The Write Angle

Letter from the Editors

Founded in 2020, 'The Write Angle' is Exeter Mathematics school's official student newspaper. This is an accumulation of works from our students, run by a collection of student editors, posted on a fortnightly basis. Here you can see articles, opinions and insights into life at EMS. We encourage all students to participate, whether by submitting articles or becoming a part time editor.

LGBTQ+ history month

Competition time!

February is LGBTQ+ History month, so to celebrate the occasion we are hosting a competition! To be in with a chance of winning, all you need to do is write a paragraph on your favourite LGBTQ+ (or suspected LGBTQ+) icon in history, and submit it to one of our editors via email or Teams. Prizes are up for grabs (to be awarded when in person schooling is back in session) and the deadline for this competition is 07/03/2021. You do not need to identify as a member of the LGBTQ+ community to take part, and all submissions are welcome. We wish you all good luck, and happy writing

Gay in space

In 1983 Sally Ride became the first US woman to go to space, but it wouldn't be for another 29 years before the general public found out that Sally Ride was in fact a Lesbian. Sadly, Ride lived her entire life in the closet, with the true nature of her love life not coming to light until after her death from pancreatic cancer in 2012, where her obituary introduced the world to her partner of 27 years, Dr Tam O'Shaughnessy (professor of psychology at San Diego State University).

NASA and the US military have a long history of disguised discrimination surrounding rules annd regulations enforced upon their ranks. With their 'don't ask dont tell policy' ('DADT'- lifted in 2011), and the Houston Texas sodomy laws (ruled as unconstitutional in 2003), it is understandable that being openly gay in this time would have been a tough, if not impossible task to accomplish. Ride was also reportedly a very private person, but whether that had anything to do with the lack of acceptance within society, is a 'chicken or egg' question to be left for another time.

Sally Ride very nearly pursued a career as a professional tennis player, before attending Stanford university and eventually graduating with a PHD in astrophysics. Not only was she the first American woman to be sent to space (at the age of 32), she was also the first American woman to be sent on a second mission, the first woman to operate a robot arm in space and the first person to use that robot arm to retrieve a satellite. After retiring from space expeditions with NASA Sally Ride, along with her partner Dr O'Shaughnessy went into business with each other and set up 'Sally Ride Science' which was a foundation aimed at encouraging girls of a middle-school age to pursue careers in STEM.

Ride's accomplishments makes her far more than just 'a brave lesbian' or the first US woman in space. Sally Ride created her own legacy by working just as hard as her crew mates. She never accepted being treated differently, and purposefully went out of her way to avoid interactions where this occurred. Because of this, her chosen battle wasn't campaigning for LGBTQ+ rights, it was to fight the gender disparity seen in STEM and to encourage young girls to aim just as high as the boys in their class. A year after her death, she was awarded the presidential medal of freedom by president Obama. This award was accepted posthumously by her widow Tam O'Shaughnessy.

In 2018, Ann McClain became the first openly gay astronaut in US history. After years of inequality and discriminatory laws, McClain's trip marked a milestone in NASA's history. The unfortunate lack of openly gay astronauts up until recently, has reflected the culture both at NASA and our homes. We can only hope for a brighter future within all fields of study, where individuals are judged on their merit and not on who they love or the gender they are perceived as being.

Land Of Maths

A Question on Groups

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A Question on Groups Chloe-Anne England and Isobel Shaw 1 Generally speaking, for a good way for someone to consolidate their new knowledge about a specific topic is to answer hard questions that require a deep understanding of the concepts they have covered. And so having just learnt about what a group is in school, we went looking for an interesting question from an EMS alumni. And this is the question he posed:

G is a set with an associative binary operation $\cdot : G \to G$. For every $g \in G$ there exists a unique g^* such that:

$$g \cdot g^* \cdot g = g \tag{1.1}$$

Show that $(G, \cdot)$ is a group.

(If you want to answer this question for yourself, we advise not to read on, unless you are in need of hints. Don't panic if it is taking you a long time to solve this problem, it did take two of us a week to solve.)

In order for $(G, \cdot)$ to be a group, four conditions must be met:

- There is **closure** of $\cdot$ on G, i.e. $\forall a, b \in G, a \cdot b \in G$
- $\cdot$ is **associative** on G, i.e. $\forall a, b, c \in G, (a \cdot b) \cdot c = a \cdot (b \cdot c)$
- There is an i**dentity** element $e \in G$ such that $\forall a \in G, e \cdot a = a$
- For each element $a \in G$, there is an **inverse** element $a^{-1} \in G$ such that $a \cdot a^{-1} = e$

After reading the question, we know that $(\cdot : G)$ is associative and closed. We therefore need to prove that there is a unique identity element and a unique inverse $\forall g \in G$. Initially, we said the question was easy as we assumed that g^* would be the inverse, giving us $g \cdot g^* = e$. After a few minutes of celebration, we realised that our argument was circular, we cannot assume an identity and inverse, we needed to prove that they existed and thus panic ensued. We insisted for a long time that we had no idea how to solve the question. Now we set out trying to prove that $g \cdot g^* = e$. We knew (1.1) and therefore:

$$g \cdot g^* \cdot g \cdot g^* = g \cdot g^* \tag{1.2}$$

by substituting (1.1) twice for g.
However we found that this did not lead us anywhere. After we thought for a bit, we defined

$$e_g = g \cdot g^* \tag{1.3}$$

and needed to then prove that $e_g \cdot h = h$. After a few attempts, we failed to do so. We thought that knowing $e_g \cdot e_g = e_g$ would help us, it seemed like an obvious thing, but we needed to prove it. Using (1.2) and substituting in (1.3), we can get:

$$e_g \cdot e_g = e_g \tag{1.4}$$

(This will come in handy later as we didn't know how to use it yet) We needed to prove $e_g \cdot h = h, \forall h \in G$, because this makes e_g an identity in G. Our first thought was to try using (1.4):

$$\begin{aligned} &e_g \cdot h = e_g \cdot e_g \cdot h \\ \implies &h = e_g \cdot h \end{aligned} \tag{1.5}$$

However this is incorrect as we cannot assume that there exists an inverse of e_g so we cannot remove it from both sides.

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It was at this point that we realised that g^* being unique was helpful. So if $*$ is the inverse, proving that $g = g^{**}$ might be useful. First we started messing around with putting things in and working out what we could and couldn't do. By considering all $g \in G$, we came up with the following:

$$g^* = g^* \cdot g^{**} \cdot g^* \tag{2.1}$$

By substituting (2.1) into (1.1), we can rewrite g as:

$$\begin{aligned} g &= g \cdot (g^* \cdot g^{**} \cdot g^*) \cdot g \\ &= (g \cdot g^*) \cdot g^{**} \cdot g^* \cdot g \\ &= g \cdot g^* \cdot g \end{aligned} \tag{2.2}$$

$$\begin{aligned}\implies g &= g^{**} \cdot g^* \cdot g \\ &= g \cdot g^* \cdot g \\ \implies g &= g^{**}\end{aligned} \tag{2.3}$$

However, here we have assumed that can just get rid of e_g as it is the identity, but we cannot do this. We proceeded to get annoyed at our failure to prove this as we kept making similar mistakes, however after more messing about with things we could do, we considered substituting (1.1) into itself again:

$$\begin{aligned}g &= g \cdot g^* \cdot g \\ &= (g \cdot g^* \cdot g) \cdot g^* \cdot g \\ &= g \cdot (g^* \cdot g \cdot g^*) \cdot g\end{aligned} \tag{2.4}$$

as $\cdot$ is associative.
Therefore, we are given that

$$\begin{aligned}g \cdot (g^* \cdot g \cdot g^*) \cdot g &= g \cdot (g^* \cdot g^{**} \cdot g^*) \cdot g \\ &= g\end{aligned} \tag{2.5}$$

$$\begin{aligned}\implies g^* \cdot g \cdot g^* &= g^* \cdot g^{**} \cdot g^* \\ &= g^*\end{aligned} \tag{2.6}$$

As h^* is unique $\forall h \in G$, we can conclude that:

$$g^{**} = g \tag{2.7}$$

It was at this point that we finally felt like we were getting somewhere.

3

In a group, we have $e^{-1} = e$, and so it may be useful to show that $e^* = e$. Using (1.1) we looked at

$$g \cdot g^* = (g \cdot g^*) \cdot (g \cdot g^*) \cdot (g \cdot g^*) \tag{3.1}$$

and using (2.1):

$$g \cdot g^* = (g \cdot g^*) \cdot (g \cdot g^*)^* \cdot (g \cdot g^*) \tag{3.2}$$

$$\begin{aligned}\implies g \cdot g^* &= (g \cdot g^*) \cdot (g \cdot g^*)^* \cdot (g \cdot g^*) \\ &= (g \cdot g^*) \cdot (g \cdot g^*) \cdot (g \cdot g^*)\end{aligned} \tag{3.3}$$

as $(g \cdot g^*)^*$ is unique:

$$\implies (g \cdot g^*)^* = (g \cdot g^*) \tag{3.4}$$

Our first instinct was actually correct for once, which was a relief.

4

We defined $g \cdot g^* = e_g$ and if we prove that this is the identity, we can conclude that $*$ is the inverse. In order to do this, we need to prove that $\forall g,\ h \in G,\ e_g = e_h$ and therefore $*$ is the inverse. After we failing several times to prove this, we defined

$$f = e_g \cdot h \tag{4.1}$$

Using (1.4), i.e. $e_g \cdot e_g = e_g$:

$$\begin{aligned}\implies e_g \cdot f &= e_g \cdot e_g \cdot h \\ &= e_g \cdot h \\ &= f\end{aligned} \tag{4.2}$$

We can also say that:

$$\begin{aligned}f &= f \cdot f^* \cdot f \\ &= f \cdot f^* \cdot (e_g \cdot f) \\ &= f \cdot (f^* \cdot e_g) \cdot f \\ \implies f^* &= f^* \cdot e_g\end{aligned} \tag{4.3}$$

Knowing that eg $\cdot f = f$ and $f^* \cdot e_g = f^*$, $\forall f \in G$, we can prove that eg $\cdot\, h = h$, $\forall h \in G$:

$$f^* = f^* \cdot e_g \cdot h \cdot f^* \tag{4.4}$$

Using (4.3):

$$\begin{aligned}(f^* \cdot e_g) \cdot h \cdot f^* &= f^* \cdot (e_g \cdot h) \cdot f^* \\ &= f^* \cdot h \cdot f^* \\ &= f^*\end{aligned} \tag{4.5}$$

Since f^{**} is unique, $f^{**} = e_g \cdot h = g$:

$$e_g \cdot h = h, \forall g, h \in G \tag{4.6}$$

Knowing this, we can say:

$$\begin{aligned}&e_g \cdot h = e_h \cdot h \\ &\implies e_g \cdot e_h = e_h \cdot e_h = e_h \\ &\implies e_h \cdot e_g \cdot e_h = e_h \cdot e_h \cdot e_h = e_h \\ &\implies e_g = e_h\end{aligned} \tag{4.7}$$

So this means that e_g is a unique identity, and finally we are done. Therefore $*$ is the inverse and $(G, \cdot)$ is a group. After being shocked that we have proved it, we decided that we had, and thus concluded that we knew groups well enough for our exam (-ish).

5

The moral of this story is that when given a hard question, and you see no solution, that you should keep trying even the most absurd of ideas. Perhaps one of these might lead you in a helpful direction. Even when you feel disheartened and want to give up, the continued failures are worth the eventual success and will increase how proud you feel after spending such a long time working on a problem. You are always more successful and learn more things when you collaborate with one another and share your ideas, which is what modern mathematics is built on. And you can bond with others over your passion for maths.

By Chloe-anne England and Isobel Shaw

Land Of Science

Hydroponics - the quirky solution to all our problems?

Over the course of our world's history, over and over again, we have faced some sort of food crises . These crises are often caused by a shortage of food, impacted by multiple factors which can usually be traced back to an increase in demand, due to a sharp rise in population, or a decrease in production - such as during world wars, where rationing came into effect, and many farmers had to leave to fight in the war. Recently, scientists are looking for more sustainable ways to grow food to ensure that, for the foreseeable future, we will always have enough food to go around.

So, how can we begin to grow plants in more sustainable ways? One of the main answers is hydroponics. Hydroponics involves cutting out the soil when growing a plant. Why? Whilst soil usually has the right nutrients a plant needs to grow and the right level of water retention, these levels are hard to control. If soil doesn't contain the right nutrients, it becomes harder to grow plants - and when large populations need feeding (often in places with low quality soil) it can be more efficient to use hydroponics.

So, how does it work? Hydroponics is the process of suspending a plant in some sort of medium, which can be anything really, as long as it lets water move through easily. Some examples are; sand, gravel, clay pellets, and even wool. Next, the plants are given a mixture of nutrients and water, either by spraying the exposed roots, soaking them for a few minutes every hour, or even by creating a fog in a closed chamber.

Hydroponics gives us a way for plants to be grown using less water - as water is used much more efficiently, and allows for plants to be grown practically anywhere, as heat and light conditions can easily be controlled through electricity. This is especially important in space travel, as it means that scientists do not have to plan for whether plants can grow in a given location - but it also means that, in theory, anyone could eat local, organic plant based food. As a nice bonus, it is also much more space efficient, as growing locations can be built upwards, rather than outwards.

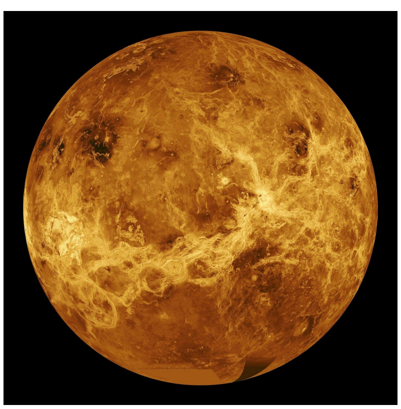
All in all, while hydroponics provides an incredibly versatile and powerful way to grow plants, it has high start-up costs compared to more traditional farming methods. Because of this, it is unlikely that hydroponic farming will become the norm. However, there are certain cases where it can be the best and most sustainable option.

By Louie Bond

Climate News

Extra-terrestrial Hints:
What Venus can teach us about Climate Change

With its temperatures averaging around 471 degrees celsius, acid rain, and an atmosphere 90x thicker than that of earth's, it is hard to believe that (much like Earth today) Venus was once covered in water. But what could cause such dramatic changes in a planet that was once deemed as habitable?



Up until recently, it has been widely believed that Venus's hostile environment arose from temperature increases, caused by the aging of our sun. The theory was that, as our sun aged, it became hotter and therefore the water on Venus began to evaporate. Water vapour is a greenhouse gas and therefore accelerated the rate at which planetary temperatures rose. As the oceans on Venus vaporised, any carbon stored within the water was released, thickening the atmosphere and causing the runaway greenhouse effect which in turn created the environment we see on Venus today.

However, recent research has shown that heating from the sun may not have been substantial enough to cause an event as large as to stop the water cycle. Unfortunately, the real cause is, as of yet, unknown. It is however theorised to have been caused by a large global resurfacing event, such as frequent large scale volcanic eruptions. Although, this is just a theory, and our lack of knowledge surrounding this topic is disconcerting as it provides us with a large unknown when it comes to climate change predictions on earth.

We can however plot how the increase in planetary temperatures affected venus and compare those changes to climate modelling here on earth. For example, it was in fact the study of climate change on Venus that prompted NASA scientists to look for ozone holes on Earth. Since finding a hole, international agreements have been formed to cut the production of compounds (such as free radicals) that eat away at the ozone layer.

In a famous interview on the topic of climate change, Stephen Hawking spoke of what he called 'Venus Syndrome'. Hawking warned of the consequences of a runaway greenhouse effect, taking place over billions of years, using the planet Venus as an example. While the imminent effects of climate change on Earth may not be as radical as those seen on Venus, these warnings are not something we should take lightly.

Climate change deniers will still argue against statistical evidence and climate models. And, while it is often fruitless to argue with such people, perhaps we should think of changing the subject of conversation to holiday destinations instead. I heard that Venus was quite nice this time of year…

"Next time you meet a climate-change denier, tell them to take a trip to Venus; I will pay the fare."- Stephen Hawking

On a lighter note…

Here at The Write Angle, our favourite fact about Venus is that it's planetary temperature is so hot that it actually 'snows' metal.

Minerals such as bismuthinite and galena are vaporised by Venus's immense heat. These vapours are then circulated up into the atmosphere, condense and settle in deposits on mountain tops, where the temperature is slightly cooler. It is uncanny how similar these mineral deposits look to the snowy mountain tops we see on earth, and we encourage you to google these images yourself.

By Freya Dover

Global Affairs

What's happening with Aung San Suu Kyi

On 1st February 2021, a military coup d'etat was carried out against the Myanmar leader and nobel peace prize laureate, Aung San Suu Kyi, the paramount leader of the Burmese transition to democracy, whose father, Aung San, a national hero and widely considered the father of the nation. Aung San Suu Kyi first rose to prominence within the Burmese pro-democracy movement in the 1980's, as the general secretary of the National League for Democracy (NLD) party. Aung San Suu Kyi after winning a landslide victory in the 1990 Myanmar Election would then spend the next 15 years under house arrest under the authority of the military government. It was during this time she was awarded the Nobel Peace Prize.

In 2012, 2 years after her release from house arrest, Aung San Suu Kyi announced she would run for president however she was unable to due to a clause in the country's 2008 constitution forbidding people with spouses and/or children of a foreign nationality that seemed to written purposely so that Aung San Suu Kyi could not assume the presidency. After the successful election of Htin Kyaw, an ally of Aung San Suu Kyi, he appointed her the newly created role of "State Councillor" akin to that of Prime Minister where she would lead the country as de facto head of government.

However Aung San Suu Kyi's tenure has been marred with failure to address the country's deep rooted economic issues and ethnic tensions. In an event perputrated by the millitary, described by many UN agencies as a genocide, the ethnic minority known as the Rhohingya people, inhabitants of the Rhakine state, have been stripped of their Myanmar citizenship and their houses, schools and villages have been burnt to the ground. It has been estimated that at least 24,000 Rhohingya people have been killed, 18,000 Rohingya women and girls have had sexual violence committed against them, 116,000 people have been the victims of physical violence and over 700,000 Rhohingya people have been forced to flee their country for the neighbouring country of Bangladesh. These events have shown to many people that the State Councillor, despite her official title, does not appear to hold the balance of power. In 2019, Aung San Suu Kyi was called to The Hague to defend, in front of the International Court of Justice, the actions of the military power she has fought against for much of her life.

On the 8th November of last year, an election that has been declared fraudulent by the military, increased the margin of NLD's supermajority. As a result the military carried out the events that transpired on the morning of last Monday. NLD members of the Myanmar Assembly, NLD ministers, the President of Myanmar and Aung San Suu Kyi herself have been detained. Power has been transferred to the Commander-in-Chief of the military under the declaration of a national emergency. It is still however unclear what this event will mean for the future of the Myanmar state as the situation continues to develop.

By Jabez Ken

Good News

PrEP is routinely available

PrEP, formally known as pre-exposure prophylaxis is a drug to protect someone from getting HIV. I'm pretty sure you all know what HIV is, but here is a quick run down.

HIV stands for human immunodeficiency virus spread by sexual contact or needles. It is a virus that weakens the immune system, by damaging the cell in your immune system, making your body's ability to fight everyday infections and diseases dilapidated. HIV can lead to a person developing AIDS (acquired immune deficiency syndrome), a range of infections occur when your immune system is weakened by HIV. Most people who contract HIV, will not develop AIDS, as with an early diagnosis and treatment, people with HIV can lead a full life.

HIV is still dangerous. If left untreated, it will develop into AIDS, and when it is treated, it still doesn't just go away. You will be prescribed antiviral drugs for the rest of your life, you won't be able to donate your blood or organs, you won't be able to join the armed forces, you will have difficulty getting life insurance, you will not be able to visit some countries, if you become pregnant there is a risk of your baby contracting the virus (though only 1% with the correct treatment).

In 2017, 93385 people received HIV treatment in the uk. In 2019, 4139 people were newly diagnosed with HIV. It is still being transmitted across the uk, showing how much PrEP could do to help prevent it's transmission.

Before 2021, PrEP was only available in England through a capped trial, however routine commissioning of the drug began in october of 2020 and most clinics prepared to open their PrEP services by the end of 2020, making the drug readily available to those who fulfill the criteria. This is great news for England, and a step towards the government's promise to end HIV transmissions by 2030.

Condoms will always be the best way to prevent the spread of STDs and STIs. If you believe you are at risk contact a doctor, as an early diagnosis can make all the difference. If you want more information on HIV or other STIs, then visit the nhs website.

By Molly Berridge

Devine's Problems

This week's Problem

Suppose you want to colour the blue dots on this drawing, in a way that no two blue dots have the same colour if connected by a line. How many different colours do you need?