Ignite

CERC Newsletter

MAY 2021

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Founder

Sujit Bhattacharya
Mentor

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Editors

Message from the Founder of CERC

Dr. Shrobona Bhattacharya

In this global pandemic that we are going through, science and technology are the only way to get us out of this danger through vaccines, medicine, oximeters etc. Thus, studying science and technology and working towards the new innovations, we will be able to bring the world out of any danger.

Children in the Electronics and Robotics club are passionate about learning different technologies, it helps them to align with the national and global goals through a continuous process.

I am happy to see the children are keeping their motivation high for the FIRST LEGO competition and continuing the practice with a winning spirit. CERC brought the Trophy home for the Regional Championship since 2019 and this year also children have shown their full potentials to be the winner in the Cambridgeshire region.

Lockdown is currently getting to an end; thus, I am positive to hold the annual Science Festival 2021 in the summertime, we will announce the date as soon we know the new rules to hold an event for a large group.

Message from the Mentor Dr. Sujit Bhattacharya

COVID-19 has ushered in dramatic and permanent changes in how students are educated. Our **Mentor Led Self Learning (MLSL)** teaching pedagogy has seen a very good impact on the students. While it has been a challenging year for the young people, the sliver lining is the increased access to the virtual mentoring that they are now able to access. For many students, these online classes offer exactly the type of freedom and self-guided learning they prefer. It also provides an opportunity to learn topics that are not offered in local high school.

We will be soon staring special free online sessions for the South Asian students who now have no access to education due to this sudden uprise in the number of COVID cases.

“The best thing about teaching is that it matters. The hardest thing about being a teacher is that it matters everyday.” – Todd Whitaker

We are also very proud of our Young Scientists Vivek, Sai and Akshith for reaching the Phase 2 of the Mission Space Lab Challenge 2020-2021 organised by ESA in collaboration with the Raspberry Pi Foundation. With the experience gained, we are confident that we can have Team CERC code into the International Space Station (ISS) very soon. Well done team CERC.

Message from Editorial board by Venkat Kommi

Current pandemic has created the most changeling time for science. If you can encourage your children form young age about writing and reading science articles hopefully we can flight future pandemics like current one more efficiently.

It is nice to see different topics for this edition of Ignite. We are looking forward to seeing more response from the readers.

Readers please feel free to comment on their articles. This will boost their confidence levels.

The Ignite magazine is a community based volunteered magazine, where a group of professionals, academics and young children are working together.

These articles are written by the children and are edited by a team.

The editorial team is in charge of the publication of the magazine.

If you have any questions, suggestions, or concerns, please address them to ignite.camcare@gmail.com

The Extraordinary Competition between Airbus and Boeing

by Jamie JiJo 12 Years, Perse School, Cambridge

The Covid-19 pandemic has caused severe complications within the Aviation industry. Many companies bankrupt, multitudes of jobs lost and a vital amount of cash lost. Analysis of the global air transport industry [1] showed that airliners faced a complete loss of $84.3 billion last year itself. The revenue will continue to drop; it will be a while before it is regained. Among the commercial enterprise are the two leading aerospace companies; Airbus and Boeing. During this article, I will be able to take a glance at each company's status and the way they plan to improve and continue with future projects during this prevailing situation.

The aeroplane manufacturing industry is dominated by the USA's Boeing and Europe's Airbus. Through subsidies, the United States and several other European countries have made significant financial contributions to their respective manufacturers, creating competition and damaging the trade principles of market competition within the process. The incredibly great number of economic contributions received by Boeing and Airbus from their respective countries of origin has sparked an outsized rivalry between both companies. Many comments by the aerospace companies have led to intense competition. The conflict between them both, which has become amplified by several Boeing aircraft - manufacturing defects - complicates the question of whether countries should provide extensive financial support to domestic companies, like the United States and Boeing. This might be beneficial since Boeing's history of mechanical failures, a declining reputation and loss in market share make the corporate desperate for assistance. On the opposite hand, the USA could severely impair free trade through its contribution to Boeing, maybe even perpetuating the subsidy war that has already lasted for nearly 18 years.

Boeing and Airbus, together, have always ruled the aircraft manufacturing industry. Boeing held significantly more market power until 2003 [2], when, through financial support from European governments and loan forgiveness, Airbus overtook Boeing as the leading airline manufacturer in the world. At this point, the conflict between Airbus and Boeing heightened in complexity when the United States brought a case to the World Trade Organisation [3] and argued that EU member states provided illegal subsidies to Airbus. In response to this, the EU filed a claim that the US government subsidies which were provided to Boeing were in significantly larger amounts. Both cases were investigated and the final results were quite alarming.

The literature surrounding this subject, instead of favouring a particular company, has gone on to blame the WTO for its incompetency and inability to devise an effective and successful strategy to end the dispute. Many scholars argue that the WTO is ineffective due to two main reasons: the delicate nature of the Dispute Settlement Board within the WTO

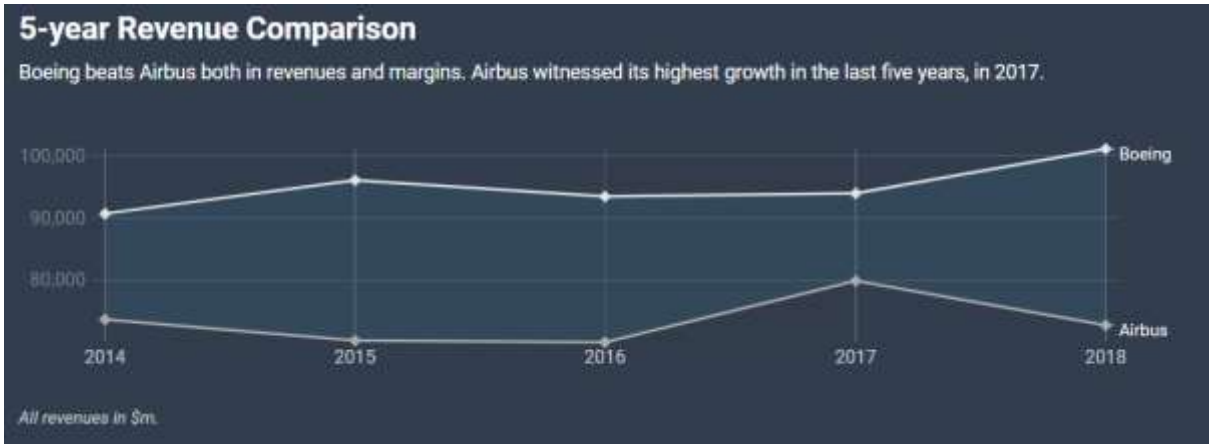
and also the complexity of the problem itself. The legal structure within the WTO is not powerful enough to render a decision that may ever be followed through by the losing side - in this case, the EU. Essentially, scholars see the situation as giving the WTO excessive power than they can absorb or utilise, leaving the situation at a standstill. The nature of this conflict, through numerous cases and examples filed on either side and a scarcity of an effective solution, demonstrates the weakness within the international institutions. Such is the case of the WTO trying to solve complex problems for which they are incompetent. However, a lack of a clear solution and a minimal contribution by the WTO further incentivises both sides - the United States and the European Union - to continue subsidising their respective industries.

In this circumstance, it should be up to the World Trade Organisation to strengthen their ability to exercise a considerable amount of pressure on both parties if there is to be any change made in the existing tensions between the US and the EU regarding the issue of subsidies.

There have also been many heated discussions about the aerospace companies' geographic diversification. Currently, we can see that Airbus' revenues are more beneficial and are from markets that have high growth potential such as the Asia Pacific, especially China. The company earns more revenue from the Asia Pacific than Europe and also the two regions together contribute approximately 65 - 70% to its gross revenue. Although Boeing also earns a similar size of its revenues (approx. 70%) from just two geographic areas - the United States and the Asia Pacific - its revenues are more concentrated in the US, unlike Airbus, which has a much better diversification. Likewise, Airbus also earns a higher revenue from the Asia Pacific, which Boeing too recognises to be a crucial market for its future growth [4].

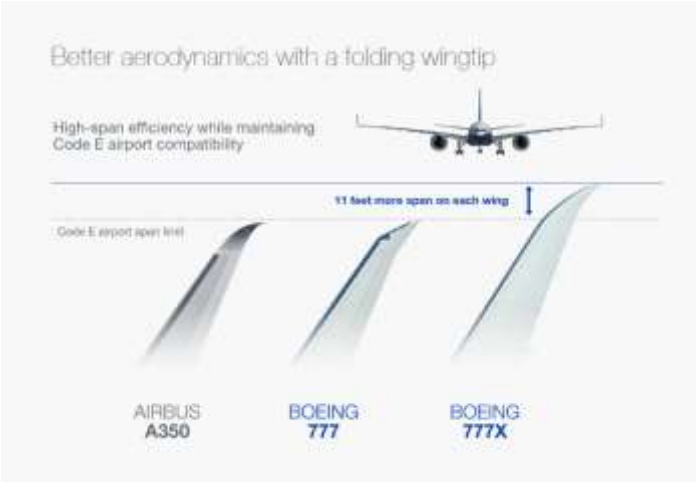
From this data, we can also see that Airbus has been struggling to grow its revenues in the last five years. Airbus registered a Compound Annual Growth Rate, CAGR, of 0.7% since 2014 compared to its rival Boeing, whose revenues grew almost three times faster, at 2.74%, over the same period. Boeing's rate of growth was also not at the cost of margins, as we can see by its 50% higher operating margins (11.85% in 2018) compared to Airbus (7.92%) [5].

Another major concern for both aerospace companies is passenger safety. One of the most important segments within this competition is the reliability of the aircraft. Incidents such as grounding due to serious technical issues could significantly impact the reputation and sales of commercial aircraft manufacturers. Airbus planes have not suffered major grounding issues apart from a temporary grounding of 14 Airbus A320 Neo aircraft in India due to Pratt & Whitney engine failures in 2018. However, Boeing has had to deal with two major groundings. Its entire fleet of 737 MAX aircraft was grounded in March 2019, due to two fatal aircraft crashes within the space of a few days. The company had an order book of 4,636 units worth $600bn of the 737 MAX family at the time of the grounding and continues to face order cancellations from several airlines due to the tragic events. Earlier in January 2013, the Boeing 787 'Dreamliner' fleet also grounded due to issues of onboard lithium-ion batteries. However, the grounding did not cause a significant impact on the 787 orders and deliveries since the United States Federal Aviation Administration (FAA) allowed the US carriers to operate the 787. The Dreamliner project was continued after making the required changes to the battery systems in April 2013.



A significant element in the competition is the outcome of future products by both companies. Airbus state that they are aware of their responsibility towards climate change and pledge to half net emissions by 2050 [6] (compared to 2005). They understand their role in global warming and want to contribute by developing low-emission aircraft. The aim is to reduce carbon emissions and participate in reducing Climate change. Future aircraft projects have been released by Airbus' official website [7] to tackle the amount of kerosene/paraffin; widely used as fuel by the aviation industry. One of their most ambitious and anticipating outlines is the *ZEROe* project [8]. The desire is to create the world's first zero-emission commercial aircraft. The use of Kerosene is a major issue and plays a very big task in the form of Climate change. They aim to change this by using Hydrogen propulsion, thus creating a hybrid-hydrogen aircraft. Powered by hydrogen combustion through modified turbines, this may be one of the most efficient ways to overcome this desperate situation.

There is also a similar idea behind the factories of Boeing. Currently, they are hoping that 2021 will represent a more successful year that allows it to put the difficulties of 2020 away. The ongoing global pandemic heavily impacted nearly every portion of the airline industry, and Boeing suffered no less. Due to the grounding of the Boeing 737 MAX, the situation for Boeing and the timing of the pandemic was far from ideal. They have decided to further compete in the long-range widebody aircraft. The best way to do this would be to take information from one of the largest birds in the sky: the Boeing 777. The 777X [9] - the name of Boeing proposed project/plane - will become the largest and most efficient twin-engine jet in the world. It will combine many aspects from the 787 Dreamliner and the 777 itself. Although continued from the original 777, many of its features will be unique to itself. It includes 10% lower operating costs, an all-new composite wing, and the most unparalleled feature, the folding wingtip [10].



An Infographic of the Boeing 777x Folding Wingtip

The folding wingtip on each wing will result in better aerodynamics. The 777X wing will have 11 feet more span, resulting in adequate length for a folding wingtip. This new design will prove to be more efficient and more aerodynamic and a longer flying range.

From all the aspects covered, we can see many captivating designs by both aerospace companies. Many crucial points have been gathered and awarded to either company in terms of safety, marketing, passenger comfort, and efficiency.

Currently, due to the global Covid-19 outbreak, we might not see these future products released for a long time. However, some countries have been proactive such as India, where a large increase in demand for domestic aircraft will take place [11]. They are planning to order many aircraft in the coming decade, since India's Domestic Aviation Industry is growing, and will need more planes to create a higher revenue and to serve more passengers. India is one of the fastest-growing aviation markets and is expected to serve 520 million passengers by the year 2037. Hopefully, after the industry finds more customers like India, it will be able to comeback faster than we had predicted in these circumstances. We can see that each aerospace company is suited to a specific market. From gathered data, Embraer and Bombardier are very good competitors for the short-haul markets, containing small turboprops and turbofans. The Airbus A321XLR would be a suitable option for medium-range due to its incredible efficiency. Boeing expected the 737 MAX to also contribute to the New-Midsize Aircraft (NMA) sector but it didn't turn out as foreseen, resulting in a complete loss. They have chosen to work on Long-Haul, as we saw from the 777X project, and they will most likely continue to do so after coming up with more designs for efficiency-based

purposes. In conclusion, we can see a growing industry, and both Airbus and Boeing are now occupied with regaining their core customers to whom they pay the most attention. After this, they will likely think about safety and more efficient ways to reduce carbon emissions. We hope to see breakthroughs with the technology the aviation industry has created for us, and wish to see a result soon.

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[1] - How COVID-19 has affected the aviation industry and its approach to risk - Willis Towers Watson

[2] - Airbus-Boeing WTO dispute: What you need to know | Business| Economy and finance news from a German perspective | DW | 13.10.2020

[3] - How Airbus Has Grown Over The Years To Dethrone Boeing As The Largest Commercial Aircraft Maker (forbes.com)

[4] - Geographic Diversification - Boeing vs Airbus (dwcdn.net)

[5] - 5-year Revenue Comparison (dwcdn.net)

[6] - Airbus - Home - Aerospace pioneer

[7] - Future of flight - Our topics - Airbus

[8] - ZEROe - Hydrogen - Airbus

[9] - Boeing: 777X

[10] - Boeing: 777X By Design

[11] Aviation Industry in India - Aviation Sector Analysis, Growth (investindia.gov.in)

About Marie Curie by Maya Acharya 14 Years, Cambridge

WHY WAS SHE IMPORTANT?

Marie Curie was a Polish-French scientist who won two Nobel prizes. Her work focused on radioactivity, which is a property of some chemical elements.
Curie helped to discover two radioactive elements, polonium and radium. She also successfully isolated, or separated, radium from the rock in which it is found. Science, medicine, and industry soon found important uses for these elements. For example, radium was used for many years to treat cancer.

EARLY LIFE

Marie Curie was born Maria Salomea Sklodowska on November 7, 1867. She was born in Warsaw, Poland, which was under Russian rule. Her parents were teachers who valued education, but women in Poland could not get university degrees. So, Maria and her sister, Bronislawa, saved enough money to study in France. In 1891 Maria entered the Sorbonne, a university in Paris. She began calling herself Marie.
Within three years, Marie completed degrees in physics and math. She began working with a French scientist, Pierre Curie, whom she married in 1895. They had two daughters, Irène and Ève.

CAREER

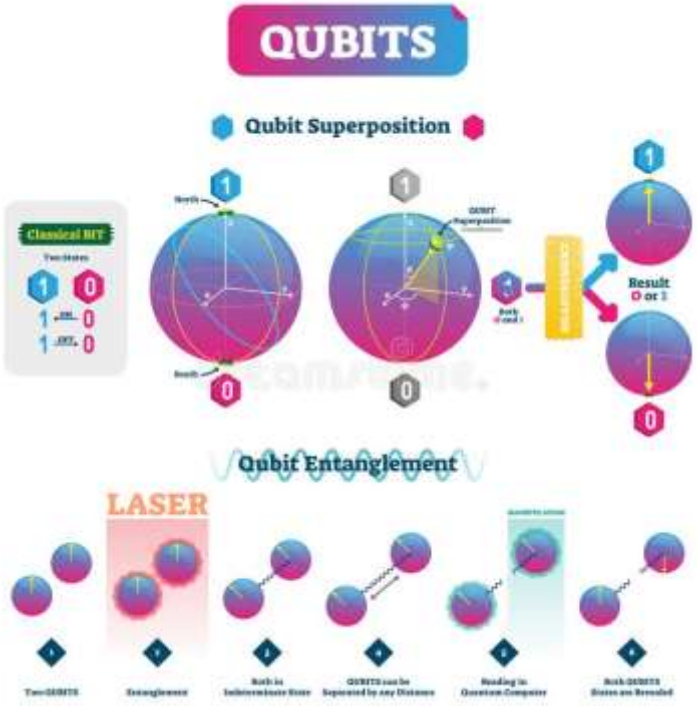
In 1896 a French scientist named Henri Becquerel discovered the unusual rays of energy given off by the element uranium. Marie began studying this, which she named radioactivity. In 1898 the Curies announced their discovery of radium and polonium. They named polonium after Marie's homeland of Poland. In 1903 the Curies shared the Nobel Prize for Physics with Becquerel.
After Pierre died in 1906, Marie carried on their research. She also became the first woman professor at the Sorbonne. In 1911 she won the Nobel Prize for Chemistry for isolating pure radium.
During World War I, Marie helped to build a car that carried X-ray equipment to doctors treating wounded soldiers. After the war, Marie continued her study of radioactive substances and their use in medicine. Her Radium Institute in Paris became an important center of scientific research.

What is Quantum Computing by Vivek Kommi 12 Years, Cambridge

An ordinary computer chip uses bits. These are like tiny switches that can either be in the off position represented by a zero – or in the on position represented by a one. Every app you use, the website you visit, and the photograph you take is ultimately made up of millions of these bits in some combination of ones and zeroes.

This works great for most things, but it doesn't reflect the way the universe works. In nature, things aren't just on or off. They're uncertain. And even our best supercomputers aren't very good at dealing with uncertainty. That's a problem.

This is because, over the last century, physicists have discovered when you go smaller than a microscopic scale, weird things start to happen. A whole new field of science has been developed. It is called Quantum Mechanics.



Quantum computers are machines that use the properties of quantum physics to store data and perform computations. This can be extremely advantageous for accurately simulating any of those things, they need a better way of making calculations that can handle uncertainty. This is where Quantum Computing comes in.

Quantum computers are machines that use the properties of quantum physics to store data and perform computations. This can be extremely advantageous for chemistry, which is the foundation of biology. So for scientists to accurately simulate any of those things, they need a better way of making calculations that can handle uncertainty.

Our modern computers encode information using classical bits: “0” and “1”(Boolean Logic). On the other hand, Quantum Computers have quantum superpositions where their bits called qubits can be “1”, “0”, or both. This works because particles behave like waves. Similar to how multiple waves can overlap each other to form a single new wave, quantum particles can exist in multiple overlapping states at the same time. Another feature that qubits have is entanglement.

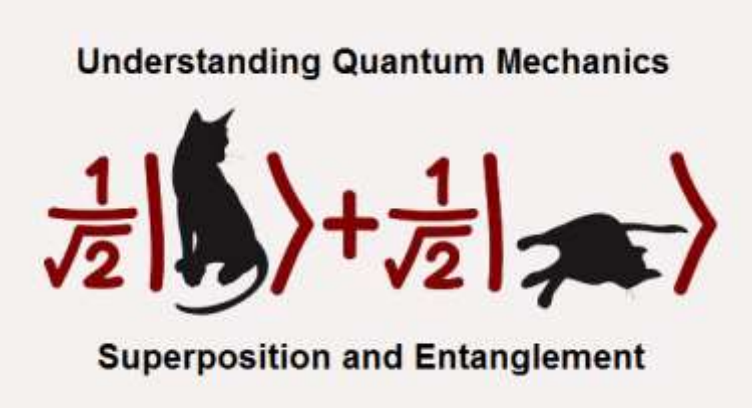
Quantum entanglement means that multiple particles are linked together in a way such that the measurement of one particle's quantum state determines the possible quantum states of the other particles. This connection isn't depending on the location of the particles in space. Even if you separate entangled particles by billions of miles, changing one particle will induce a change in the other. Even though quantum entanglement appears to transmit information instantaneously, it doesn't violate the classical speed of light because there's no "movement" through space. Albert Einstein called it “Spooky action at a distance”

Shrödinger’s Cat was a theory by Erwin Shrödinger, he revolutionized Quantum Superposition and he was a Famous Physicist who was a great friend of Einstein.

Schrödinger wanted people to imagine that a cat and poison were inside of a sealed container. The amount of Poison had a 50/50 probability. Until someone opened the container and observed the system, it was impossible to predict the cat’s fate. Thus, until the system collapsed into one configuration, the cat would exist in some superposition zombie state of being both alive and dead.

*|> is a ket which is a notation in quantum and the opposite would be <| which is a bra. This fits together as a bra-ket(Dirac’s Notation) This is referencing the Shrödinger’s cat picture.

Quantum Supremacy is another fundamental concept of Quantum Computing. In quantum computing, quantum supremacy is the goal of demonstrating that a programmable quantum device can solve problems that no classical computer can solve.



Constellations by Sreenidhi Kunisetty 13 Years, Cambourne

What are constellations?

A constellation is a group of stars which make up an imaginary outline or pattern in the night sky (the celestial sphere). They are usually said to represent an animal, mythological person or creature in a shape. When seen, the group of stars seem to make a pattern. Some examples of constellations are Ursa major, Orion, Leo, Draco, Cancer etc. Constellations are useful for tracking artificial satellites and in assisting astronomers and navigators to locate certain stars. The sky was divided up into 88 different constellations in 1922. This included 48 ancient constellations listed by a Greek astronomer, as well as 40 new constellations.

What are the uses for constellations?

Constellations are useful because they can help people to recognise stars in the sky. By looking for patterns, the stars and locations can be so much easier to spot. The annual cycle of the zodiac was used by ancient cultures to determine the time of year. This was very important so that people knew when to plant and harvest crops. Another important use for constellations was navigation. By finding Ursa Minor it is quite easy to spot the North Star (Polaris). Using the height of the North Star in the sky, navigators could figure out the latitude, helping ships to travel across the ocean.

Star maps

The 88 different constellations divide up the entire night sky as seen from all around the Earth. Star maps are made of the brightest stars and the patterns that they make which give rise to the names of the constellations. The maps of the stars represent the position of the stars as we see them from Earth. The stars in each constellation may not be close to each other. Some of them are brighter because they are close to the Earth while others are brighter because they are very large stars.

Are the stars in a constellation near each other?

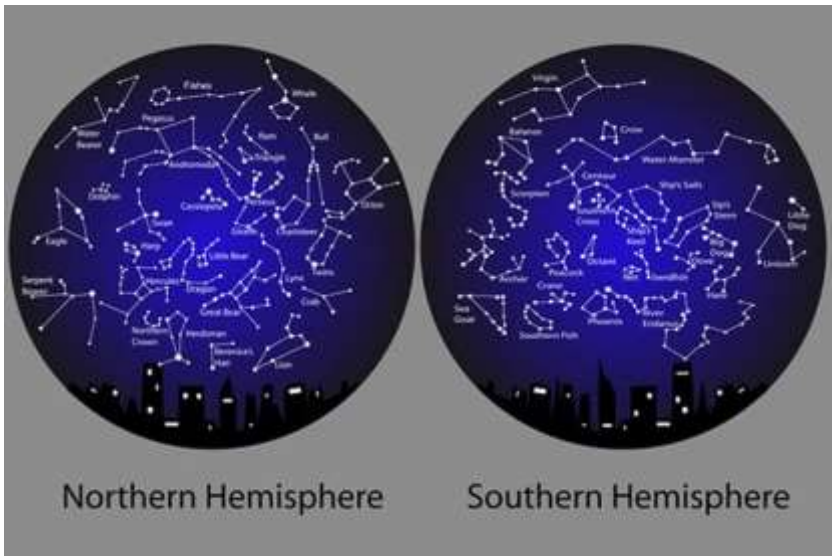
Stars in a constellation are not necessarily near each other. Each constellation is a collection of stars that are distributed in space in three dimensions – the stars are all different distances from the Earth. The stars in a constellation appear to be in the same plane because we are viewing them from very, very, far away. Stars vary greatly in size, temperature and their distance from the Earth. Dimmer stars may be smaller, further away, or cooler than brighter stars. Also, the brightest stars are not necessarily the closest.

Of the stars in Cygnus, the swan, the faintest star is the closest and the brightest star is the furthest.

Hemispheres and seasons

Not all of the constellations are visible from any point on Earth. The star maps are typically divided into maps for the northern hemisphere and maps for the southern hemisphere. The seasons of the year can also affect what constellations are visible from where you are located on Earth.

Constellations from the Earth:



Why do we see different constellations during the year?

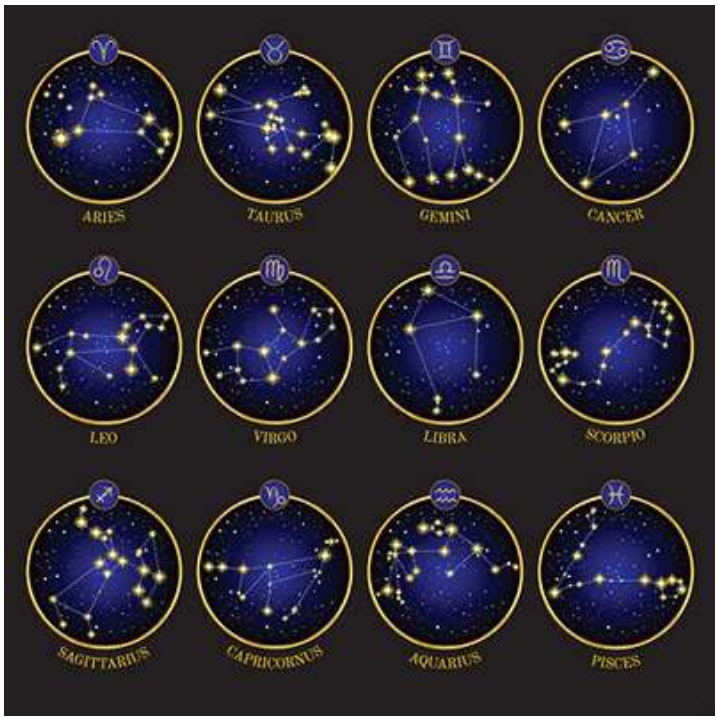
If observed through the year, the constellations shift gradually to the west. This is caused by Earth's orbit around our Sun. In the summer, viewers are looking in a different direction in space at night than they are during the winter.

What is the Zodiac?

Earth orbits our Sun once each year. Viewed from Earth, our Sun appears to trace a circular path. This path defines a plane called the plane of the ecliptic. The zodiac is the group or "belt" of constellations that fall along the plane of the ecliptic. It is through these constellations that our Sun appears to "pass" during the year. There are 13 astronomical zodiac constellations: Capricornus, Aquarius, Pisces, Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, and Ophiuchus. 13 was considered an unlucky number, so one of the constellations was dropped from the mythology—the massive constellation of Ophiuchus. It was merged into Sagittarius and Scorpio. The annual cycle of the zodiac was used by ancient cultures to determine the time of year. Most of the planets (except Pluto) also have orbits that are very close to the ecliptic plane defined by

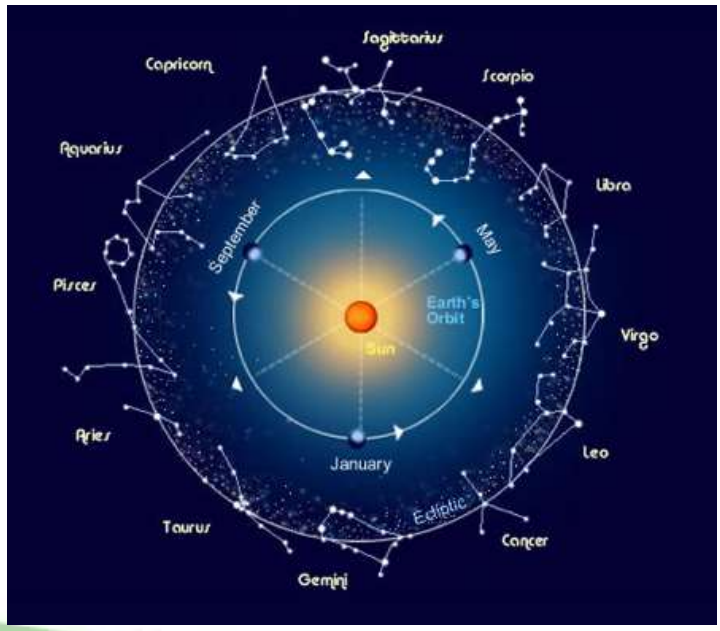
Earth's motion (within about 8 degrees above or below). If you include all the constellations encompassed by this broadened definition of the ecliptic plane, you have 21 to 24 constellations of the zodiac.

The Zodiac constellations:



The zodiac constellations are the constellations that are located within a band that is about 20 degrees wide in the sky. This band is considered special because it is the band where the Sun, the Moon and the planets all move.

The Zodiac band:



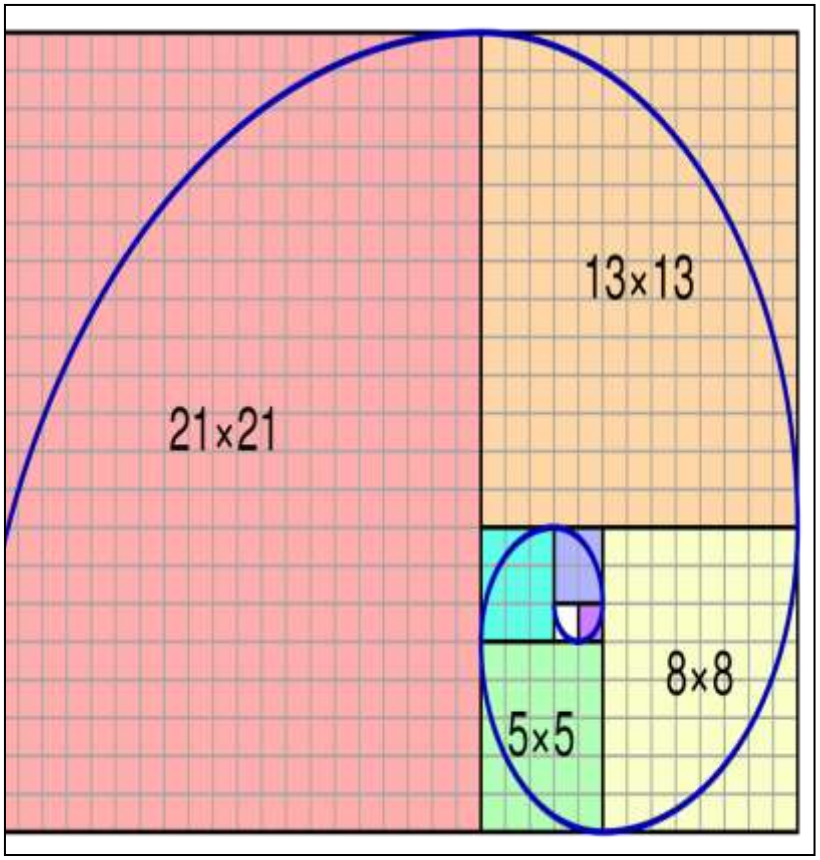
Fun facts about constellations

- The largest constellation by area is Hydra which is 3.16% of the sky.
- The smallest is Crux which only takes up 0.17% of this sky.
- Small patterns of stars within a constellation are called asterisms, these include the big dipper and the little dipper.
- The word “constellation” comes from a Latin term meaning “set with stars”.
- There are 21 northern constellations and 15 southern constellations.

In Hindu culture, the Nakshatra is the term for lunar mansion. A nakshatra is one of the 27 (sometimes 28) sectors along the ecliptic. Their names are related to the most prominent patterns of stars in respective sectors.

Fibonacci numbers by Sahasra: Age 10, Cambourne

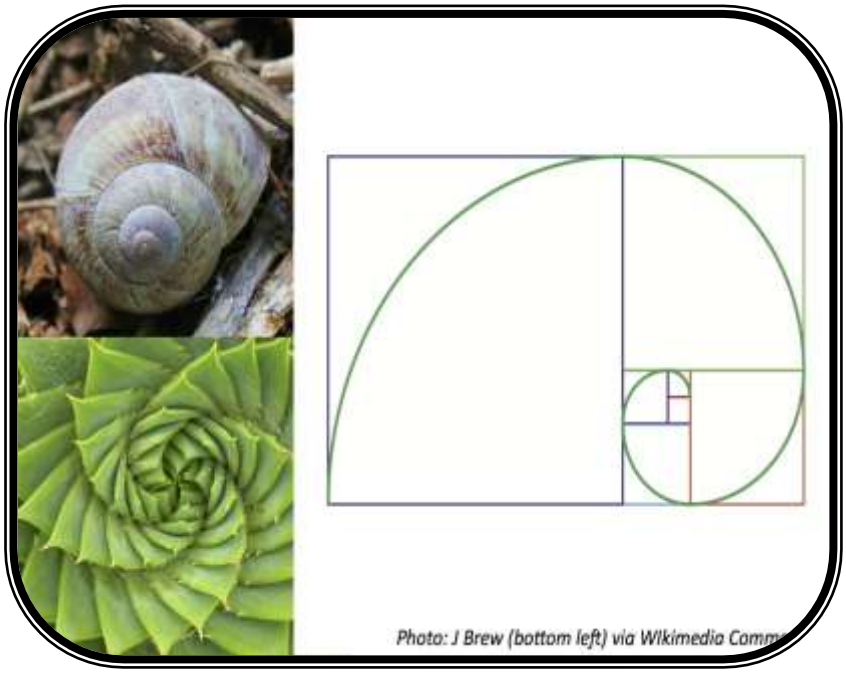
Leonardo Fibonacci invented the Fibonacci sequence and the golden ratio. The Fibonacci numbers are 1,1,2,3,5,8,13,21,34,55,89,144,233,377... as you can see if you add the previous number to the number you are looking at you get the next number for example if I'm looking at 55 then add the previous number which is 34 then you get the next number which is 89.Just like that you can do it any number in the Fibonacci sequence.



Interestingly, you can find the Fibonacci pattern anywhere like on a snails shell and on flowers, broccoli and more. The Fibonacci pattern is on many objects in nature it looks like the shape of a spiral that keeps going on forever. Fibonacci is remembered for an important reason which is to help spread the use of the Hindu system of writing numbers 0,1,2,3,3,4,5 in Europe instead of using Roman numerals.

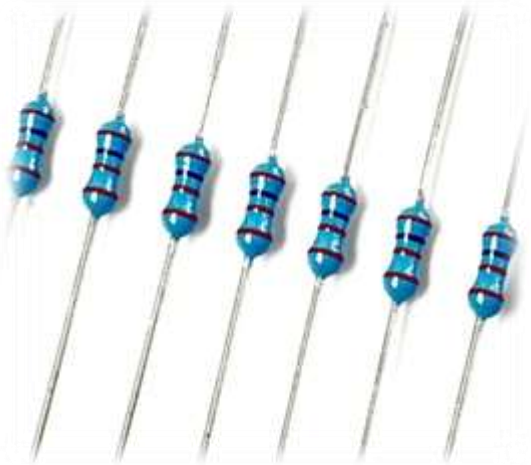
DID YOU KNOW!

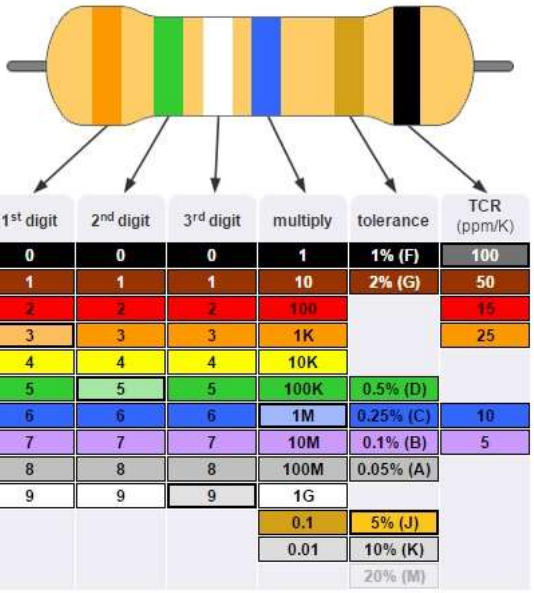
The Fibonacci pattern will be bigger than the galaxy at some point because it is an infinite pattern.



Resistors – by Akshara Kunisetty: Age 10, Cambourne

There are 3 main resistors carbon-composition resistors, carbon-film resistors, and metal-film resistors. Resistors are used to slow down the energy or say it was light it will control the light. Resistance is measured in ohms that came from the Greek word omega. What resistance is measured in is named after a German scientist named Georg Simon Ohm. A resistor is something that limits the flow of current in an active circuit. Resistors come with different colours in different places.





	1st digit	2nd digit	3rd digit	multiply	tolerance	TCR (ppm/K)
Black	0	0	0	1	1% (F)	100
Brown	1	1	1	10	2% (G)	50
Red	2	2	2	100		15
Orange	3	3	3	1K		25
Yellow	4	4	4	10K		
Green	5	5	5	100K	0.5% (D)	
Blue	6	6	6	1M	0.25% (C)	10
Violet	7	7	7	10M	0.1% (B)	5
Gray	8	8	8	100M	0.05% (A)	
White	9	9	9	1G		
Gold				0.1	5% (J)	
Silver				0.01	10% (K)	
None					20% (M)	

This is how a resistor looks This is a chart that tells you what a Resistor is worth.

How to measure a resistor

Basically, you're supposed to, say the resistor was all black then all the digits would be 0 and then multiply it by 1 then it is 0 ohms or say it was black then black then brown then brown then it would be 10 ohms.

Series and parallel

There are series resistors and parallel resistors. A series resistor is where the resistors are linked one after another and a parallel resistor is where the resistors are linked over one another.

Here are different Types of Resistors

- Wire-wound Resistors.
- Metal film Resistor.
- Thick film and Thin-film Resistors.
- Surface mount Resistors.
- Network Resistors.
- Variable Resistors

What are resistors made of?

Usually resistors are made of carbon, metal and metal oxide film. Carbon resistors are a lot better than wire wound resistors because they have higher energy pulses.

Article from the Young Scientists for the Next Issue:

Ignite Team is looking for young scientists to write an article for the next issue of the magazine. Please submit the article by ***Sunday, 29st May 2021*** *by emailing the article at ignite.camcare@gmail.com and with a subject "Article for Ignite".*

Please use the following template for writing the article:

https://bit.ly/3nF820h

Volunteers Needed:

Ignite Team is looking young volunteers with knowledge of Editing/Presentation Skills, HTML, Web Authoring tools.

Volunteering certification can also be provided for the Duke of Edinburgh Skill enhancement.