Navi Mumbai Science Foundation

EdUREKA

Education for Spirit of Science

Year 2, Volume 2, Issue: No.04 **January-March 2021**

JOURNEY OF VACCINE DEVELOPMENT !!!!!!

January-March 2021
Year 2, Volume 2, Issue: No.04
****

Editor-in-chief: **Dr S.T. Mehetre**
Reach me: smehetre@gmail.com/9920467755

Published by:
Navi Mumbai Science Foundation

Address:
B-51, Gitanjali, Plot No.52, Sector-17
Vashi, Navi Mumbai-400703
[Regn. No.: Maha/2592/10/ (Thane)
BPT Regn. No. F/24093/Thane]

Webpage:
www.navimumbaisciencefoundation.org

Email: edureka.nmsf@gmail.com

Contact No: **022-27891475**

****

This is a quarterly e-magazine published by Navi Mumbai Science Foundation, a society engaged in spreading science education and scientific temperament among students of Navi Mumbai region for last one decade. The magazine will cover all the activities of the society as well as articles on educating science to the students and teachers.

Navi Mumbai Science Foundation
EduREKA
Education for Spirit of Science

Contents .....

Image courtesy: https://www.mhrd.gov.in/

Views expressed in the magazine are from authors and editor may not agree with it.

To receive the copy of E-magazine, send your mail id to edureka.nmsf@gmail.com

From Editor's Desk!!....

In keeping with the original thinking behind launching of this magazine, efforts were being continuously made to give it a significant "student oriented" direction. They seem to be fructifying now. The primary focus of the magazine thus continues to remain on the needs of students of Std. VI to X, where the seeds of **"inclination towards science subjects"** start sprouting. This issue may therefore be viewed from that perspective where the hopes of desired changes are gaining ground.

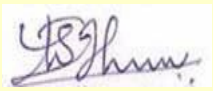
A few headings are also listed below which the likely contributors may find useful for their mini articles – may be, at times, as a series of similar articles as well.

- Lingering scientific doubts from school days,
- Accidental scientific discoveries,
- Interesting anecdotes from the lives of scientists,
- "History of science" related brief articles,
- Science through stories,
- Brief scientific articles covering specific points,
- New scientific discoveries (in simple words),
- Brief communications from teachers/senior students to Junior students,
- Brain teasers &
- Many more…… (suggestions are invited here).

This issue has articles on i) lingering doubts, ii) essays of winners of "Dr. Vikram Sarabhai Essay-cum-Elocution Competition-2020" on the topic: Life in a Space Colony – Future of Mankind", iii) under students' corner, articles like a) fear a stepping stone & b) experiment with germination test. Towards the end there is an article on vaccine development – which is the dire need of the hour.

Thus, the issue has something for all segments of readers. I hope readers will enjoy the contents and the changes it endeavours to bring in.

Stay safe!!! Stay Healthy!!!!!



Lingering Doubts.....???

Nature of a change: Physical or Chemical

1. **Dissolving common salt in water.**
2. **Boiling an egg.**

We know that a physical change is a change that results in a difference in form or appearance of a substance without changing the composition. The properties of the original substance are retained. In a chemical change a new substance with completely different properties is formed.

What happens when common salt is dissolved in water. Common salt is a compound on sodium and chlorine. It is an ionic compound. The positively charged sodium ion (represented by small blue circles) is surrounded by negatively charged chlorine ions (represented by larger green circles) in all directions.

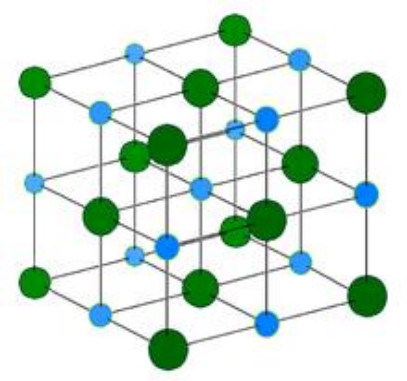


Figure 1: Sodium chloride crystal.

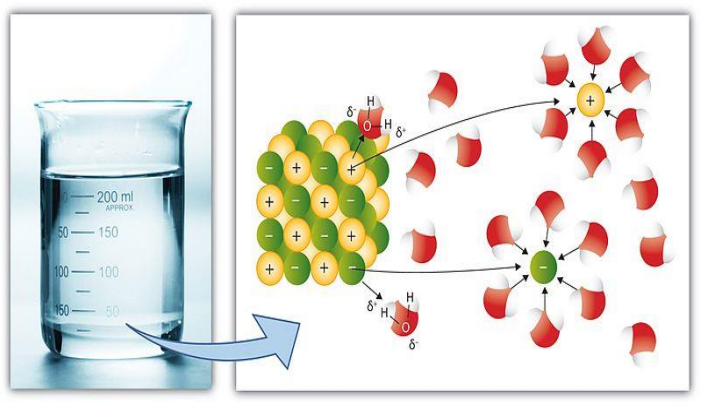


Figure 2: Dissociation of sodium chloride.

When sodium chloride is dissolved in water, the water molecules pull the sodium and chloride ions apart, breaking the ionic bonds that held them together. These ions are then surrounded by water molecules. This process is known as dissociation. When salt dissolves in water new products (sodium ion and chlorine ion) with different properties, as compared to the original salt, are formed. This can be represented by the following chemical equation:

$$NaCl(s) \rightarrow Na^{+}(aq) + Cl^{-}(aq)$$

Hence, even though salt does not react with water and it is easy to recover the salt from the solution **this dissolving of salt in water would be a chemical change**. Here it is important to note that reversibility is not a criterion to determine whether a change is a physical change or chemical change. For example, while it not possible to get wood from sawdust the conversion of wood to saw dust is a physical change because saw dust is just small particles of wood and no new substance is formed.

Now let us focus our attention on egg. Eggs are a rich source of protein. The egg white or albumin contain 90% water and 10% proteins. The egg yolk contains almost 50% water, 30% fat, 17% proteins and the remaining are carbohydrates and other minerals.

Proteins are long organic molecules made of chains of amino acids. When a protein is in its native state (original form), the amino acids are folded in a very specific way that gives the protein its shape and properties. A large part of what determines the shape of proteins is how it interacts with water. Parts of the protein are hydrophilic, meaning they love water, and other parts are hydrophobic, meaning they hate water. The water-loving parts will be attracted to water molecules and will face outwards and the water-hating parts hide on the inner side; and the weak bonds between the amino acids leads to the formation complicated 3D structures.

When eggs are boiled the chains of amino acids are changed from their original state. The heat disrupts some of the bonds that held the molecule into shape. The protein molecules then get tangled with each other causing the egg white and yolk to harden. This process is called denaturation of proteins.

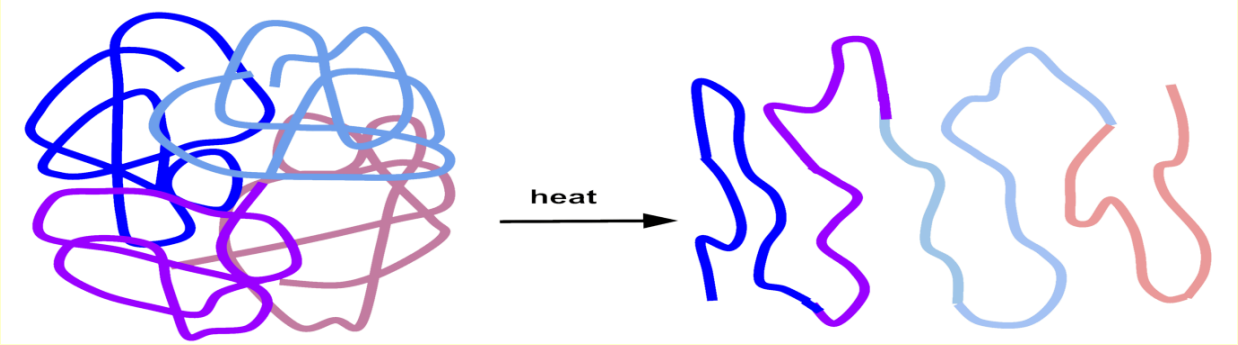


Figure 3: Protein denaturation. **Image credits:** Wikipedia.

Protein denaturation clearly involves breaking and forming of new bonds and the properties of the denatured proteins are different from the original proteins and the change therefore is a chemical change.

It is, however, possible to reverse this process and get the protein back in its original form. So yes, it is possible to unboil an egg!

Shri Tejas Shah

tejas.shah@agnelhamara.net

CARDIAC ARREST, HEART ATTACK & STROKE

Disclaimer: This article is written by a non-medical expert for the sake of education and awareness for school students only.

All the organs and muscles in the body require oxygen and other important nutrients for working properly and to remain healthy. These constituents are carried by **Blood** through the large network of blood vessels distributed through all the tissues. The all too important job of pumping blood to every part of our body is carried out by the **Heart,** which is made up of a special type of muscle called **myocardium**. An inadequate blood supply to an organ or a muscle, a condition called **ischemia,** results in the organ not getting enough oxygen and can cause it to malfunction.

Heart has four chambers (two smaller chambers - left and right atria; and two stronger pumps - the left and right ventricles). The contraction of the atria forces blood into the ventricles. While the right ventricle pumps the oxygen-poor blood to the lungs, the left ventricle, the strongest of the four, pumps blood out to the entire body. This pumping action happens in a specific rhythm throughout the entire body. The heart has its own electrical system that coordinates the work of the heart chambers (heart rhythm) and also controls the frequency of beats (heart rate). The sinus node (located in the right atrium), acts as the heart's natural pacemaker supplying the electrical impulse required for the heart muscle to contract. The electrical current is then transmitted via specific pathways throughout the heart, enabling regular contraction and relaxation. This

continuous activity is regulated by the autonomic nervous system, that controls and regulates the internal organs without any conscious recognition or effort by the organism.

What can go wrong?

- Problems with the heart's electrical system can cause it to beat in an erratic manner – arrhythmia [too fast (tachycardia) / too slow (bradycardia)]. The abnormal heart rhythms are controlled by a **pacemaker** - a small device that's placed in the chest or abdomen. This device uses electrical pulses to prompt the heart to beat at a normal rate.
- When the heart's pumping function is "arrested," or stopped or beats in an abnormal way, it leads to **Cardiac Arrest**. Caused by heart's electrical system malfunctions, this can result in death if proper steps aren't taken immediately. Cardiac arrest may be reversed if **CPR** (cardiopulmonary resuscitation) is performed and a **defibrillator** is used to shock the heart and restore a normal heart rhythm within a few minutes.
- Problems with the health of the heart muscle affect its contractility and its ability to relax. This can happen due to a viral infection of the heart muscle or an inherited heart muscle disorder or by **ischemia**, altered blood supply to the heart muscle itself.
- A problem with the heart valves that control the flow of blood in and out of the chambers can also disrupt the normal flow of blood and cause problems for your heart.

Ischemic heart disease, coronary heart disease (CHD) or **coronary artery** disease are the terms given to heart problems caused by blocked or narrowed coronary arteries that supply blood to the heart muscle. Most often, the blockage is caused by a build-up of fat, cholesterol and other substances, which form a plaque in the arteries that feed the heart. The ***myocardial ischemia*** can develop slowly over a period of time. In some cases, plaques rupture and can form a clot that blocks blood flow. A blocked coronary artery results in the lack of blood & oxygen supply and can lead to a **HEART ATTACK** that destroys part of the heart muscle. The damage can be serious and sometimes fatal.

ISCHEMIC STROKE: When the blood vessels that carry blood to the brain, **Carotid arteries,** get clogged, vital blood flow and oxygen to the brain gets cut-off and can cause a **brain attack** also called as a **STROKE**. Ischemic **stroke** is the most common type of stroke while **hemorrhagic stroke** is another major sub-type that occurs when a blood vessel in the brain ruptures and blood leaks into surrounding tissue. High blood pressure that strains the walls of your arteries can cause a hemorrhagic stroke.

The electrical current that is responsible for the contraction of the heart muscle can be detected on the surface of the body (i. e. the chest wall) via adhesive electrodes. Thus, the heart activity as determined by measuring signals from electrodes placed on the torso, arms and legs is called an **ECG, Electrocardiogram**.

As we have realized, both **stroke** and **heart attack** can occur due to blocked arteries. Though the symptoms for them are different, they share several common factors that contribute to the conditions. These factors include life style, eating habits, genetic predisposition, other disease conditions, etc.

A heart-healthy lifestyle is the foundation for great health!

Dr AVSS Narayan Rao
MBD, BARC, Mumbai 400 085
avssnr@gmail.com

Dr Vikram Sarabhai Essay-cum-Elocution Competition - 2020: Essays of winners ****

Winner 1: Life in a space colony - Future of mankind

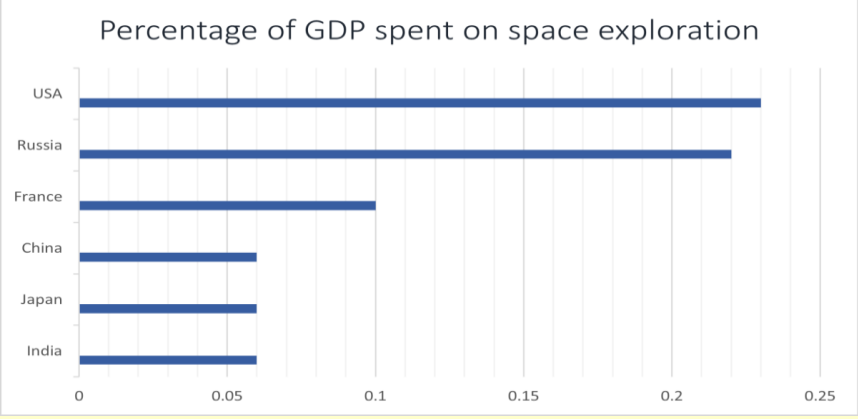
Miss Yachana Shah, Reliance Foundation School, Koparkhairane

Do you ever look at the vast night sky and wonder, 'What if we lived there?' Of course, we have heard about it, we have watched movies about it, we have told stories to kids about it, but *have we actually ever thought about it?*

We are standing at the threshold of a new era. Human colonization on other planets is no longer science fiction, it can be science fact. The human race has existed as a separate species for about two million years. Civilization began about ten thousand years ago, and the rate of development has been steadily increasing. If humanity is to continue for another million years, our future lies in boldly going where no one else has gone before."

-Stephen Hawking

The question is, what's stopping us? Although the global budget for space exploration is $70.9 billion, it constitutes only a quarter of a percent of the world GDP. At present, humanity simply does not have the resources to carry out mass colonization. With ambitious ten thousand crore projects like Gaganyaan, India is no doubt trying to put humans out there. We can dramatically reduce these costs by manufacturing and using more of reusable rocket parts.



Living in space will have its challenges. Being in a zero-gravity area causes physiological changes like the weakening of bones. Astronauts lose 2% of their bone mass every month in space which is why they have to keep exercising. The blood and water move to the upper body. The brain then thinks that there are too many fluids and orders the body to make lesser. The longest time a human has spent in space is only four hundred and thirty-seven days. This is why if we are to spend a lifetime outside of Earth it needs to be on a planet or a Moon. A helpful way would be to dig into the surface. This will protect us from thermal radiation, cosmic rays and meteors. The colony might still be dependent on Earth for some of its resources like minerals, fuels, oxygen and more.

The Moon is one of the potential future homes. We have proven that it is comparatively easy to reach. The limitations are that it is small and does not have an atmosphere or magnetic field to deflect solar radiation. There is evidence of ice on the north and south poles which could be used as a source of oxygen. The power could be provided by nuclear energy or solar panels. The Moon could also act as a base for travel to other planets.

The other target is Mars. There are various similarities between Mars and Earth. Mars too has a metallic core and a rocky mineral composition. The rotation period of Mars is only 44 mins more than that of Earth. Even the axial tilt of Mars is 25 degree compared to 23 degree of Earth. This means that the seasonal variations are very similar although the temperatures are not. The average temperature on Mars is -46^0C. It is predicted that Mars once had a magnetic field which decayed four billion years ago. The absence of a magnetic field also means absence of protection from harmful cosmic rays. Similar to the Moon, Mars has little to no atmosphere. Of what little it has, 96% is carbon dioxide. On Mars liquid water would vaporize in the near vacuum. Being 70% water, humans cannot survive on Mars without complex life support systems. Yet, there are traces of frozen water on the poles.

Elon musk envisions a pressurized glass dome with parks and plant life on Mars. In a place as such, power could be provided by sturdy solar panels that can brave the violent dust storms. The concept of hydroponic farms can be applied to a Mars colony as well. These farms require no soil and minimal water. There might be underground water on Mars. It is ideal for extensive research on factors like these. The air to breath here can be obtained by splitting the carbon dioxide molecules into carbon and oxygen through electrolysis.

Photo: A representative picture of surface of Mars. Image courtesy https://mars.nasa.gov

No other planet in the solar system seems fit for colonization. If we are to venture out of the solar system, then planets like Proxima b of the Alpha Centauri star system and Kepler-452b are some to consider. Getting to these planets is not an easy task. If we can increase the exhaust speed of a rocket to that of light and upsurge the percentage of mass left behind, we can travel much faster. One project that aims to build a 'space probe' travelling at a fifth of the speed of light is Breakthrough Star shot. It was led by the late theoretical physicist Stephen Hawking. It intends for this space probe to reach Alpha Centuari star system within twenty-one years. It plans to launch a nano craft of miniscule size and use powerful laser beams to eject it. This is based on Albert Einstein's dream of riding a light beam.

Homo sapiens have made some irreversible changes to this planet that are not in their best interest. The chances of solving the problems here and surviving on Earth are slim. The day Earth is uninhabitable is not far. Therefore, we must set time bound goals for ourselves. Scientists aspire to have a Moon base by 2050 and a human landing on Mars by 2070.

I would like to conclude by saying that I believe space colonization is the ideal future of mankind and by now I'm sure you do too.

Winner 2: Life in a space colony - Future of mankind

Miss. Riddhi Shukla, DAV Public School, Airoli.

"The sky is the limit only for those who aren't afraid to fly"

And we, humans, are the dauntless explorers. It is the primary reason why we are a dominant species. After conquering the most hostile topographies to life on our won planet, we yearn to take the next obvious step – to explore the great beyond our planet – which we call space, with the fuel of our everlasting curiosity and the launchpad of our technology and imagination.

Looking at this expansive unascertained universe, we might wonder where to start. We may fantasize living in asteroid houses or seeing the infamous sci-fi 'death stare' while we travel light years away. But at the top of the list of our present scope of space exploration is Mars – the 'Red Planet' with ancient oceans frozen underground and a huge impact of solar radiation due to absence of a magnetosphere, consequently an atmosphere which was slowly stripped away by the solar wind. But it is still the top preference because it is the next most hospitable object to humans in space after our home planet – the Earth. The curiosity Rover launched by Nasa to the surface of mars has found that there are eroded alluvial fans mineral pieces with water inside them and clay in the gale crater below the rusted top surface. Even below it is a table of water ice which is so humongous that if all of it were melted, the entire planet would be drowned in thousand feet of water. The obvious second ranker on the list is the moon with 100 billion kilogram of water ice in the perm shadow region as discovered by chandrayan-1.

But before laying out a plan for humans to hike on the mars or moon, we need to figure how to get there. Well, space-X, an organization whose desire is to make humanity multiplanetary, just has the best solution to this. BFR (The Big Falcon Rocket) spacecraft, because of Space-X's astonishing mastery of propulsive landing, which has enabled sense of boosters reducing the cost of space travel so drastically that giant BFR with a diameter of 9 meters and a length of 48 meters would have the biggest capacity of any rocket ever built but would have the best cost per launch accounting for reusability of all we have to pay for here is oxygen and methane the second launch onwards. It will also make use of the unheard-of refuel technology - literally refueling the rockets in space.

Building a colony on other celestial bodies, first Mars and Moon, would require a number of attempts to be accomplished. But how would a colony of humans survive on the Mars or the Moon? Firstly, we need to build a dwelling space where we would make all survival conditions possible. The obvious first step in this direction would be to create transparent domes up to 100 metre in diameter with minimum manual labour by using 3-D printers on the Mars or Moon surface, an inflatable spaceship like the one tested by Bigelow Aerospace and the solid structure on it can be made by mixing the Martian or Lunar soil with water and a binder, just like ISRO scientists are making bricks for colonization on the Moon by using the Lunar soil, guar gum and urea. But these structures should be strong enough to withstand the dust storms on Mars which can damage our lungs badly. Aggravating ever, if the particles get charged, lightning may strike. The harmful cosmic and solar radiation, which can cause cataract and cancer to the astronauts, may penetrate the dome if there is some damage, owing to which, we need to find some alternative place to live too. Lava tubes of currently extinct volcanoes present on both the Moon and the Mars may serve this purpose. These pre-created lava tubes will protect us from harmful radiation and will also provide a suitable living temperature but even these lava tubes aren't easy to find.

Now let's get to what we need to stay alive. The gas of life-oxygen can be obtained by converting the carbon dioxide in Martian atmosphere to oxygen. 96% of the Martian atmosphere is made up of CO_2. This gas can be broken down into Carbon Monoxide, which can be used as a fuel and oxygen. Not only from the Martian atmosphere, we can even recycle the carbon dioxide released by us during respiration for this purpose. For getting water, we need to utilize the moisture in our breath, urine, sweat and runoff from stinks and showers the same way the International Space Station does. Water on the Martian and Lunar surface is not potable as it may contain some harmful chemicals. Here what may help us is the electrolysis of water ice available below the surface. Not only will it provide oxygen, but will also provide hydrogen which is a raw material for the Sabatier process which will generate methane and drinkable water on Mars given the input of Carbon dioxide and hydrogen. Thus, we will obtain methane and oxygen for our fuel and also potable water surviving on Mars.

Thanks to the refueling process, we don't need propellant production on the surface of the Moon. We also need to grow food on Moon and especially, Mars because we can't simply export

everything from Earth to Mars. Despite the top soil containing the explosive perchlorate and being rusted this, having no organic compounds, the soil below it is rich in minerals and can be suitable for some crops if mixed with good manure. This can be done with a greenhouse in a hydroponic chamber. It can also be done underground by using LED lights. But a simple and efficient way to obtain food there would be by creating small ponds in hydroponic chambers and perform algal cultivations certain algae have all the nutrients the human body needs.

All these processes to sustain life require power. The foolproof way to obtain this is by using solar panels. This approach will work on the moon but Mars receives half the solar radiation the earth does and the problem of dust storms is also prevalent. So, we will need efficient nuclear reactors also to carry out our work. Presently Plutonium-238 power the curiosity Rover.

With this, we can all set to mark our feet on the Mars and Moon, create space stations there and then augment the base of humankind, making it multi – planetary. But celestial bodies pose many limitations for the settlement of humankind.

Firstly, terraforming them may prove to be hazardous. Secondly, many planets in the solar system have a lot more or a lot lesser gravity than earth's – both of which harm the astronauts. Staying in space without gravity for large periods of time causes leaching of calcium out of the bones, muscles become sore and 6 months of radiation in space is equivalent to 40 years of it on earth.

Considering this and many other reasons, researchers have found out that the best place for humanity to live in space is not on any planet or Moon but rather in free floating orbital space colonies. There are many models for this astonishing earth – like suspended colonies. All of these are floating space habitats where everything including the weather can be controlled. But the most acceptable one is the O'Neill space cylinder so much so that Jeff Bezos wants to create enough O'Neill cylinders to board a trillion people. It is supposed to be a huge vehicle 6.5km in diameter and 26 km in length. According to scientists, mining the moon and some nearby asteroids would suffice for making it. Its assembly would take place in the liberation space between the earth and the Moon. It would have a shuttle made of boron nitride nanotubes to absorb the neutrons coming in from the solar storms, flares etc. The O'Neill cylinder competes a full circle in 2 mins which generates enough centripetal force to imitate earth's gravity. To make

these structures more stable, we would connect two counter-rotating cylinders with a sturdy metal rod. We can mimic Earth's air pressure, sea level and temperature inside it. Aluminum shield mirrors give us control of the amount of light entering the spacecraft allowing us to maintain our own day and night cycle.

It is conspicuous that it will be powered by the sunlight using the solar panels covering most of the cylinder's exterior which would also keep the cosmic rays out. The most intriguing task here is to create an artificial earth – like topography inside. Water can be brough in from the icy comets. Having taken care of these, internal travel would be possible with cable cars.

But there are always some perplexities to overcome. Here we need to be really good at recycling all the waste generated inside – be it electronic or biological to keep the craft clean and resourceful. Initial separation of the earth settlers from the rest would also pose a situation of colour.

In spite of so many challenges, space colonies are the opportunity to unite al the nations for something optimistic so that we can address fundamental issues back here on earth. To actualize this dream let's teach our youth about space the way they love – experiments, on site observations and video games like 'The Frontiers'. This is going to be a new dawn for humanity.

……..…

Joint Winner 3: Life in a space colony - The future of mankind

Miss Nupoor Teli, New Horizon Public School, Airoli

Today I was watching a YouTube video of the great scientist Stephen Hawking. He said, "Humans won't be able to survive for more than 1000 years from now!" If we think about this deeply, it does make sense. The way we humans are using up the resources our mother earth provides us, there are absolute chances of humans being extinct in the next 1000 years! But we do have our intelligent scientists who are struggling day and night to find ways to get through this problem. One such scientific research that scientists are slaving after is 'life in space colonies.' Yes, you read it right. Life in space! Isn't that interesting? Yes of course. Let's see what it means, what it looks like and how on earth will that work! (Not earth, space actually).

Jeff Bezos, founder of Amazon and one of the richest people in the world, has developed a hypothetical idea of space colonies. In this space colony, there will be different kinds of architecture, Agriculture, transport and a whole new world. He even says that he will have animals there! Strange right?

Well, through my eyes, space colonies have got to be something really magical. Every aspect of human life will be carried out in a different way. First of all, oxygen. Will we have to carry oxygen tanks with us all the time? Just as the hikers and the astronauts do? Well, perhaps, till that time we might have a small machine that might provide us oxygen. Just like a mini oxygen tank. Maybe. What about water? Will we carry water from earth to those colonies? That seems quite impossible. And even if somehow, we managed to get the water there, how long will it last? We can't rely on this plan. Certainly not! But what if scientists developed a way to 'create' water? That too seems a bit unreliable. But what if we take water from moon? Yes, the moon. Moon has water. Even though it is in solid form, a machine can be developed to collect the solidified water, liquefy it and make it usable. That's a big process. Yes, it is. But we need to work if we require a sustainable life in space.

Now let's talk about agriculture. Well, even today, there is a way of farming without soil! That is 'hypotonic farming.' In this type of farming, there are fluids developed that contain the nutrients plants required for photosynthesis and other processes. Plants will be planted in pipes so as for easy distribution of water. Maybe even artificial sunlight will be developed. Moving on to the transport. Just imagine having space vehicles! But wait, there won't be any gravity! Will all of this float? Just imagine, floating farms, houses, lakes, animals and humans! Not actually. Jeff Bezos says that his own O'Neil will keep using energy to attract radiations and produce some amount of gravitational force. Relieved! There will be tiny houses and some tall buildings. Maybe we won't have any stairs in our homes or lifts of buildings as the gravitational force would be less so we can float and reach at any height! Oh, we even might wear a kind of space costume. I have always visualized space costumes as very cool.

There might even be huge machines to keep the temperature stable. But guess what? There won't be any earthquakes, landslides or tsunamis! That's a great plus point. Even the wind will be controlled by machines.

Well, this imagination is just a start. Creating a world like this is not a cake. It will ask for tremendous hard work, inventions, patience, failures, finance and so much more that cannot be counted. But if we apply the sci – fi rule, nothing is impossible. What is sci-fi? Sci-fi means science- fiction. It says that anything that we feel as fiction today, it will turn out to be the science of tomorrow.

Maybe scientists might be working on this, but it won't happen in a few years. Probably not us but our future generations will live in these space colonies. But today, it is the foremost duty of every human to stop being harsh on earth. For she is our mother. And a mother is never to be hurt, she is only to be loved and cared for.

……

Joint Winner 3: Life in a space colony - The future of mankind

Mr Rishikesh Sridhar, Reliance Foundation School, Koparkhairane

"The Universe is a pretty big place. If it's just us seems like an awful waste of space".
The above quote is by a famous astronomer which makes us think about the future of mankind in space.

The year 2020 has taught everyone to be ready for the unpredictable, unknown and uncertain future. The earth is a unique planet and we have not found a replacement or something similar. It is burdened beyond anybody's expectations. Increasing population, resources' consumption, pollution, etc. has made living on Earth dangerous.

The year 2019 started with the Covid19, then 2021 could bring a new virus, new disaster or a new climatic change which will change the way we live or survive. The conditions on Earth would be going from worst to terrible. The problems of living on Earth will be increasing day by day. At first, the government would try its best by putting all the efforts to solve this problem. But soon they would be facing new challenges and realities which were never seen before.
There could be major environmental changes in the Sahara Desert which is the hottest places in the world; it could be completely frozen. Also in places like Greenland where the temperature in

winter is -4 to 1 degree Celsius, the temperature could reach up to 35 degree Celsius. This would lead to weather changes all around the world.

Floods, tsunami, earthquake and volcanic eruptions would happen frequently. The government would start to take initiatives like reducing carbon emissions, pollution and many other climate friendly initiatives. But it would be too late.

So, all the governments in the world would come up with a plan. To ensure continuity and saving our entire civilization it would be decided that the only option to save the people on Earth is by leaving the wonderful planet Earth.

They know that they would not be able to do it alone. So, all the countries would come together to look at space to set up colonies. This has to be developed at a faster rate than our imagination. This would be a great benefit as the earth would get a break to rejuvenate and repair itself.

People are already investing and making plans to visit space. It was done for understanding space and looking out for someone similar or extra intelligent than us in this universe. It is done with the thinking that people in Earth are not alone in this universe. But now it would have to be relooked in from a different angle and different thought.

"To save the Earth and mankind, life in a space colony will be a reality."

Different option would be considered like making Mars habitable, building huge space station, space shuttles, looking at the moon of Saturn - Titan and considering the Earth's moon as a pit stop. Titan has liquid lakes, climatic conditions with weather patterns and surface features similar to Earth.

Private companies like Tesla are trying to put people in for a roundabout trip to the International space station as a tourist program.

At present, it costs more than 81 million dollars per person per seat. This is one major problem which has to be solved anyhow. The price has to be reduced drastically and find an economic alternative. It would be decided to send satellites to the space at a lesser cost. There would be six international space agency, NASA, ISRO, CNSA, Roscosmos, Space X & ESA which would carry out the entire operation of planning and executing this herculean mass transportation. Humanity as the whole will be working for these organizations in one way or another. The ISRO would be the most sought out space agencies as it can send anything on space at a fraction of

cost. The rich and well-developed nations will be looking at transporting its citizens to Mars or Saturn's moon - Titan.

The developing and less developed countries will be looking at sending their citizens to International space stations which would be revolving around the Earth. These stations are huge space ships. It would be a cheaper alternative to leave the planet Earth.

DEVELOPING SPACE COLONIES

Each continent would have its own international space station. There would be standard operating procedures on the batches that would be sent to space. It would take many years for this translocation of people being sent to a different location in space. These space station would provide a safe location to live. Humans would be developing new food supplements which will take less time to produce, less space to produce and will contain the exact nutrients required for our body. The Sun's energy will be stored in solar panels and mini space station for growing crops will be made. New innovative measures would be invented to derive water from the Moon. The space colonies will be ultra-modern but with minimum structure. Everything would be built with a multifunction speciality.

Natural resources like gases are available in plenty in space. New devices of extracting these resources would be invented. Metals will be collected from space debris, asteroids and comets passing by. Mining of space resource would be conducted on a large scale in an optimum manner so that no pollution or waste is generated. Intra-galaxy travel would be the future. New planets will be discovered. There would be enough resources for everyone. There will be so much to discover that it would be impossible to exhaust it because the universe is expanding.

PRECIOUS THING

The humans will realise that the most precious thing ever we have is the mankind species itself. Also, Earth will regain its resources and will be a gigantic animal and plant kingdom. The power to create and protect is superior to anything in this universe. But we would never forget the basic place from where it all started. The mistakes made on the planet Earth and the lessons learnt would be the new constitution for all space colonies. To sum it up, all about space colonies,

"Space travel is life-enhancing and anything that is life-enhancing is worth doing. It makes you want to live forever."

Students Corner...

FEAR, A STEPPING STONE TO FAVOURITE !!!

When I was in class V my most favorite subject was EVS (Environmental Studies). When I came to know, in class VI it will have two branches Science and Social Science, that too with three separate books of Social Science, I really got scared.

“How will I manage to learn three books of only one subject” this was my greatest fear.

As I entered class VI, I started attending Social Science classes. I felt it's not that scary. The way my teacher was teaching was marvelous. She made the topic so simple and easy to learn. Fear forced me into extreme concentration and I could shed distractions.

Fear gave me so-called "Super power" so that, I can lift the load of geography, history and civics. Overcoming fear forced me to learn and embrace the subject in a better way. All this, I could not do alone. It’s all because of my teacher, who gave me the strength, inspiration to take this subject in a positive manner. She taught the subject with great enthusiasm and shared her knowledge and experiences with us, gave us small tricks to memorize the difficult topics easily. Even by making PPTs and videos, I have enhanced my learning skills.

In the end, I would like to say,” fear can become a stepping stone to success”, under the guidance of “super teacher” like I have and personal motivation, regular learning and reading can turn fear into favourite.

Yash Agarwal

VIth Std.

Vashi, Navi Mumbai

LEARNING BY DOING:

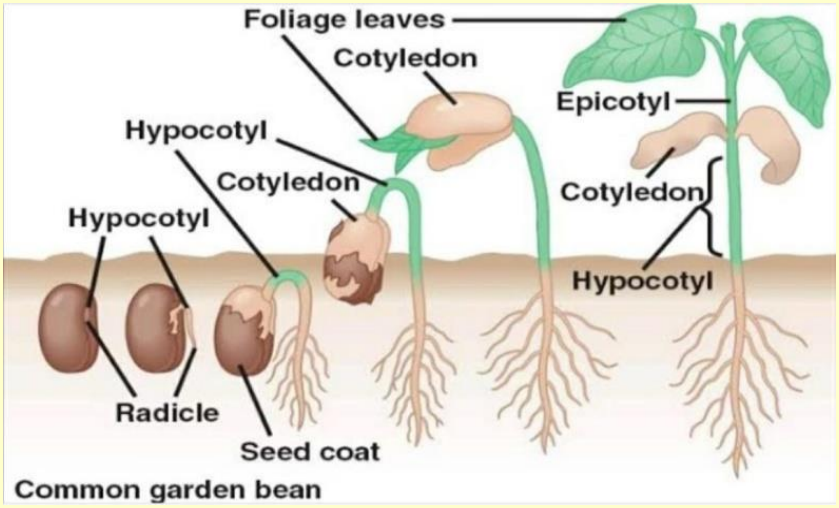
EXPERIMENT OF GERMINATION TEST

Friends, I am sharing my exciting experience of doing the germination experiment as a part of science project in school.

What is germination?

Germination can be defined as the growth of a seed into a young plant or a seedling.

PARTS OF GERMINATING SEED:



IMPORTANCE OF GERMINATION EXPERIMENT:

- A germination test is often the only test a farmer can conduct on the seed to determine if it is suitable for planting by using few representative seeds.
- By knowing the germination rate, farmers can adjust their planting rates to attain the desired plant population in the field.

It is very easy to perform without much investment and fancy instruments.

OBJECTIVE: To find the proper conditions for germination of a seed.

MATERIALS: 4 containers, tissue papers and moong dal seeds.

METHODS:

- First, I took four containers and neatly covered them with tissue papers. I considered them as container A, B, C and D. I also take a bowl.
- Then I spread some moong dal seeds in the containers.
- In container A, I soaked the tissue paper in water, wrapped it with seeds and kept it under the sunlight.

- In the container B also, I soaked the tissue paper in water. Then I wrapped it with the seeds but kept it away from the sunlight and also rubbed cream over one of the seed after few days.
- In container C, I soaked the tissue paper in water and kept it inside the refrigerator with the seeds.
- In container D, I did not directly soak the seeds in water; I just sprinkled few drops of water once and kept it under the sunlight with the seeds.
- By day 6, I prepared the soil bed.

Initial status of Containers

A B C D

Container A-under the sunlight at normal room temperature

Container B- little away from sunlight at normal room temperature

Container C- inside the refrigerator

Container D- under the sunlight at normal room temperature without water.

Table listing the observations as made on different days.

Day	Container A	Container B	Container C
2	Seeds swelled up (osmosis)	Seeds swelled up	Seeds swelled up
4	Radicle started to grow and green cover got separated.	The green cover got separated but the radicle did not grow.	No such Change
6	Transferred to soil and two leaf like structure grew.	Radical started to grow	No such change
8	Continued to grow	Grew but not much	No such change

10	A sapling has grown with two leaves	Cream rubbed over one of the seed continued to grow	No change
12	Continued to grow	Little growth of the seed not rubbed with cream.	No change
14	The apical tissue is growing. Another two leaf like structures are starting to grow.	Little growth of the seed not rubbed with cream. The other seed is not growing.	No change

Observations:

Results: The seeds in the container A have germinated properly as the seeds in this container were kept in the proper conditions with proper amount of Sunlight, water and oxygen. Photos below substantiate it.

Conclusion: The seeds will only Germinate properly when they are kept under sunlight with water and are in the presence of oxygen but also some seeds can germinate in darkness also.

Photos of container "A" on different days.

Day 2

Day 4

Day 6

Day 8

Day 10

Day 12

Day 14

Miss Kaushambi Mitra
Std. VII
Atomic Energy Central School-2, Anushaktinagar,
Mumbai 400 094.

STORY OF VACCINE DEVELOPMENT!!!

Vaccination is the method of exposing an individual to a no harmful version of a pathogen/virus in order to create an immune response which gets activated on actual infection of the real virus and thus saves one from falling ill. Inoculation is the traditional type of vaccination practiced since over 2000 years ago in India and China which involved intentionally exposing an individual to the matter from smallpox pustules in order to initiate a mild, protective response to the disease against smallpox (Boylston, 2012).

Modern vaccination method is generally credited to Edward Jenner who used matter from the less harmful cowpox pustules to inoculate patients successfully against smallpox in 1796. Since Jenner's invention, till about 1900 AD, there were two human virus vaccines developed against smallpox and rabies, and three bacterial vaccines developed against typhoid, cholera and plague.

There are several types of vaccines. Each type is designed to teach our immune system how to fight off certain kinds of infectious agents or pathogens like virus and bacteria.

Following points are important for vaccine development:

a) How our immune system responds to the pathogens?.
b) Who needs to be vaccinated?.
c) Which is the best technology to create the vaccine?

Following are the main types of vaccines:

Vaccine Type	Strategy used
Live-attenuated vaccines	Live vaccines use a weakened (or attenuated) form of the pathogen/virus that causes the disease.
Inactivated vaccines	Inactivated vaccines use the killed/inactivated version of the pathogen/virus
Subunit, recombinant, polysaccharide and conjugate vaccines	These vaccines use specific parts of the virus - like its protein, sugar, or capsid (a casing around the pathogen)
Toxoid vaccines	Toxoid vaccines use a toxin (harmful product) made by the virus causing a disease.

India's indigenous COVID-19 vaccine 'COVAXIN' developed by Bharat Biotech in collaboration with the Indian Council of Medical Research (ICMR) is the inactivated type of vaccine.

The Oxford vaccine produced by 'Serum institute Pune', is a chimpanzee adenovirus vaccine vector. This is a harmless, weakened adenovirus that usually causes the common cold in chimpanzees (adenovirus are commonly found virus in our body and vectors means they are the carrier of the vaccine).

The modern types of vaccines are,

1) **RNA vaccines:** RNA vaccines use mRNA (messenger RNA) inside a lipid (fat) membrane.
2) **DNA vaccines:** DNA in DNA must be translated to mRNA within the cell nucleus before it can subsequently be translated to protein antigens which stimulate an immune response.

The Pfizer BioNTech and the Moderna COVID-19 vaccines are both RNA vaccines. There are currently no licensed DNA vaccines, but there are many in development.

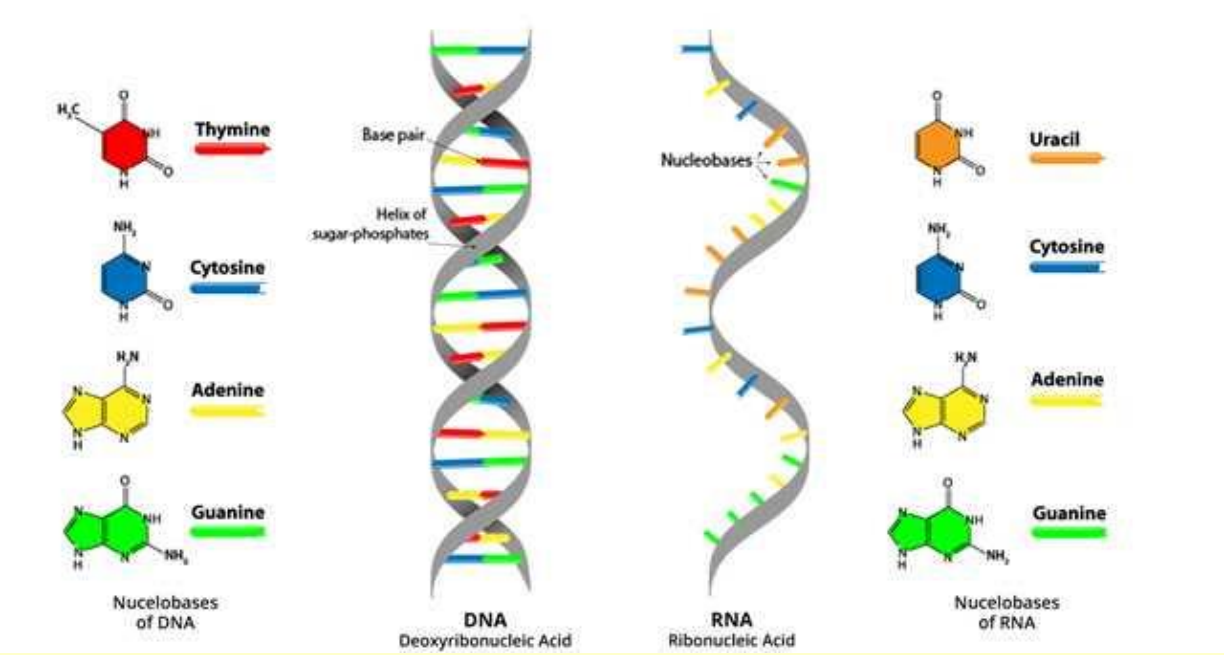


Photo: The important difference between DNA & RNA (https://www.technologynetworks.com)

What are the ingredients in a vaccine?

The main ingredient of a vaccine is a micro size fragment of the virus or the blueprint (like mRNA) for making these fragments. Besides this, the vaccine also contains other ingredients to keep the vaccine safe and effective. These secondary ingredients are included in most vaccines and have been used since many decades in all the vaccines.

Each of these vaccine ingredients serves a specific purpose, and each ingredient is tested in the manufacturing process for its targeted use and also for safety.

Following are the general ingredients of a vaccine

1. **Antigen:** All vaccines contain an active component (the antigen) which generates an immune response, or the blueprint for making the active component. The antigen can be any of the substance discussed above in types of vaccines.
2. **Preservatives:** They are used to prevent the vaccine from contamination once the vial has been opened, if it will be used for vaccinating more than one person. The most

commonly used preservative is 2-phenoxyethanol. It has been used for many years and is considered safe for use in vaccines, as it has little toxicity in humans.

3. **Stabilizers:** Stabilizers prevent chemical reactions occurring within the vaccine and also prevents sticking of the vaccine components to the surface of vaccine vial. Stabilizers can be sugars (lactose, sucrose), amino acids (glycine), gelatin, and proteins.
4. **Surfactants:** Surfactants keep all the ingredients in the vaccine blended together. They prevent settling and clumping of elements that are in the liquid form of the vaccine.
5. **Residuals:** Residuals are tiny amounts of various substances used during manufacturing or production of vaccines and may include egg proteins, yeast or antibiotics etc.
6. **Diluent:** A diluent is a liquid used to dilute a vaccine to the correct concentration immediately prior to use. The most commonly used diluent is sterile water.
7. **Adjuvant:** An adjuvant improves the immune response to the vaccine, sometimes by keeping the vaccine at the injection site for a little longer or by stimulating local immune cells. The adjuvant may be a tiny amount of aluminum salts.

Stages of Vaccine Development and Testing

Vaccine development and testing requires following a standard set of steps.

Pre-Clinical Stage

In Pre-clinical stage, tissue or cell culture studies along with animal testing are carried out for assessment of the safety of the vaccine and its immunogenicity, i.e. its ability to provoke an immune response. These studies give an idea of the expected immunity responses to the pathogen in humans. They also evaluate a safe starting dose for the next phase of research as well as a safe method of administering the vaccine. In this stage, researchers may vaccinate the animals and then try to infect them with the target pathogen. It is a very important stage and most of the candidate vaccines fail to produce the desired immune response in this stage itself. The pre-clinical stages often last for 1-2 years.

Once this stage is successful, the vaccine is then subjected further to three phases of clinical testing involving humans.

Phase I Vaccine Trials

This first stage involves a small group of about 20-80 adults. If the vaccine is intended for children, it is first tested on adults, and then gradually the age of the test subjects is stepped down until they reach their target. Phase I trials may be non-blinded (where the subjects know whether a vaccine or placebo is used. The placebo may be a simple saline solution, a vaccine for another disease, or some other substance. Placebos simply means it do not contain an active substance which may affect our health).

The goals of Phase 1 trials are to assess the safety of the vaccine and to determine the type and extent of immune response that the vaccine provokes. The participants in these studies are carefully monitored and conditions are carefully controlled.

After successful completion of Phase 1 trial, the process will progress to the next stage.

Phase II Vaccine Trials

In this stage, a larger group of several hundred individuals participates in the testing. The subjects could be the amongst the most probable risk groups. These trials are randomized and well controlled, and include a placebo group. Phase II trials are done to study the vaccine's safety, immunogenicity, proposed doses, schedule of immunizations, and method of delivery.

Phase III Vaccine Trials

After successful completion of Phase II, vaccines move on to larger trials, involving thousands to tens of thousands of people. The Phase III trials are randomized, double blind and involve the experimental vaccine being tested against a placebo.

Phase III trials are performed to assess vaccine safety in a large group of people. Certain rare side effects might not be observed in the smaller groups of subjects tested in earlier phases. Thus, a large group of up to a lakh or more people can be tested in this stage. In phase III, mainly the vaccine efficacy is also tested besides safety.

Approval and Licensing

After a successful Phase III trial, the vaccine developer applies for a License to the approving authority. The approving authority then inspects the data, efficacy, safety and the facility where the vaccine will be made and upon satisfaction of all their parameters, approves the vaccine.

Post-License Monitoring of Vaccines

Various systems monitor vaccines after they have been approved. These include Phase IV trials, the Vaccine Adverse Event Reporting System, and the Vaccine Safety Datalink etc.

Phase IV Trials

Phase IV trial are optional studies that drug companies may conduct after a vaccine is released. The manufacturer may continue to test the vaccine for safety, efficacy, and other potential uses.

References:

- Boylston Arthur (2012) The origin of inoculation. J R Soc Med 105 (7) 309:313.
- Woodville W. The history of the inoculation of the small pox in Great Briton Vol I London: Printed and sold by James Philips, George Yard, Lombard Street, Section II, 1796:35-52.
- U.S Department of Health and Human Services. Vaccine product approval process. U.S. Food and Drug Administration. Updated 01/09/2018.
- U.S. Department of Health and Human Services. Investigational New Drug (IND) Application. U.S. Food and Drug Administration. Updated 10/05/2017.
- Lilienfeld, D.E. (2008) The first pharmacoepidemiologic investigations: national drug safety policy in the United States, 1901-1902. Perspectives in Biology and Medicine. 51.2: 192-96.

Shri Rahul C Bhangare

EMAD, BARC, Mumbai

rcbarcb@yahoo.co.in

DON'T MISS IT.....

COMING UP IN NEXT ISSUE No 4

(April to June 2021)

1. **1 MILLION DOLLAR TEACHER: RANJITSINH DISALE**
2. **NOBLE WINNERS 2020**
3. **STUDENT'S CORNER**
4. **TEACHER'S PAGE**
5. **FROM MY BOOK SHELF....SCIENCE AND EDUCATION BASED BOOKS**

DO YOU HAVE A INTERESTING EDUCATIONAL STORY???
SHARE WITH US!!!!

FROM NMSF's EVENTS CALENDAR-2021

Information regarding the next activity

Homi Bhabha Bal Vaidnyanik Competition (HBBVC)

(To be held in September/October 2021)

Guidance Sessions for Students of Std. VI.

(For those passing std. V & going to VI)

(Students going to std. VII are also welcome to join for a revision)

Learn Basics of Science from Scientists (while at Ease)

DURATION: Sunday, June 6, 2021, onwards, for 15 Sundays.

For enquiries, parents may contact:

Dr. D. A. R. Babu: 97699 69694; Shri M.P. Bellary: 90823 13349; **or**
Dr. A.M. Bhagwat: 93241 68510, (after 1800 hrs). **OR**
write a mail to nmsfscienceutsav@gmail.com

For more information, visit NMSF's website:

http://www.navimumbaisciencefoundation.org