

UPPER  
FOURTH  
CROSS  
CURRICULAR  
PROJECTS 2023



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# KNOWLEDGE

# IS IT BETTER TO BE AN ALL-ROUNDER OR TO SPECIALISE?

by Bianca Baratta

My artefact shows that being all-rounded in knowledge is more efficient than being excellent at one or two subjects.

An example of a genius in maths and science is Albert Einstein. He was a mastermind, but did you know that when he took a test to get into the Swiss Federal Polytechnical School, he passed the maths and science tests but failed all the rest! I believe being all-rounded is very useful because if one day you decide to try something new, you will have enough knowledge to build a foundation on. Again, Einstein wrote to a newspaper declaring “I would rather choose to be a plumber”<sup>1</sup>, but he had already chosen to be a scientist when he was only 15. In conclusion, I think that having other options is important, and because if one day you are in a difficult situation and need some general knowledge, it is helpful to have it.

In my artefact, you will see pottery inspired by Phoebe Cummings, whom we learned about last year. I liked her art as she doesn't fire her pottery as she can always mould it again, which for me symbolises that the brain can always learn new topics/knowledge. Secondly, my cuttlefish bone has quotes from *The Tempest's* Caliban and Prospero. Prospero's side of the head shows knowledge that is curated and needed on the upper level, like school and work. Caliban's side indicates all the knowledge humans have buried, like our communication with nature and our wild sides. Thirdly, the hand construction indicates science. In the past, we thought people with disabilities were inferior, but that is because we didn't have enough knowledge to make an informed deduction. Now we work with disabilities and use our knowledge to help and improve other people's lives so they can learn more and add to the world's collective knowledge. Lastly, the sea levels chart shows how little knowledge we have about our ocean compared to observable universe. In my opinion, humans want to do more and achieve more, so instead on expanding our knowledge here on earth, we look for broader things to study.

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## Endnotes

<sup>1</sup>History Working Group, *Einstein, Plumbers, and McCarthyism: Einstein's response to a political climate increasingly hostile to scientists and teachers* (2017), Institute for Advanced Study <<https://www.ias.edu/ideas/2017/einstein-mccarthyism>> [accessed 20 February 2023].

# THE HIDDEN MESSAGES IN WAR PROTESTS

by Alex Clutton Mendias

The power of knowledge is extremely useful in the context of hidden messages. These are only revealed once people look inside what has been said and dig deeper. A very recent and continuous example of this are the protests in Russia against the war and Putin.

The war in Ukraine is no secret to the world. The violence happening in Ukraine however is extremely covered up to the citizens. Putin has continuously told the people of Russia that there is no war— that the whole thing was started by the Americans. This hasn't fully been believed by all those who listen.

These people decided to protest against the government for lying about the war and the fact there is a war going on in the first place because of Putin wanting Ukraine instead of the lies he tells the masses. However, this is deemed illegal by the government and those who actively protest will get arrested by the police. The government says those who protest are paying no respect to Russia's war heroes. These brave protesters have resorted to hiding their protests in elaborate disguises. From lost dogs to ballerinas, if there is a symbolic meaning that goes against the war and Putin that one can decipher, they'll have it.

A lost dog poster doesn't seem like the type of thing to have meaning hidden in the notice, but that's what someone, unnamed as to not get in serious trouble with the police, ended up doing to spread their opinion on the political things happening around Russia. With a picture of a dog to boot, this missing poster has the caption: "A dog is lost! It ran away after Russia's invasion of Ukraine. Its name is Future"<sup>1</sup>. This is referencing the loss of freedom not only the Ukrainians had, but the Russians as well. This start of a war has isolated Russia from the rest of the world, unable to get information from anyone desperately willing to share it.

People are asking for the famous ballet dance, *Swan Lake*, to be broadcasted all over Russia. To anyone who lives in Russia or knows its history with this piece, it makes perfect sense for this to be a symbol of protest. For many Russians, *Swan Lake* is something to be proud of, it's even used politically. When Leonid Brezhnev died in 1982, after nearly two decades in power, the television stations didn't broadcast his death or news about who would lead next, but instead broadcasted *Swan Lake* in its entirety. These broadcasts were a stalling tactic, meant to block access to the

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## Endnotes

<sup>1</sup> Markus Ziener, *War critics in Russia, facing continuing crackdown, turn to craftier, coded protests* (May 2022), LA Times <<https://www.latimes.com/world-nation/story/2022-05-20/war-critics-in-russia-face-crackdowns-turn-to-coded-protests>> [accessed 26 February 2023].

news while the Soviet leadership settled on a succession plan. The same happened following the deaths of Yuri Andropov and Konstantin Chernenko<sup>2</sup>. *Swan Lake* also plays whenever the government is in political trouble.

This only playing when Russia's government needed a way to calm and distract the citizens has backfired. Protesters demand this be played again. How is this protesting? When this piece is only played when a very beloved, long-lasting political leader dies, that means when people ask for its broadcasting, they are calling for Putin's death. They want this to be played, telling Russia that they want Putin's death so the war could end.

These are all people who've taken their culture and everyday things to craft a way of protest against a government who doesn't know it exists. Using Russian pronunciation, a woman protesting against the war was able to convince the police that she was instead protesting against fish, saying she hated fish. This is a hidden way of rebellion. By using *Swan Lake*, something Russians are very proud of, they protested their opinion and weren't caught, just because of *Swan Lake's* popularity. However, anyone who put the context of *Swan Lake* being broadcasted when Russia's leaders died could see what they truly meant. A missing dog poster is one of hundreds, people can see them anywhere. There are no restrictions on them so some brilliant mind decided to incorporate a hidden meaning.

These signs of protest continue in more elaborate ways as Russia's rules grow ever more strict, people were getting arrested for holding up blank pieces of paper during a protest. They show their knowledge of what's truly going on in Russia using something people would have to be actively searching for to tell their opinion. Those who want the better for Ukraine find each other in their desperate times, to band together and to construct more hidden messages against the war. They use the things people wouldn't second guess in Russia to their full advantage. People could be just asking for *Swan Lake* to be broadcasted because they like it, not for hiding the message that they crave Putin's death. The knowledge of Russia's history, their language, will help you find these people's true intentions. But for everyone else, it's just someone else's problem.

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#### Endnotes

<sup>2</sup>Amelia Schonbek, *This Portentous Composition: Swan Lake's Place in Soviet Politics* (16 March 2015), *Hazlitt* <<https://hazlitt.net/feature/portentous-composition-swan-lakes-place-soviet-politics>> [accessed 27 February 2023].

# HOW HAS OUR KNOWLEDGE OF GEOGRAPHY CHANGED THE MODERN WORLD?

*by Isla Chew*

Geography is important because our lives are constantly altered by human and physical geography. Geography has changed our lives and taught us about the balance between the environment and humans.

A substantial knowledge of human geography allows us to expand our understanding of topics like migration and globalisation and how they change society.

The influence of immigrants on America's society has led to racial shifts, as outlined by the Graduate Center at The City University of New York.<sup>1</sup> For most of the 20th century, race was purely seen as black and white. In 1960, 85% of Americans were white, and black people were seen as the minority. Now, we have a wider range of descriptions for race such as Hispanic which describes people from South America (including other terms such as Latinx). Other examples include 'African American' and 'American Indian' among others. Immigration has made America more diverse, creating more precise terms to describe race. Immigration has provided benefits such as slowing population loss and stimulating economic growth. Immigrants have provided a 'lifeline' in cities that were losing population. They played a large part in the growth of cities like Las Vegas by giving it a growing population. In 2014, one in five business owners across the U.S.A were immigrants and they also developed around a quarter of new firms. By contributing to the use of goods and services, immigrants have boosted the economy.

Our grasp of globalisation has allowed us to grow our global cooperation. Enlarged globalisation has been connected to a decrease of conflict, although not abolishment.<sup>2</sup> The increase of interdependence between countries has made the concept of world war less of a threat, as countries like England rely on countries like Venezuela to produce like crude oil. Globalisation has also produced global alliances such as N.A.T.O which protect each other.

An understanding of physical geography has taught us how topics like natural hazards and climate change alter our lives. People adjust their lifestyles because of natural hazards. Our knowledge of natural disasters has enabled us to create safety nets such

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## Endnotes

<sup>1</sup>Office of Communications and Marketing, How Immigration Changed U.S Society (2022), Graduate Center <<https://www.gc.cuny.edu/news/how-immigration-changed-us-society#:~:text=In%20many%20central%20cities%2C%20immigration,and%20into%20the%20early%202000s.>> [accessed 26 February 2023].

<sup>2</sup>Tim Stobierski, 6 Pros and Cons of Globalisation to Consider (2021), Harvard Business School Online <<https://online.hbs.edu/blog/post/pros-and-cons-of-globalization>> [accessed 26 February 2023].



as insurance to compensate for any damage. We can roughly calculate when a natural disaster is going to happen like hurricanes by observing the weather of a location. If there is an increase of cloudiness, increasing tides and heavy rainfall, a hurricane warning can be sent out.<sup>3</sup> This allows people to move into shelter or away from the country completely to prevent injury or death.<sup>4</sup>

One can also adjust the infrastructure to prepare for disasters. For example, in some areas people have netting over their shelves to prevent objects falling off them. The impacts of climate change on our lives are extremely prominent as drought can harm food production and therefore human health.<sup>5</sup> Flooding is increasing due to an increase in global temperature and abnormally heavy precipitation events are occurring across the U.S.A.<sup>6</sup> The climate issue is also affecting our food supply as increased temperatures, drought and water stress, diseases and weather extremes create many difficulties for the farmers.<sup>7</sup> Knowledge of the climate and growth of crops make it possible for us to adapt certain agricultural techniques and technologies like planting cover crops to ensure that the plants and soil are in the best condition.<sup>8</sup> As the ocean temperatures rise, hurricanes become stronger and wetter contributing to deaths caused by hurricane damage and flooding.<sup>9</sup> Increased flooding can also lead to the spread of waterborne diseases.<sup>10</sup> Vulnerable groups such as children, the elderly, low income workers and adults with pre-existing health conditions are at a higher risk of being affected by climate change.<sup>11</sup> Our understanding of geography helps us to provide solutions for problems climate change presents.

To conclude, geography both physical and human, plays an unnoticeable but major role in our lives. Our knowledge of how geography works allows us to adjust our lives to the negative changes and take advantage of the positive changes. A knowledge of human geography has allowed us to benefit off the economic growth of migration and the peaceful growth of globalisation. A knowledge of physical geography has allowed us to change our infrastructure to withhold against natural hazards and adjust our technologies to overcome the obstructive impacts of climate change.

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#### Endnotes

<sup>3</sup>Tropical Cyclone Track Forecasting (2023), Wikipedia <[https://en.wikipedia.org/wiki/Tropical\\_cyclone\\_track\\_forecasting#:~:text=The%20weather%20of%20a%20particular,tides%2C%20squalls%20and%20heavy%20rainfall.>](https://en.wikipedia.org/wiki/Tropical_cyclone_track_forecasting#:~:text=The%20weather%20of%20a%20particular,tides%2C%20squalls%20and%20heavy%20rainfall.>) [accessed 26 February 2023].

<sup>4</sup>V. Kerry Smith, Adjusting to Natural Disasters (2006), Springer Link <<https://link.springer.com/article/10.1007/s11166-006-0170-0#:~:text=People%20adjust%20to%20the%20risks,protect%2C%20or%20they%20can%20insure.>> [accessed 26 February 2023].

<sup>5</sup>Climate Change Impacts (2021), National Oceanic and Atmospheric Administration <<https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts#:~:text=The%20impacts%20of%20climate%20change%20on%20different%20sectors%20of%20society,availability%2C%20and%20limit%20worker%20productivity.>> [accessed 26 February 2023].

<sup>6 7 8 9 10 11</sup>Climate Change Impacts (2021), National Oceanic and Atmospheric Administration.

# HOW KNOWLEDGEABLE IS CHATGPT?

By Naomi Maltais

ChatGPT has become popular for its ability to re-generate pieces of websites and articles to create an answer suitable for a user's question. Open AI, the creators of ChatGPT have spoken about the AI's limitations, however, many say that AI is the future for humans and that it is able to generate good-quality essays in seconds. However, as more people start awaking to the fact that it is now easy for students to plagiarise their work, many people have also started doubting ChatGPT's knowledge and understanding of a subject. So, how knowledgeable is ChatGPT? How much can it talk about a subject? Can it not plagiarise? What are its limitations?

To figure out whether the AI is knowledgeable we must agree on what is knowledge. There can be many definitions for knowledge, like the IQ of a person or how much general knowledge one knows. In the Oxford Dictionary, knowledge is defined as "facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject".<sup>1</sup> If we use this definition, we summarise knowledge as the understanding of information and the amount of this information we know. To apply this to ChatGPT, can it sustain knowledge and not plagiarise every text it gives to a human; will it be able to understand inadeptly a subject and analyse a novel in detail; can it write essays fluently, with the understanding it requires? Though, as the Oxford Dictionary states, knowledge is gotten from an experience or education, this is something that the AI does not currently have, the mistakes and improvement an education or experience grants you.

To start, I am going to ask it a simple question like: Write me a short paragraph describing a black cat. Afterwards, I will run it through 3 plagiarism checkers to analyse how much ChatGPT generated itself and what was taken from articles and websites. The first website (Plagiarism Detector) told me that there was 0% plagiarism in the paragraph, however, the 2 other websites told me that there was approximately 18-25% plagiarism. What this shows is that ChatGPT is capable and able to write paragraphs with little to no recognition by multiple plagiarism checkers. This opens a huge door for plagiarism and how teachers will inevitably mark something which they don't even know was written by a computer. To follow on, ChatGPT doesn't just simply generate paragraphs for you, it can do maths equations, it can help you code, and even write whole books. Though, an issue

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Endnotes

<sup>1</sup>*New Oxford American Dictionary*, ed. Angus Stevenson and Christine A. Lindberg, 3rd edition (Oxford: Oxford University Press, 2010), p. 967.

with this is how it's stuck in the world of 2023, with outdated information and little to no information about anything beyond that.

We know that ChatGPT can write simple paragraphs without being Plagiarised but what about longer pieces of work? So, when Mr Strathdene was interested in ChatGPT I sent him two essays written by the AI. I first wrote to ChatGPT 'write me an essay on freedom and speaking out in [a novel]'. Mr Strathdene emailed me back saying that the essay wasn't great and that I should improve the prompt given to ChatGPT; Making the essay longer, including quotes, and for the AI to analyse them. However, after I adjusted the prompt, writing to the AI 'write me a long essay on freedom and speaking out in [a novel] with quotes and analysis' and sent it to Mr Strathdene he told me how much better quality this was. This showed me how just a few words in a prompt given to the AI changes the quality of its work. How even if someone uses a powerful machine like ChatGPT to write for them and do their assignments, they still need a good prompt to activate the machine. Demonstrating how even though it can produce whatever the user asks, it must be told specifically about improvements so that the essay is outstanding. This creates limitations for the AI, as humans still need to re-read its work and adjust their prompts accordingly. Even if it isn't plagiarised the quality of its written work is low and needs a good prompt for it to be improved.

To summarise, ChatGPT is an AI that has been programmed to read and re-generate websites and information that is required for the user's question. It can pass plagiarism tests and with the right prompts make good pieces of work. Though the AI is advanced and can generate even maths questions there are large limitations such as how it only holds good information from 2021 and before. These limitations can cause false information and the AI still needs the help of a human to improve its otherwise basic answers. However, it does tick most boxes of knowledge, this being: holding information, inadeptly analysing novels, and most importantly generating answers which haven't been largely plagiarised. Therefore, my final answer to how knowledgeable is ChatGPT is **quite**. This is mainly because the AI can't learn or understand what it has been told, and the AI cannot improve its own mistakes without a human to help it.

# BEAUTY

# THE BEAUTY OF IMAGINATIVE PLAY

by Lily Appleby

There are many aspects to beauty, both physical and mental. However, the common idea of beauty in today's world is that it is a physical concept, and is used to describe the look or appearance of a person or object. Dictionary.com defines beauty as, "(adjective) relating to or being something intended to enhance a person's physical attractiveness".<sup>1</sup> I argue that beauty should not simply be about a person's physical appearance. It also comes from within. Inner beauty can be defined as your emotions, your characteristics, your personality, your mindset and your morals and values, all of which hold just as much importance as the concept of physical beauty.<sup>2</sup> This essay is about the beauty of imaginative play, and how amazing and beneficial it can be for a child to explore their imagination and trigger emotions like happiness and feelings of self-worth.

A person's physical appearance is more often than not based around these expected beauty standards, social constructs of perfection, certain beliefs of what ideal beauty should look like, standards we all must meet if we want to fit in. It often feels like these standards are relentlessly forced upon us. It can feel overwhelming and never-ending and these unrealistic expectations of what someone should look like can flood a person with negative thoughts and emotions.

Beauty standards have been around for many years, and are constantly changing. From ancient times where Greek gods and goddesses were depicted with larger stomachs to show wealth, to nowadays where importance is placed on being both slim with a flat stomach, or chiselled and masculine. The negative impacts beauty standards have on people has led to 31% of teenagers and 35% of adults feeling depressed or ashamed because of how they perceive their bodies.<sup>3</sup> Insecurity about body image can also lead to low self-esteem, self-hatred, shame, anxiety, mood disorders, eating disorders and even suicidal thoughts.

On the other hand, imaginative play has the opposite effect on the mind. Children are free to play and craft whatever they imagine, and be as creative as they please.

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## Endnotes

<sup>1</sup>Beauty (n.d.), Dictionary.com <<https://www.dictionary.com/browse/beauty>> [accessed 1 March 2023].

<sup>2</sup>What is inner beauty and why is it more important than outer beauty? (2020), U Soul Beautiful <<https://usoulbeautiful.org/blog/2020/02/06/what-is-inner-beauty-and-why-is-it-more-important-than-outer-beauty/>> [accessed 1 March 2023].

<sup>3</sup>Chris Foy, *Beauty Standards, Mental Health, and Their Eye-Catching Relationship* (2022), FHE Health <<https://fherehab.com/learning/beauty-standards-mental-health#:~:text=Negative%20body%20image%20can%20lead,self%20esteem%20and%20healthier%20relationships.3>>> [accessed 1 March 2023].

<sup>4</sup>How play helps children's development (n.d.), ni direct government services <<https://www.nidirect.gov.uk/articles/how-play-helps-childrens-development>> [accessed 1 March 2023].

Imaginative play brings many hours of happiness to a child, and has a lasting joy from the memories made. It can also help to produce endorphins, natural feel good chemicals. Not only this, but playing also enhances a child's development skills such as cognitive, physical, social, motor and problem solving, as well as improving emotional wellbeing.<sup>4</sup> The beauty of a child's mind is their innocence, unlike the judgemental beauty standards of today.

I have an eight year old brother, so you can understand that imaginative play is a big part of our lives at home. A recent example of this is when he saw a large, simple sheet of silver bubble wrap and his imagination brought it to life as a pair of moon boots. The confidence he had in his idea and his eagerness to create something out of nothing kept him excited throughout the process. He demonstrated many of the above mentioned development skills, like problem solving and enthusiasm. He was extremely proud of his creation, so much so that he even wanted to wear them out on a recent trip to the cinema and made special modifications so that they could be worn outdoors.

Not only did he describe the boots as amazing, but he also thought they were beautiful, and he was overjoyed by his finished creation. There was a noticeable physical change in his appearance when he finished making the boots. He seemed to walk taller with shoulders back, almost strutting around the house. The emotions of joy and happiness that radiated from my brother as he showcased his "amazing" moonboots for us all to see was pure beauty.

I am happy that my brother is so imaginative, and I am confident that the skills he learns through imaginative play will help him to combat negative social constructs, whatever they may be and however they may challenge him as he moves forward in his life. Imaginative play is not only important for childhood development, but it will help him to build a fundamental set of skills such as developing confidence, self-esteem, resilience, interaction, social skills, independence and curiosity, all skills that will help him with study, work and relationships in future life.<sup>5</sup>

Many may see play as just a childish activity, but in fact it has huge benefits for a child. The positive emotions and physical transformation that my brother demonstrated are a true representation that learning through play is not 'simple' or 'childish', but a highly effective and an incredibly important construct that helps children to develop into beautifully well-rounded humans, thus supporting my argument that beauty is not simply about a person's physical appearance; we are all so much more than just what we look like on the outside. As the saying goes, "beauty is only skin deep". Imaginative play is an important building block to inner beauty, and inner beauty is true lasting beauty.

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Endnotes

<sup>5</sup>*How play helps children's development* (n.d.).

# THE BEAUTY OF THEATRE, BUT AT WHAT COST?

by Grace Harris

Imagine, you've just sat down in your red velvet seat surrounded by the buzz and excitement of all the laughing people around you. Suddenly, the lights start to dim; you feel your heart beating faster and faster and then... the show starts. The breathtaking costumes, the amazingly choreographed dances and the melodious songs will keep you on the edge of your seat. You feel exhilarated. Possibly the greatest, most beautiful night of your life, but at what cost?

Firstly, theatre tickets are very expensive and many people have to spend a lot of extra money, on top of that theatre ticket, just to get to a theatre because they don't live in London. Many people also have to book hotels as an evening show usually starts at around 7:30pm and finishes between 10 and 11:30pm, so their last train might have left, or they might not want to be travelling that late. The prices of tickets have increased significantly since Covid-19. According to research by theatre publication *The Stage*, prices for top tickets to see West End shows have risen by 21% since before the pandemic.<sup>1</sup> If a ticket was £90 before Covid-19, it is now £109, which is a big increase and many people can no longer afford it.

Although it is very expensive, there are many ways theatres can be more accessible. For example, Theatre week is a week (Monday 20 February to Sunday 5 March) where most musicals in the West End have massive discounts; *Bonnie & Clyde* tickets are usually £65, but during Theatre Week they were only £15! Another solution is to enter a theatre lottery. This is like the national lottery but you win discounted theatre tickets instead.

Secondly, although it may seem like the actors have a really easy, chilled out job, they don't. Most musical theatre actors get paid the minimum wage. The BBC reported that more than half of West End performers receive the existing union-agreed minimum wage, which is £629.41 a week.<sup>2</sup> This is barely enough to live in London. Also, they have a very unsteady income with lots of uncertainty - if they are in a show, they get paid, but if they aren't, they don't.

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## Endnotes

<sup>1</sup>Associated Press in New York, *The Phantom of the Opera to close on Broadway after 35 years* (17 September 2022), *The Guardian*, <<https://www.theguardian.com/stage/2022/sep/17/the-phantom-of-the-opera-to-close-on-broadway-after-35-years>>.

<sup>2</sup>Yasmin Rufo, *West End theatre performers threaten strike action* (19 January 2023), *BBC News* <<https://www.bbc.com/news/uk-england-london-64330629>>.

When they aren't in a show, they are most likely going to lots of auditions to find a show that wants them and aren't getting paid during this time. Even if they audition, it is extremely hard to actually get a role because the theatre world is so competitive. One musical theatre actor, Jordan Luke Gage, said on one of his Instagram stories that he has to audition 20+ times before he gets a new role. This level of rejection can be very demoralising. Many actors have to get a second job, do social media or do some advertising. For example, Hannah Lowther, who has been in a few shows such as *Heathers the Musical*, is also a social media star to earn some extra money.

Theatre can also be physically demanding, with long rehearsals, performances, and tours pushing the actors to their limits sometimes. Not to mention the live element means there is always a risk they might forget their lines, miss their cue, or fall over. Being in theatre requires discipline, dedication, and sacrifice, often taking away from personal time and relationships. Therefore, in order to be in musical theatre, you have to have a strong passion for it and a lot of patience.

Finally, we can't forget the business side of the theatre. All of the theatres are struggling to make a profit after issues such as COVID-19. They lost a lot of money because all theatres had to close for a very long time and when they did reopen, there wasn't a high occupancy rate. *The Guardian* reported that *The Phantom of the Opera*, Broadway's longest-running musical, never fully recovered from the pandemic shutdown and will close next February. This shows that even a big show hasn't been able to survive post COVID-19. In addition, producing a play or musical can be very expensive, requiring funding for costumes, sets, lighting, sound, and advertising.

So is the theatre still beautiful despite these costs? Whilst there are lots of struggles behind the scenes, there's lots going on to increase access to theatres. Also, although the actors struggle, it's clear from any closing night performance that all the pain they go through to get the role is all worthwhile. You can see how much the actors love to be on stage and how much their passion for musical theatre shines through. Whilst some theatre productions fail, they make space for new and exciting shows that audiences love. In conclusion, while the theatre is magnificent and beautiful, behind the curtain there is great sacrifice but it is all worth it.

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#### Endnotes

<sup>3</sup>Associated Press in New York, *The Phantom of the Opera to close on Broadway after 35 years* (17 September 2022), *The Guardian*, <<https://www.theguardian.com/stage/2022/sep/17/the-phantom-of-the-opera-to-close-on-broadway-after-35-years>>.



# THE VERITY OF BEAUTY

by Helena Malpica

I decided to create my artefact on the verity of beauty – In other words, the actuality of what defines beauty. In my work there are a few articles which touch on numerous spectrums of beauty and I would like to briefly discuss them.

As seen in my artefact (bottom right corner), Audrey Hepburn made a point about how beauty is not always gained by appearance and how one's outside looks do not define their beauty. She said: "For attractive lips... Speak with words of kindness", I believe that this in itself is so compelling as it presents how if allure is what you crave, then you must have the ability to speak with thoughtfulness and sympathy. Hepburn then goes to say how "For lovely eyes... Seek out the good in people", this line portrays that rather than wanting pleasant eyes, use your eyes to see the kind in people.<sup>1</sup> Overall, I agree with Audrey Hepburn's perception of beauty as it reflects the way in which beauty is subjective and does not rely solely on external appearance.

Now I will go on to explain the process of creating my artefact. I began by researching various articles about the different views of beauty, as well as reading into their opinions presented in order to grasp a better view on the ideas of beauty. Next I stuck down the articles on an A3 sheet of paper in a way that focused on significant sections of the articles. I then painted, with watercolour, a female face utilising a method which concentrates on shadows and deep tones. The painting was done solely with hues of blue; I layered several shades of blue in different places in order to create the shape of a females face. The blue in my eyes acts as a gentle centrepiece to break the chaos in the background of the art work.

Ultimately, I feel as though the watercolour painting in the middle (of a woman) alongside with the articles about beauty in the background emit a strong and valuable message.



## Endnotes

<sup>1</sup>Barbara Mikkelson and David Mikkelson, *Did Audrey Hepburn author these 'beauty tips'?* (8 August 2022), *Snopes* <<https://www.snopes.com/fact-check/my-fair-lady-2/>>.

# THE BEAUTY OF MATHS

by Elsie Pearson

When you think of beauty what comes to mind? Perhaps a striking supermodel, an absorbing piece of art, a mountain range at sunrise, or a rose in full bloom. But have you ever considered that maths could be beautiful? Although many people think of maths as a confusing, difficult and boring subject, brain scans have proved that the same beauty which is felt by looking at great art and the most admired music can be evoked by a complicated mathematical formulae.<sup>1</sup> An example of this is Euler's Identity, which many mathematicians view as the most beautiful equation. This has been proven by survey and a brain scan. In fact, it has been thought so remarkable that it has been compared to a Shakespearean sonnet.<sup>2</sup> Many people won't think of maths as a beautiful subject, but there are many patterns and connections in numbers which underlie beauty in the world.

A pattern that many of you might think of is the Fibonacci Sequence, which has become one of the most famous sequence in maths. In the sequence, each number is the sum of the number that comes before it. For example, the sequence starts with: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, and so on. Here, for instance, you can see that the number 8 is the sum of the preceding two numbers before it. You may be thinking: what has this got to do with beauty? Well, this famous pattern is everywhere in nature. If you were to count the petals of an iris, you would find there are 3. On a buttercup there are 5 petals and on a corn marigold there are 13.<sup>3</sup> These are all numbers in the sequence. However, this isn't the only instance nature reflects the Fibonacci Sequence. Spirals in nature are also something that we all perceive as beautiful. Cacti, pinecones, shells and even spiral galaxies in outer space are all good examples. When you look closely at a sunflower, you may notice that its seeds are arranged in a certain way, containing two types of spirals. Typically, there are 34 spirals in one direction, and 55 in the other. You may notice these numbers are successive in the Fibonacci Sequence. In some larger sunflowers, the number of spirals are larger, but both numbers are still two consecutive numbers in the sequence.

There is a famous ratio which is derived from the Fibonacci Sequence. This ratio is called the Golden Ratio, which is a ratio between two sequential numbers in the

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## Endnotes

<sup>1</sup>James Gallagher, Mathematics: *Why the brain sees maths as beauty* (13 February 2014), BBC news <<https://www.bbc.co.uk/news/science-environment-26151062>>.

<sup>2</sup>David Stipp, *A Most Elegant Equation: Euler's Formula and the Beauty of Mathematics* (New York: Basic Books, 2017).

<sup>3</sup>*Fibonacci Flowers: The secret formula of flowers* (n.d.), Funny how flowers do that.co.uk <<https://www.funnyhowflowersdothat.co.uk/fibonacci-numbers-secret-formula-flowers>>.

series, and equals 1.618. This ratio frequently appears across design, architecture, and art. Many see it as being the most aesthetically pleasing way to proportion an object. It's supposedly a key factor in how people perceive human beauty. There are many proportions between features on human faces which are more 'beautiful' if they are equal to the Golden Ratio. For example, the distance from the top of the nose to the centre of the lips should be 1.618 times the distance from the centre of the lips to the chin. Although most people's faces aren't correctly proportional using the Golden Ratio, Bella Hadid, the supermodel, has an almost perfect face according to the ratio. She was found to have 94.35% 'accurate' facial features.<sup>4</sup> In the search for perfect beauty, even plastic surgeons have been known to use the ratio, talking on their websites about using it when deciding how people's features align.

Maths is also evident when looking at structures or scenes that please the eye. For instance, some of you may know the 'rule of thirds' in photography, where the photographer positions the subject of the photograph a third of the distance from one of the edges. This kind of mathematical guidance is used in many places, notably in designing buildings where architects use symmetry, repeated patterns and shapes, and a deep understanding of proportion to create spaces that are considered beautiful. Even buildings such as the Parthenon in Athens used the Golden Ratio in its floor plan, the ratio of the columns and the overall façade.<sup>5</sup> And in the modern world, the Sydney Opera House and the National Gallery also reflect this same Golden Ratio in their design.

"Maths is not only seen as beautiful – beauty is also mathematical," says Dr Thomas Britz, a lecturer in UNSW Science's School of Mathematics & Statistics.<sup>6</sup> And I agree. There is something about how the brain interprets patterns, symmetry and other mathematical features that pleases it, and as a result we see great beauty in those things. I think that the beauty of maths is missing from the school curriculum. I wonder how many more people would love maths if it was taught from a position of exploring the beauty in numbers.

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#### Endnotes

<sup>4</sup>Science says this is the most beautiful woman in the world (17 October 2019), *The Economic Times*, <<https://economicstimes.indiatimes.com/news/international/world-news/science-says-this-is-the-most-beautiful-woman-in-the-world/the-perfect-face/slideshow/71630390.cms>>.

<sup>5</sup>Gary Miesner, *The Golden Ratios of the Parthenon* (11 October 2020), *The Golden Number* <<https://www.goldennumber.net/parthenon-golden-ratio-design/>>.

<sup>6</sup>Sherry Landow, *The mystique of mathematics: 5 beautiful maths phenomena* (20 May 2020), UNSW Sydney Newsroom <<https://newsroom.unsw.edu.au/news/science-tech/mystique-mathematics-5-beautiful-maths-phenomena#:~:text=Mathematics%20is%20visible%20everywhere%20in,beautiful%2C%20can%20have%20mathematic%20explanations>>.

# FAILURES AND MISTAKES

# HOW HAVE FAILURES AND MISTAKES INFLUENCED HISTORY AND OUR EVERYDAY LIVES?

By Inez Dehnugara

'Failures and mistakes': a term frequently used to summarise the faults that we make day-to-day. According to the Oxford dictionary, failure is equivalent to a "lack of success"<sup>1</sup> and a mistake is "an act...that is misguided or wrong"<sup>2</sup>, suggesting that both produce a result that is neither expected nor welcomed. When we as people fail or make a mistake, we are met with internal worry, stress, embarrassment - even fear. Although these feelings are unpleasant, they are necessary to help the brain learn from these mistakes and not to repeat them. In the past, failure could be the deciding factor of life or death. Thus, when we do make an error, our brain is naturally programmed to release an error-related negativity (ERN) signal to help solve this mistake and fix it for next time.<sup>3</sup>

In the modern day, however, failures and mistakes are often portrayed as good, and key to progress. This was demonstrated when Wilson Greatbatch was building a device to help track the rhythm of people's heartbeats. He used the wrong size of resistor, but, as a result of this, he invented the pacemaker.<sup>4</sup> Another well-known example is the famously serendipitous discovery of Penicillin in 1928. When Dr Fleming returned home from holiday, he noticed that the mould growing on a petri dish seemed to be preventing bacteria from growing around it.<sup>5</sup> This mistake saved more than 200 million lives and changed the course of medicine forever.<sup>6</sup> Unfortunately, not all mistakes are acted upon, the result being, as noted by the Spanish philosopher George Santayana, that "those who cannot

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## Endnotes

<sup>1</sup>Failure (n.d.), *Cambridge Dictionary* <<https://dictionary.cambridge.org/dictionary/english/failure>> [accessed 2 March 2023].

<sup>2</sup>Mistake (n.d.), *Cambridge Dictionary* <<https://dictionary.cambridge.org/dictionary/english/mistake>> [accessed 2 March 2023].

<sup>3</sup>Knut Overbye, *Learning From Mistakes: How Does the Brain Handle Errors?* (2020), *Frontiers* <<https://kids.frontiersin.org/articles/10.3389/frym.2020.00080#ref3>> [accessed 2 March 2023].

<sup>4</sup>*9 Successful Inventions Made by Accident* (2021), *Concordia University Texas* <<https://www.concordia.edu/blog/9-successful-inventions-made-by-accident.html>> [accessed 2 March 2023].

<sup>5</sup>*How was penicillin developed?* (2021), *Science Museum* <<https://www.sciencemuseum.org.uk/objects-and-stories/how-was-penicillin-developed>> [accessed 2 March 2023].

<sup>6</sup>*Everything You Need To Know About Penicillin* (2021), *NES Fircroft* <<https://www.nesfircroft.com/resources/blog/everything-you-need-to-know-about-penicillin/>> [accessed 2 March 2023].

remember their past are condemned to repeat their mistakes”.<sup>7</sup> In 1812, Napoleon invaded Moscow, in hopes of suspending trade with Britain. Due to extremely low temperatures and the spread of disease, of the 600,000 that started, less than 10,000 men made it back by the end of the conquest. In 1941, Hitler also decided to invade Russia (operation Barbarossa), despite knowing of Napoleon’s defeat. They set off inadequately prepared for the forthcoming winter. This resulted in many soldiers returning home with missing ears, noses, fingers and even eyelids! There were an estimated seven million casualties, making Barbarossa one of the deadliest military operations in history.<sup>8</sup>

What have these events taught us? Have politicians become wiser and more able to steer us away from such catastrophes? One could argue that questioning what has already been questioned results in mistakes being made, as we need to try several times to succeed. Nassim Nicholas Taleb talks about how for centuries, we believed there were only white swans. Then we discovered black ones. He calls it the ‘black swan theory’ which “refers only to unexpected events of large magnitude”. We as humans tend only to believe what we know, meaning the way we see things is primarily based on what we are familiar with. However, some believe that “the arrogant person can easily miss out on important information or alternative viewpoints, thus jeopardizing their decision-making process”. An example of this in action was through Alexander the Great, a leader widely known for his arrogance and lack of ability to question his decisions: “He not only destroyed himself but carried with him an entire civilization”. Thus, it is imperative for us as humans to explore alternate perspectives and learn from our mistakes. We need to see history less as a linear event and recognise that our history is messy and full of mistakes and failures. No humans are perfect because everyone has room to grow and without this drive to improve, our species would not be as

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#### Endnotes

<sup>9</sup>Black Swan theory (n.d.), Wikipedia <[https://en.wikipedia.org/wiki/Black\\_swan\\_theory](https://en.wikipedia.org/wiki/Black_swan_theory)> [accessed 2 March 2023].

<sup>10</sup>Ken Vaughan, *The Problem of Arrogance* (2019), New Horizon Partners Inc. <<https://newhorizon-partners.com/problem-of-arrogance/>> [accessed 2 March 2023].

<sup>11</sup>*The Pride of Arrogance* (2009), *Forbes* <<https://www.forbes.com/2009/06/18/alexander-great-hubris-leadership-power.html?sh=475c09eb462e>> [accessed 2 March 2023].

<sup>12</sup>*How Failures Lead To Success and Lessons That Can Help You Succeed* (2021), *indeed* <<https://www.indeed.com/career-advice/career-development/failures-lead-to-success#:~:text=Failure%20often%20allows%20you%20to,execute%20something%20the%20next%20time>> [accessed 2 March 2023]

<sup>7</sup>Ahlam Bolooki, *Lessons from history could stop us from making the same old mistakes* (2023), *The National News* <<https://www.thenationalnews.com/opinion/comment/lessons-from-history-could-stop-us-from-making-the-same-old-mistakes-1.934394>> [accessed 2 March 2023].

<sup>8</sup>Ahlam Bolooki, *Lessons from history could stop us from making the same old mistakes*.

advanced as it is today.

To conclude, failures and mistakes are a part of every being and to adapt we need to embrace failure. In Science, we would not have discovered the vast range of knowledge without the failures of our predecessors. In Maths, we need to explore several approaches to reaching an answer. Historians need to test all theories even if they seem wrong to truly understand our past. Mistakes are the best way to learn and help foster your critical and analytical skills allowing you to redirect and execute differently next time. Ultimately, perfection would never exist without failures and mistakes.

# FAILURES AND MISTAKES IN SCIENCE AND HISTORY

*by Aya El-Akabi*

This artefact is to do with failures and mistakes in science and history.

Science is a very hard subject to understand. Everyday people are trying to find new scientific discoveries to cure the world. When making these discoveries scientists have to do multiple tests and trials to find out whether their theories are true or false. History teaches you about all the events of the past; it shows you how our world came to be what it is now. This artefact that I present shows people who have made mistakes that had ended up creating something useful.

In the gallery we have four men: Percy Spencer, Galileo, Alexander Fleming, and Christopher Columbus. These people have been put in the gallery because they have all made mistakes and experienced failures.

- Percy Spencer was trying to make a military magnetron, but, while making this, his snack melted during it, which caused him to invent the microwave.
- Galileo never believed that heavy objects would fall quicker and with experiments he proved his theory wrong.
- Alexander Fleming, while studying the workings of influenza, noticed it went mouldy and, when he studied the mould, he found the cure for the bacteria and called it penicillin.
- Christopher Columbus was sailing, when his boat got lost and he landed in America; even though the events after weren't great at all, without that we wouldn't have America.

Most things in life never work out perfectly the first time. Some scientists take days to try and get the theory right and many trials to get their finishing product. Mistakes are natural and everybody makes them, for example remember when everybody thought the world was flat or that the earth was in the centre of our universe. All these people in my museum have made a mistake which had a good outcome. These people prove that failures and mistakes are common and regular, it's a natural human cause, which most people do on a regular basis, and there is no point in criticising them.





# MAO'S FAILURE OF THE GREAT LEAP FORWARD

*by Fatima Imran Ali*

On the 18th of November 1957, Chairman Mao Zedong made a populist anti-imperialistic speech saying, "The East Wind is bound to prevail over the West Wind". Oozing with confidence after successfully implementing the "first five-year plan", Mao wanted to modernise China's agrarian Economy under the second five-year plan, also widely known as the Great Leap Forward. However, this cherished plan of Mao ironically ended up being one of the greatest catastrophes in human history.

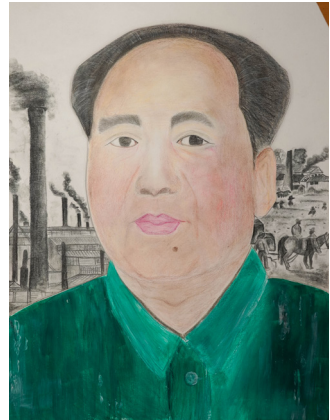
The plan had two central policies, the first being agricultural collectivisation and the second being industrialisation. The former policy started with the Chinese Communist Party (CCP) inaugurating 25,000 communes with 750 million people being organised under it in 1958. Next, the CCP annihilated the private agriculture sector with everything coming under their control. The idea was that farmers who otherwise lacked capital would have a pool of resources; for example, they would have access to more modern facilities such as chemical fertilisers and tractors. This would, in an idealistic world, translate into greater efficiency in production; however, due to the coercive and violent nature of CCP and gross bureaucratic mismanagement, it took a tragic turn.

This turn happened due to the introduction of large-scale projects with a top-down approach, which meant officials took little to no advice from locals. This meant that these projects, such as water control systems, were often poorly designed, which consistently led to problems such as soil erosion and water logging. This significantly affected crop yields, with agricultural output falling by 17.5% from 1958-1962.

However, Mao, blinded to the actual problems, believed this downturn was due to sparrows being a crop pest; hence, a widespread campaign set out to eradicate the birds. This led to swarms of locusts, as the natural predation was imbalanced due to the extermination of sparrows. This resulted in a famine that rose hastily throughout the countryside, causing up to 45 million deaths. In addition, if the farmers failed to meet their grain quota, they were accused of hoarding the grain and thus would be brutally punished; they would get tormented and often killed if they tried to escape or get more food.

This brutality led to unintended consequences as, due to the fear of punishment, lower officials in the bureaucracy did not speak up about these faults to higher authorities. This problem ruined Mao's ambitions to industrialise China, who

ironically predicted that China would soon exceed Britain in industrial output and that steel would be doubled in the first year of the new scheme. Thus, lower officials' false reporting of numbers made problems worse for higher authorities who aimed to increase steel output by 10 million per year. This fear of higher charges further caused lower officials to take radical steps such as confiscating household steel products, such as tools etc. and melting them to make additional production on paper. However, this was useless and resulted in lower-quality of steel and iron.



Industrialisation was further a failure as Mao used diversion of labour, which meant farmers also worked in industries and furnaces, with little to no knowledge about it. Moreover, the decentralised structure told that small-scale facilities were set up in distant rural areas, which caused the thematic problem of inefficiently producing poorer quality steel. This also further exacerbated the famine as production factors like labour were used in factories rather than improving crop production; because of these planning failures, there was a massive material shortage in steel and other industries, such as textiles, which fell by 40% during this period due to the diversion of labour.

This policy was further problematic as farmers, primarily men, who were enacted to the collectivisation of farming, were moved to work in urban industries instead, leaving the children, women and aged people to work on farms. This influx of people in urban cities further strained food distribution, which was already fraudulent.

To conclude, the Great Leap Forward was a policy marked by great strife, contracting GDP growth to fall to an average of just 2.9% per year in 1958-61. Mao's stubbornness to concentrate all production factors towards industrialisation and collectivisation at the expense of agriculture contributed to food shortages and widespread famine. The failure was further a product of structural bureaucratic incompetency, which led to inadequate communication between officials and millions of people dying due to starvation. Farmland was also affected and damaged by furnaces being built and trees being cut down. Overall, the policy caused one of the biggest human tragedies as Liu Shaoqi, a leading figure within the CCP, said: "The economic disaster was 30% fault of nature, 70% human error".

# THE BEAUTY OF ACCIDENTS

By Mira Iyer

Life, the Earth, and our universe were all created by accident. If the Big Bang had happened slightly differently, the whole universe could be different. If the whole universe were different, then the whole Earth could be different. If the Earth were different, then humans, animals, plants and all living things could be very different. If one singular atom that was part of the Big Bang had been changed, our entire existence as we know it could be different. Life is all just a beautiful accident.

Accidents and mistakes happen all around us every day. In fact, even the world around us is an accident. All the natural wonders of the world – the Grand Canyon, the Niagara Falls, the Northern Lights, the Great Barrier Reef, and countless others, were all beautiful accidents. Take the Great Barrier Reef for example. The beautiful corals stretch over 2,300 kilometres, and they are the home to an estimated nine thousand species.<sup>1</sup> If life in the sea was formed differently, we might not have the Great Barrier Reef, as the animals keep it alive the same way it keeps them alive. If the atoms were formed slightly differently in the creation of the Earth, none of those unbelievable places might have existed.

Looking deeper into us humans, many inventions that we use all the time were made by accident. Almost everyone owns a microwave, and uses it daily; it was accidentally discovered by Percy Spencer in 1945. Post-it notes – there’s a stack in every classroom and office around the world – invented by accident by Dr. Spencer Silver. Super glue, Play-Doh, Velcro – the list is endless.<sup>2</sup> These essential inventions, all discovered by accident, are now used everywhere in the world around us. Our entire world is a beautiful accident.

Humans have made many beautiful mistakes in all fields of life. For example, in Art; many artists such as Jackson Pollock use a technique that involves spilling and throwing paint across the canvas, making the artwork seem as though someone has accidentally spilled a can of paint over it. We are also taught in Art not to worry about what we see as mistakes, as there is ‘no such thing as a mistake in art’; everything can be seen as art, and everything can be turned into art and something beautiful, even if it is originally an accident.

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## Endnotes

<sup>1</sup>National Geographic Society, *Great Barrier Reef* (2022), National Geographic < <https://education.nationalgeographic.org/resource/great-barrier-reef/> > [accessed 28 February 2023].

<sup>2</sup>Morgan Greenwald, *30 life-changing inventions that were totally accidental* (2018), *Best Life* <<https://bestlifeonline.com/accidental-inventions/>> [accessed 28 February 2023].

Another example is in History. Humans have made so many mistakes in History, and although we are meant to learn from history and not repeat our mistakes, this does not happen. Take the World Wars, for example. The First World War was unspeakably horrible, and then only twenty-one years later, there was another war. Personally, I think that should be regarded as one of humanity's biggest mistakes. However, the wars showed that you can find beauty in everything. The bright red poppies that grew after, covering the soldiers' corpses have now become a symbol of remembrance and peace across the world. Although the war was unarguably horrific, hopefully it taught humanity to value life and learn from mistakes and will result in no more global wars.

The way the brain reacts to accidents and failure is very interesting. In short, if you get something right the first time, no matter how much effort it took you, there is not much change happening in your brain.<sup>3</sup> However, if you fail the task that you are trying, synapses (electrical signals moving through your brain) fire, causing reaction in your brain and stimulating it more, which in turn causes it to grow.<sup>4</sup> This activity interestingly happens whether or not you are aware you have made a mistake or not. Many people also believe that these reactions which cause your brain to expand only happen if you fail at first but then get it right later on, but this is not the truth. Your brain grows any time you make a mistake in any situation.

Something else that mistakes cause in the brain are less physical and more psychological; studies have shown mistakes improve your learning. For example, a study that took place in Columbia University found that "when students make errors that are followed up with corrective feedback, they learn better and ultimately remember the correct answers long-term".<sup>5</sup> This further emphasises that fact that mistakes and accidents are essential in life for progress in humanity.

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#### Endnotes

<sup>3</sup>Jo Boaler, 'Mistakes "Grow" Your Brain', *YouCubed* (2017), 1-4 (1).

<sup>4</sup>Jo Boaler, 'Mistakes "Grow" Your Brain', *YouCubed* (2017), 1-4 (2).

<sup>5</sup>Ivanhoe Newswire, *New research shows mistakes may actually be key to learning* (2021), KSAT <<https://www.ksat.com/news/local/2021/06/01/new-research-shows-mistakes-may-actually-be-key-to-learning/#:~:text=Researchers%20from%20Columbia%20University%20reviewed,the%20correct%20answers%20long%2Dterm>> [accessed 28 February 2023].

# HOW STEAM RELIES ON MISTAKES AND FAILURES

by Isobel Windross

STEAM is an acronym that stands for the subjects of science, technology, engineering, art/architecture and mathematics. STEAM education relies upon using the idea of apparent ‘failure’, or mistakes, and reapplying them to benefit students.<sup>1</sup> Einar Skallvik, a professor at the Norwegian University for Science and Technology, said that “Teachers need to emphasise that mistakes are part of the learning process”.<sup>2</sup> In this essay I will explore how mistakes and failures are crucial to STEAM subjects and the development of these fields.

In technology and computing, mistakes are a worry – a single typo can lead to disaster. For example in June 1963 the Mariner 1 was launched into space relying on the accuracy of its code. It crashed five minutes after launch – all due to a hyphen that had been left out. This cost the US government \$630,000,000 in today’s money.<sup>3</sup> Mistakes can be prominent, but correcting them is often easy. At the same time, in order to make a mistake in the code for a NASA rocket the programmer must have been incredibly adept.

Mathematics has an interesting approach to failures and mistakes. There is always one solution that you must find through logic and methods – each problem comes with a designed set of steps to get to the correct answer. An alternative point of view relates to Newton, who discovered gravity. Most of Newton’s work has been superseded by Einstein, so Newton’s work is not technically a mistake but nor is it correct - so mistakes can get you closer to the truth than you have been before.<sup>4</sup> Mistakes do not need to be failure, they can be development, and this often applies to maths. Every mistake you make may seem useless but it gets you closer to the truth. It is important to distinguish the difference between mistakes

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## Endnotes

<sup>1</sup>5th High School of Agrinio, *STEAM in the Classroom: Challenges and Suggestions* (2023), *STEAM builders* <<https://steambuilders.eu/steam-in-the-classroom-challenges-and-suggestions/>> [accessed 28 February 2023].

<sup>2</sup>Einar Skallvik quoted in Tiffanie Wen, *The Myth of being ‘bad’ at Maths* (2020), *BBC Worklife* <<https://www.bbc.com/worklife/article/20200506-how-to-tackle-your-anxiety-about-maths>> [accessed 28 February 2023].

<sup>3</sup>National Aeronautics and Space Administration, *Mariner 1* (2023), *NASA Space Science Co-ordinated Archive* <<https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=MARIN1>> [accessed 28 February 2023].

<sup>4</sup>Jeremy Deaton, *Einstein showed Newton was wrong about gravity. Now scientists are coming for Einstein* (2019), *NBC News* <<https://www.nbcnews.com/mach/science/einstein-showed-newton-was-wrong-about-gravity-now-scientists-are-ncna1038671>> [accessed 28 February 2023].

and failures. Another example is Pi – the infinite number – there’s no calculation of pi and yet every maths paper you do involves the ‘number’ pi. Pi is not accurate which means that everyone will give an incorrect calculation. Numbers calculated from pi are an approximation, and an approximation is a mistake. NASA only needs to use fifteen decimal places of pi when trying to send out probes.

In core sciences – biology, physics and chemistry – being a practitioner means experimentation is crucial. You often have no desired outcome – it begins in theory, asking questions and proving or debunking the answer and, as such, mistakes aren’t negative. Learning that what you tried was wrong is often as important as reaching the end outcome. One of the most valuable and important breakthroughs in scientific history is the discovery of penicillin. Penicillin was discovered by the biologist, Alexander Fleming in 1928 – he discovered this drug when he went on holiday and returned to work to find mould growing in his petri dish. He then noticed that the area around the penicillin had no bacteria around it. The result of his supposed ‘mistake’ created one of the most relied on antibiotics we have today. This is incredible as he was searching for a cure all and he managed to find one.

Another example of the importance in mistakes in STEAM was the discovery of Kevlar. Kevlar is an incredibly strong and powerful synthetic fibre – which is strong enough to stop steel bullets - and was essential in the creation of bulletproof vests and aerospace engineering. Stephanie Kwolek discovered Kevlar in 1965 after an experiment.<sup>5</sup> She was experimenting with some of the leftover polyamide particles. The original experiment had been considered ‘a failure’ and the end chemical product was going to be wasted but she was playing around with it and she discovered its incredible properties.<sup>6</sup> Now due to her curiosity and willingness to learn from her mistakes, she discovered a substance which is used to save millions of lives across the world. This shows the importance of experimentation and not giving up from your mistakes in STEAM as they are often crucial to furthering the collective knowledge of the subject.

Art is a core part of the STEAM and, unlike other subjects in the curriculum, mistakes don’t apply at all to art. Art is subjective to each individual viewing the piece. Although there can be a common reaction, mistakes are just what you believe is wrong. However, in school, we are still marked for our work – our marks are generally given by our art teachers – or at least for more significant work. Different teachers will have different views on your work so there cannot be an

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#### Endnotes

<sup>5</sup>ACS, *Stephanie Kwolek 1923-2014* (n.d.), ACS <<https://www.acs.org/education/whatischemistry/women-scientists/stephanie-kwolek.html>> [accessed 28 February 2023].

<sup>6</sup>Anne-Marie Imafidon, *She’s in Ctrl: how women can take back tech* (London: Penguin RandomHouse, 2022), pp. 114-115.

accurate 'mark', although assessment criteria provide the framework. So, due to the subjectivity of art who can say what is good and bad?

In conclusion, I think that mistakes and failures are essential to learning and of course learning is essential to advancement, so school must be a safe area to perform and experiment. STEAM subjects especially focus upon experimentation and getting things wrong is often incredibly important as you learn from your mistakes and know where you must be careful next time. Creativity and experimentation are crucial parts of STEAM.

