Navi Mumbai Science Foundation

EdUREKA

Education for Spirit of Science

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AI Singularity

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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 the last one decade. The magazine will mainly cover activities and articles on science education useful to students, teachers & society at large.

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

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From Editor's Desk!!....

Editor's Corner

Dear Readers, students and teachers, we continue with our endeavor to bring articles to you which will give you a different perspective to things that you already know or introduce you to new concepts.

We bring you articles of interest in science, and interesting science/maths activities.

This issue deals with some important topics like how to do science projects, how simple science principles are used in submarines and an introduction to what is Artificial Intelligence

Some activities are also included the solutions to those activities will be published in future articles.

How to do a science project?

After vacations, when students come back to school, there are announcements about an even which will come very soon. It is called science exhibitions, where students present their science activities/projects.

However, how to choose a project, how to implement the idea, etc is something which needs discussion. This article deals with such issues.

Science project, as defined by a senior faculty of TIFR, is “Of the student, by the student and for the student”.

This short definition will be the guideline for this whole article and should be the basis of doing a school science project. This article is quite long and hence will be split in two parts.

What does this definition mean? It means that the project should be project of the student. At the least the idea should be of the student, maybe with the help of the teacher/mentor. It should be done by the student, as much as possible. Here teacher can help and guide when the student encounters a hurdle. Finally, the project should be for the student, which means that there should be as much learning component for the student, as possible.

We shall discuss these points in detail.

The project should be such that it makes students a self learner, though the hands-on activity and experiment. Projects should be such that they teach students how to understand a question (school level or real-life level). The project should be such that it trains the student to observe, understand, and analyse the data and phenomena under study.

So the learning component for the student should be a prime goal of the science project. Example: A student brought a project where he claimed that he had designed a universal remote for operating household devices. When probed in depth, it turned out that the student had purchased the remote. The learning component for the student in that project was an absolute zero.

Students should be encouraged to do the activity with their own hands and learn the maximum, irrespective of how simple the project is. These days arduino and electronics based projects have become fashionable. But do the student understand the electronic components. Can they replace one component, if it goes out of production?

How to select a science project?

First the student should identify a broad field of interest. Then look for a question.

The question NEED NOT be a question which the world or society if facing. It can even be a curiosity question. One of the best project I have seen is the curiosity of finding a relation between height different between two parallel lines and the distance between them. A very curiosity based question and aim.

Define an Aim of the project, as clearly as possible, and expected conclusion. The aim should be as simple and specific as possible. A project with multiple aims diverts the attention of the student(s) and the teacher. A very broad aim, limits the scope of student activity, in given limited time in a school year.

Multiple aims/questions also indicates that the student/teacher lacks clarity on the topic.

A science project, should not be repeated unless there is a modification to the process, data, analysis technique etc. No question/aim is wrong.

Let us take an example. An aim : Pollution. A very wide topic with no specific interest. An aim: Pollution in a lake: a more specific question with a lot of scope of understanding the problem and a possible solution. However, if the aim is Pollution in a lake after Ganesh Immersion, gives scope of understanding the problem in depth, look for a possible cleanup solution after the festival and also be a very strong learning opportunity to understand the chemistry, botany and even zoological ecosystem, the effect of pollution on them and a possible application to a society issue locally.

Similarly. Aim: Solar panels. No learning component for the student/teacher.

Aim: the power output from a solar panel. Better understanding of energy input to the panel, energy output etc.

Aim: to compare different types of solar panels. Can bring in financial implications, economical viabilities and hence a possible connection to daily life issues.

Hypothesis.

Student should form a hypothesis of the problem at hand. It gives an opportunity to make the road map of the problem.

Hypothesis should be based on some previous work, project or established facts. At student level a slight modification to existing work can be considered as a

good hypothesis. The result should be achievable and doable by students in their local surroundings. Example: a project which is doable only in some sophisticated laboratory is not a good project.

Hypothesis should not be wild and/or baseless. Example. Extract of a certain plant is good insecticide. Without proper background, such hypothesis can lead the student into complete chaos, with no end result.

Or hypothesis that suggests a new design of space station. Etc. Such hypothesis make no sense.

Example: project on time machine and then write an essay. Or project on why growing trees is very good for environment. Project on chimneys of big industries, as they require great amount of knowledge on chemistry and economics.

Certainly students should avoid copying material from internet as the learning component for the students in such cases is minimal. Internet should be used only as a tool. Not as your guide.

Resources for carrying out the project.

As long as possible the resources should be used which are available at school or its surroundings. Materials which are toxic, or connected to hazards like high voltage etc should be avoided at all costs. Example: use of nail polish remover should be prohibited as it is a carcinogenic substance.

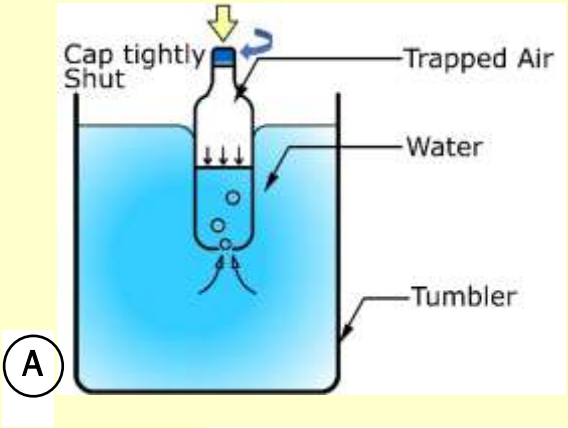
Tests that involved human beings or animals directly or indirectly, should be avoided at school level projects.

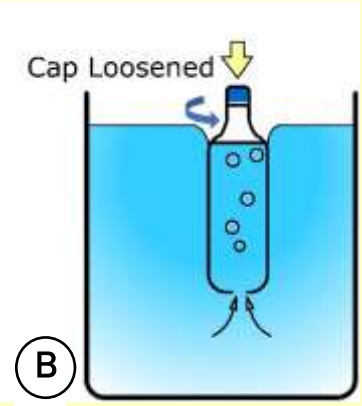
We will continue in the next article, many other issues regarding science projects.

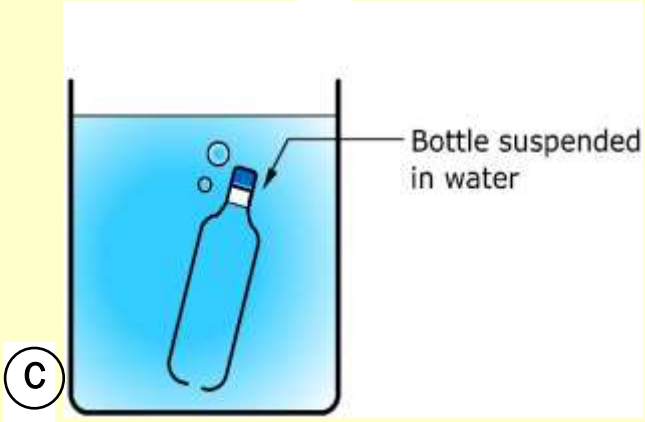
Submarines - The Science Behind its Operation

A submarine is a special type of ship that can travel both on the surface of the sea as well as deep underwater. Unlike ordinary ships that float only on water, submarines are designed to dive beneath the ocean and stay there for long periods. They are used world over by the Navies for defence, scientific research, and even exploring underwater life. The working of a submarine is based on some very interesting scientific principles.

Let us first understand this principle using a very simple activity depicted above.

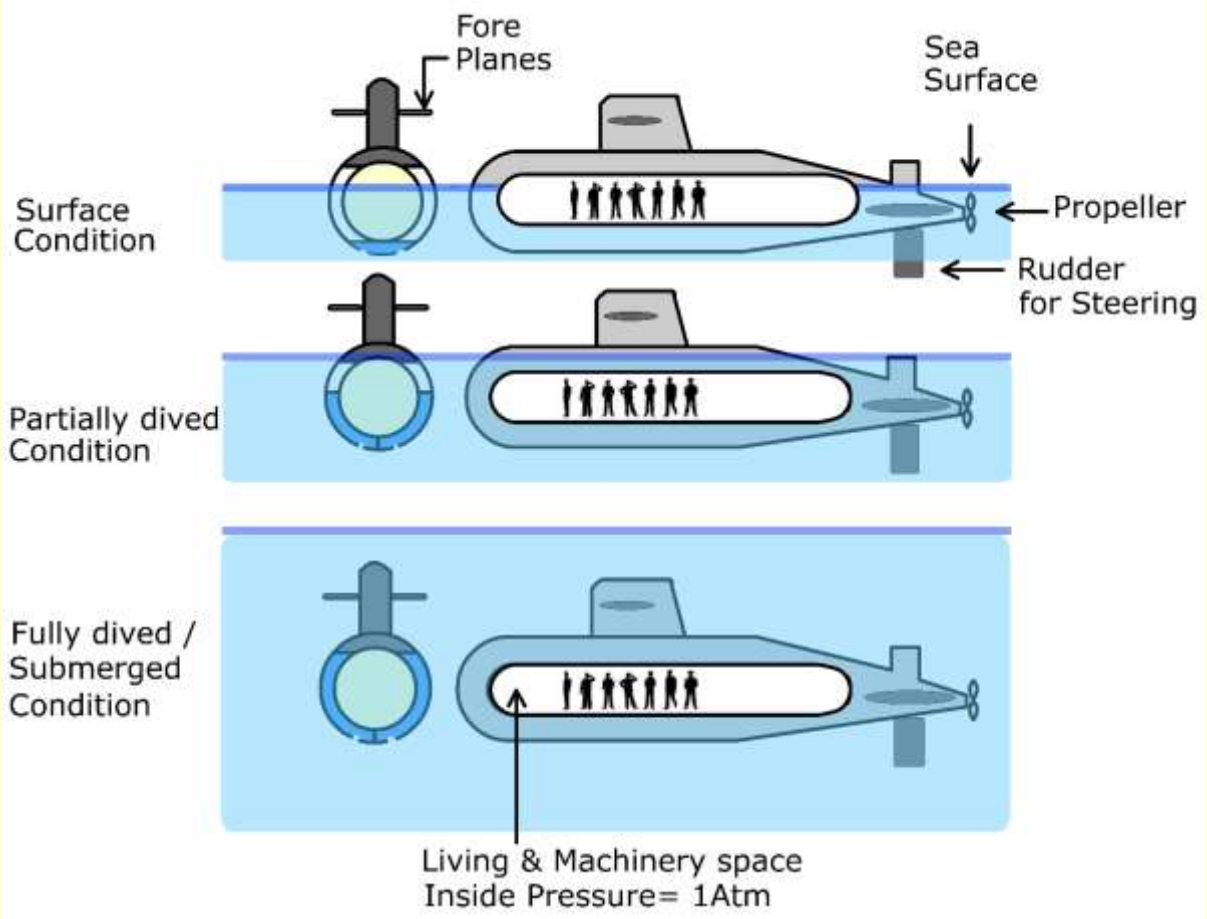






1. Take an empty 1/2 lt. soft-drink or water bottle of transparent plastic.
2. Make one hole [dia : 1cm] in its bottom side. Tighten the bottle cap.
3. Take a 10 lt. Tumbler and fill it with water.
4. Now vertically immerse the soft-drink bottle into the bucket as shown.
5. Observe that the water will initially enter the bottle from the bottom holes up to certain extent and thereafter stop. The bottle will not immerse even after applying force.
6. Now, loosen the cap of the bottle slowly. Observe that as the trapped air escapes, water enters the bottle from bottom and the bottle starts to sink.
7. In a state when the water is half filled and cap tightly shut, the bottle remains half immersed and half floating,
8. Now, again loosen the cap slowly and observe that - as the air escapes, water enters the bottle from the bottom holes and now the bottle is not able to float any more.
9. With the bottle completely filled and cap fully shut, it slowly sinks and remains suspended in the water.

This is the simple principle of working of submarines too, which is known as **Buoyancy**. It is the upward force exerted by water on an object placed in it. This idea was initially explained by the famous Greek scientist Archimedes through **Archimedes' Principle,** which states that an object will float if it is able to displace water equal to its own weight. Similarly, in simple words, if a submarine is lighter than the water it pushes away, it floats. When it becomes heavier, it sinks.



The real submarines are cylindrical in shape, floating on the water. There are chambers called **Ballast Tanks**, which are empty and contain atmospheric air. A submarine controls its floatation and submergence using these ballast tanks. These are large tanks located inside the submarine. When the submarine wants to dive, it opens the vents and allows the Ballast tanks to fill with seawater. This increases its weight, making it sink below the water surface till the buoyant force balances with the gravitational force at a certain depth. When it wants to surface again, it shuts its Vents and allows compressed air to expel the water out of the tanks. This makes the submarine lighter, and it floats upward. This process helps submarines to dive and surface from the depths of the ocean.

Another important part of a submarine is its **Propulsion system**, which consists of a rotating **Propeller**, for moving it forward or backward. For driving this propeller, submarines use power from diesel engines (when on the surface) and batteries (when underwater). Modern submarines may use nuclear power. Now when the submarine is in motion, there are winglike structures in the forward and rear sides, called **Planes**, which helps the submarine to remain horizontal and also to change the depth in the vertical direction, similar to that in an aeroplane. The Submarine uses a **Rudder** to change its direction of motion in the horizontal direction.

Submarines are also built with very strong metal bodies called **pressure hulls**. As a submarine dives deeper, water pressure increases. The hull protects the pressure hull from being crushed by the enormous pressure of deep oceans. However, in our science class we have learnt that when you are at depth of 10 m, the pressure at that depth is 2 Atm. which is equivalent of 2 kg/cm^2 of air. At 100 m one needs 10 times the atmospheric pressure to expel all water. Similarly, at 200 m depth, compressed air equivalent to 20 times atmospheric pressure is required to expel the water. The submarine uses its planes to come close to the sea surface and then compressed air is forced into the ballast tanks to push the water out for the final thrust to the surface.

Submarines also need oxygen for the crew members to survive. Since they stay underwater for long durations, they use machines to remove carbon dioxide from the air. Navigating underwater is another scientific challenge because submarines cannot use normal vision in deep, dark waters. They use a technology called **SONAR** (Sound Navigation and Ranging). This can be explained at a higher class.

As shown above in this picture, a submarine, whilst on surface is always two-thirds inside the water, which is not visible, unlike a ship's structure, visible mostly above the surface of water.

In conclusion, submarines are amazing machines that combine physics, engineering, and technology. They use buoyancy to dive and rise, propulsion systems to move, SONAR for navigation, and strong hulls for safety. These underwater vessels show how science helps humans explore and protect the mysterious world beneath the oceans.

Captain Sudeep Sen, NM (Retd.)

A Veteran Submariner of Indian Navy

https://www.nti.org/analysis/articles/india-submarine-capabilities/

AI Singularity

By Shri Prakash Agarwal B E (Hons)

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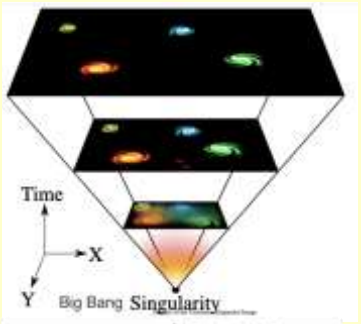
Introduction

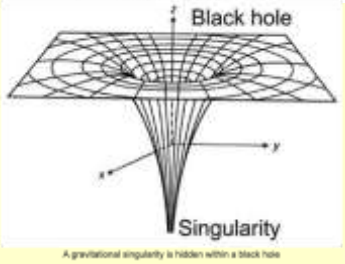
Recently in response to a news item that a social network for AI Chatbots called 'Moltbot' has emerged where they can talk to each other, the well-known visionary Elon Musk has warned that this may bring the AI reaching 'Singularity' much faster than envisioned.

As is common with new technologies, new terminologies are developed to explain the way they work. This article discusses the concept of 'Singularity' in AI (Artificial Intelligence) which will provide a new perspective of its development and impact.

Singularity Explained:

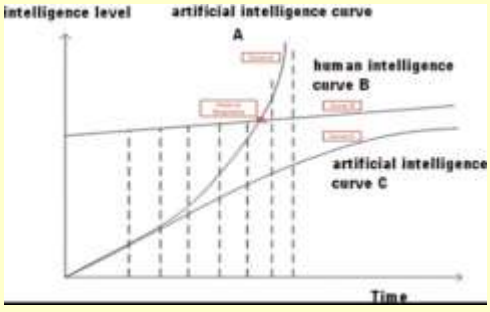


The term Singularity comes from physics where 'Matter' is crushed to 'infinite density with zero volume'. In other words, all the mass is converted into energy, as per Einstein formula $E = mc^2$. This arrives from the basic formula that you have learnt in classroom and is 'Density = mass/volume.' Therefore, when Volume of matter becomes Zero, Density is infinite.



This point where Density becomes infinite, is called as the point of 'Singularity' . At this point, no laws of Physics apply since infinity causes all equations to breakdown. Two most obvious examples are the theory of 'Big bang' and 'Black Hole' and are shown in the diagrams attached.

Singularity in Al:



Singularity in AI refers to a point, as shown in the graph, where artificial intelligence surpasses human intelligence and begins to improve itself faster than humans can understand or control it. In other words, Singularity is the moment when Al becomes smarter than humans and triggers runaway self-improvement. This causes rapid, unpredictable change to civilization. A

graph is attached to demonstrate this concept and is explained in the table below:

Timeline of Al stages mapped onto the curve:

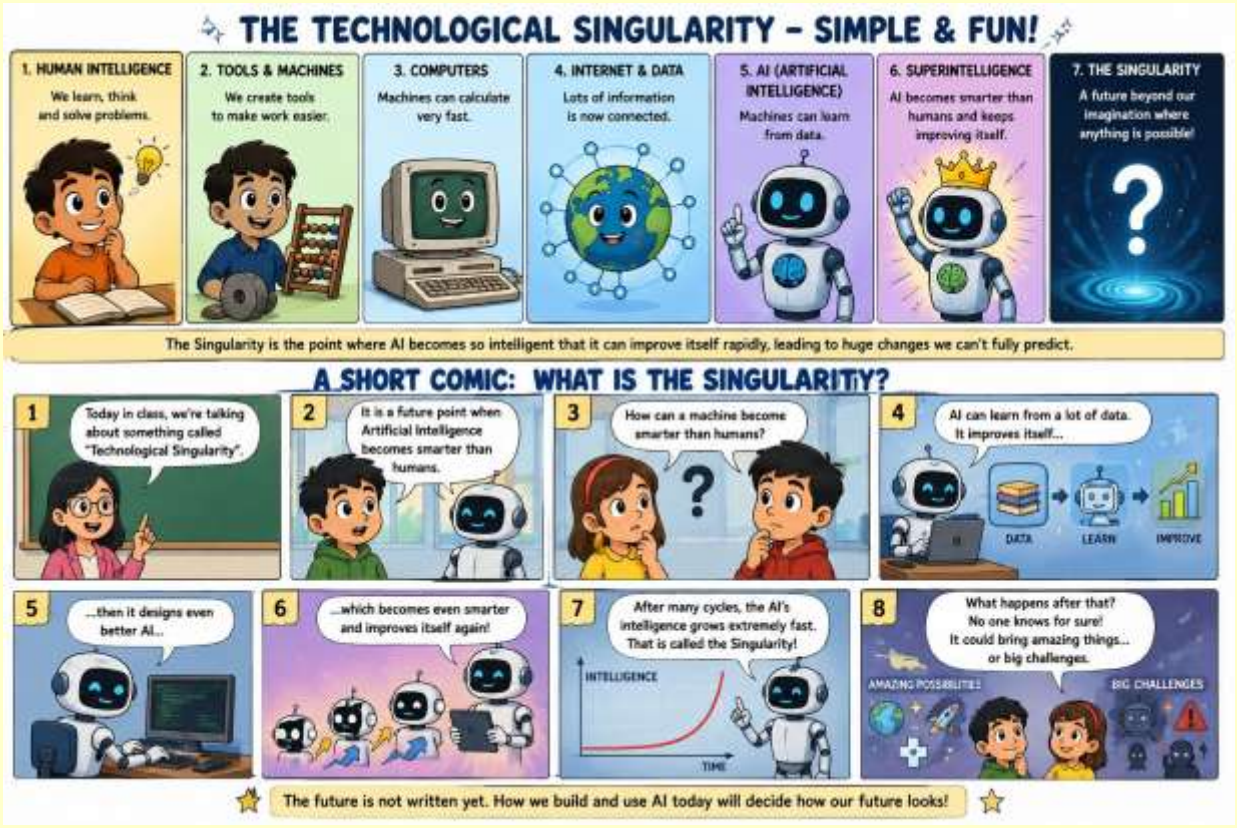
Stage	Level of AI	Time line	Characteristic	Examples	Current Status/ Analogy
1	Narrow Al (below human level)	Years: 1950 — 2020	Task-specific Al, No general reasoning, No self-improvement	Chess engines, Image recognition, Early ML systems Status: Completed ll	Completed Human intelligence = walking Early Al = bicycle.
2	Advanced Narrow Al / Pre- AGI	Years 2028 — 2032	Al performs any intellectual task a human can	This is NOT the Singularity. Growth is still under-standable	Some labs estimate early 2030s Current AI = car
3	Recursive Self-Improvement Begins,	Years: 2032 — 2040	Al improves: Its own algorithms, training efficiency, hardware utilization,	exceeds human ability to predict or control	AGI = rocket
4	True Singularity point	Years ~2045 and beyond	Models fail, and planning becomes unreliable.	Human institutions face catastrophe	Singularity = rocket that designs better rockets while flying
5	Post-Singularity	Beyond ~2050, the vertical rise of the curve	Al aligned & cooperative, dominant	Al indifferent to humanity, Singularity never stabilises	(unknown state)

In short, today's AI is like an infant who is neither self-aware nor autonomous goal-setters, cannot independently redesign themselves and not generally intelligent. They are powerful tools but not independent intelligences.

But AGI will be better than humans at AI researching itself, improving its own architecture, algorithms, and hardware use. Each improvement makes the next improvement faster intelligence grows exponentially, not linearly.

Singularity poses great challenges to humanity as AI will have no emotions and ethics that modify and control human behavior. Therefore, there is a considerable discussion on regulating the development of AI from reaching the singularity. But can anybody stop the development of technology like Atom Bomb which threatens the existence of humans!!!

Continuing the AI articles, next article will be 'Introduction to HI & AI' which will discuss 'What is Human Intelligence (HI). Some of the key terminologies used in AI will also be briefly explained.



Activity by P. K. Joshi

Body temperature is used by medial professionals for detecting the condition of our health. It is believed that our body temperature is 98.6 °F or 37 °C. But is it always the same.

As a student of science do the following activity. Get a thermometer used to measure the temperature of humans by doctors or nurses.

1 . Ask your parents the technique to measure body temperature.

2 . Measure the temperature before it touches your body. Note down this temperature.

3 . Measure the temperature for 30 seconds. Reset it to lower value.

4 . Measure the body temperature for 60 seconds. Reset it to lower value.

5 . Measure the body temperature for 90 seconds. Reset it to a lower value

6 . Measure the body temperature for 120 seconds. Reset it to a lower value.

Continue with this activity, till you find the time, after which temperature does not increase

This is the time required by your thermometer to record body temperature.

7 , Keep this thermometer near your bed when you go to sleep. As soon as you get up in the morning, record the temperature for the time, decided in above steps. Then measure this temperature after bath, after lunch, one hour after lunch, after sports and just when you go to sleep. Are the numbers same?

8 . Identify a few people, from your family, friends, neighbours etc. at a fixed time of the day, measure their temperatures. Are they all same? You can send your numbers to Edureka or discuss with your teacher.

When you go to sleep, keep the thermometer (used by medical clinics) digital or normal, near your bed.

DON'T MISS IT

Coming up in Next issue (January-March 2025)

1. More about experiments
2. Student's corner
3. Teacher's page
4. Activity question AND MUCH MORE……

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