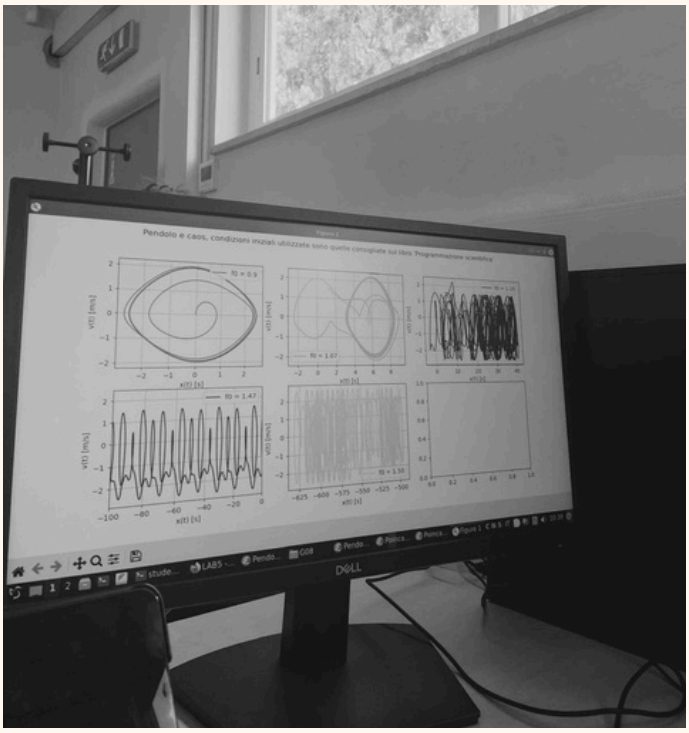
Theoretically, it's nice to know little facts about some niche interests of mines, but as a deep study, I'd probably get bored. For example, I like listening to Barbero (a famous Italian historian), but I could never read a history book and memorize it, or at least learn it in-depth.

Is there any important figure in the world of science who has particularly inspired you?

I actually don't know... I'm not really a huge fan of any specic figure, I mean, them as a person. I do like someone, but for example, everyone believes Margherita Hack should probably be my role model, you know, a woman who did astrophysics, but, not considering the important disocoveries she made, I'm not that interested in her as a figure. However, I really like Marie Curie, even though she is not related to anything I study. I really admire her, though, mostly because she's such a strong, talented woman and she literally died for what she was discovering and she never stopped. I truly admire her.

Do you have any idea about the type of environment in which you'd like to work? Would you continue in a university, research institutes, maybe space agencies, or something else?

Well, I'd like to work in research, I really want to do research honestly. Maybe one day they'll ask me if I want to go to space like in Interstellar, I think I would do it, but maybe not. I really want to work in the lab, so I'm saying, whether it's experimental or theoretical, it's still working in a lab. But I believe I really want to study. That's why I say I have an experimental mindset because I really want to receive data, collect things, guide experiments and draw conclusions, ask questions and make suggestions to theorists. Then maybe I'll also explore theorethical physics, but you see, I like more the fact that you address problems that come from experience.



How was the transition from high school to university? What changes when studying physics in high school versus university?

I honestly don't remember much about how physics was studied in high school, I've literally erased it from my memory and I imagine it was done in a very mnemonic way. I only remember doing exercises where you had a series of formulas and you would do them. In the end, you kind of understood what was going on, but not entirely, like, you understood that it worked in a certain way, but you didn't know why. Studying physics at university is completely different, and it's much more beautiful. It's much harder, much deeper. Now I

really know why those formulas are derived, I can derive them from scratch. Everything is derived from scratch; in high school, it's impossible to do things in a normal, decent way, like really decently, because you don't even know what a derivative is. You never do physics with the mathematical knowledge that, for me, is now basic. So obviously, everything is a step up from that. Moreover, it's really different because you really realize how mathematics allows you to see things, why that formula means what it does, why that formula, written in that specific mathematical way, really represents something and you really understand it when you study physics at university. Then you understand a whole series of much broader concepts. It's like going on a real journey into the mathematics of things.

Even though you're only in your second year, is there a particular subject or topic that has fascinated you the most and why?

Let me explain a bit how it works in my university. For example, up until now, I've done mechanics, analytical mechanics and next year I'll be doing statistical and quantum mechanics. So, mechanics is basically the same as what I did in high school, but in a better, more advanced way. Analytical mechanics is the same concepts, always with the classical approach, but done even better. Then, in the third year, the approach changes with statistical mechanics and quantum mechanics. I think I'll fall in love with statistical mechanics because I really like statistics, and I like mechanics. Focusing on what I studied, I think analytical mechanics is the best subject I've ever did; it's wonderful, it's beautiful and it's the first theoretical physics exam I've taken. Then thermodynamics is very close, in my opinion, to high school-level physics, at least relatively speaking. But it has a more qualitative approach, just thermodynamics as a science, and I don't like that very much. I think when I'll do statistical mechanics, which is like the advanced version, I'll like it a lot more. It will probably become my favorite subject. I quite like everything though. One thing I can say, I hated analysis, but analysis 2, which I'm studying this semester, is more interesting, it's not really my subject, but it's cool. So, in the end, I would say that analytical mechanics is my favorite.

Alessandra

Thank you so much for joining me. Ti voglio taaaanto bene tesoro, ti auguro il meglio!!
Arianna

“thanks to everyone
who worked hard to put
this issue together”

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