Housing Model for Mars

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ABSTRACT: *Earth's population is growing at a rapid speed, to the point where it becomes concerning that the* ***Carrying Capacity****of earth has been overcome. So it will be requiring to find out another planet alike earth to maintain carrying capacity. In present day, some scientists believe that in Mars environment is possible to create an ecosystem for human surviving.By the analysis of returned information from various robotic mission it is concludedthat Mars as,* ***The New Genesis of Life****.The success of such creativity would depend on the provide technology and material from Earth.*

Key Words: *Earth, Mars, Greenhouse effect.*

Introduction:

The only life we have encountered anywhere in the universe- **Is life on Earth**. Enlarging microorganisms, plants, & animals on earth from 4.0 billion year ago to tillour present day lived& diversified under a specific physical & environmental condition of Earth, where gravity of Earth plays a significant role.Every living thing survived under the common influences of Earth's gravity, atmosphere, radiation, temperature, surface pressure, and natural resources. Although there seems to be no life on Mars present day, there is considerable evidence, returned by various robotic mission, that early in the planet's history, liquid water habitats existed, and conditions may have been suitable for the origin of indigenous life. The desirable process to create an ecosystem on Mars environment alike Earth, is scientifically termed as Terraforming. Terraforming of a planet is the hypothetical process of deliberately modifying its atmosphere, temperature, surface topography or ecology to be similar to the environment of earth to make it habitable by Earth-like life. Concept of terraforming developed from science fiction & actual science.

The Aim & Objective: The objectives of present paper is to give an idea to make Mars habitable, by depicting aprobable housing model on Mars, for starting the succession process.

Data base & methodology: The data used in the paper is secondary data collected from different website, and articles. For the present study, the relevant diagram was created by using Microsoft word, Photoshop and blender 3d.

Identity of Mars:

The fourth planet from the sun and the second-smallest planet in the solar system, after Mercury Mars is a dusty, cold, desert world with a very thin atmosphere. The rotational period and seasonal cycles of mars likewise similar to those of Earth. Mars is approximately half the diameter of earth, having about 15% of Earth's volume, 11% of Earth's mass, and 38% of Earth's surface gravity.This planet has seasons, polar ice caps, extinct volcanoes (**Olympus mons**, the largest volcano and second-highest known mountain in the solar system), canyons (**Valles Marineris**, one of the largest canyons in the solar system), basin (**Utopia planitia** is the largest recognized impact basin on Mars and in the solar system). Mars is the owner of the largest **dust storms** in the solar system. Some general information of Mars is given below.

Planet	:	Mars
Planet type	:	Terrestrial
Nick name	:	Red planet
Naming	:	1. Mars: After the roman god of war 2. Red planet: Due to reddish iron oxide prevalent on its surface
Distance from	:	1. Sun: 227,940,000 km. 2. Earth: Minimum: 54.6 million km. Farthest: 401 million km. Average: 225 million km.
Length of day	:	24 hours 39 minute
Length of year	:	687 earth days
Moons	:	2 (Phobos & Deimos)

Comparison of Orbital parameters between Earth & Mars:

Property	**Mars**	**Earth**
Aphelion	249 200 000 km	152 100 000 km
Perihelion	206 700 000 km	147 095 000 km
Semi-major axis	227 939 200 km	149 598 023 km
Inclination	1.850° to ecliptic; 5.65° to Sun's equator; 1.67° to invariable plane	7.155° to the Sun's equator; 1.578 69° to invariable plane; 0.000 05° to J2000 ecliptic
Eccentricity	0.0934	0.016 7086
Gravity	3.720 76 m/s^2	9.807 m/s^2
Density	3.9335g/cm^3	5.514g/cm^3
Mean radius	3 389.5±0.2 km	6 371.0km
Mass	6.4171×10^{23} kg	5.972 37×10^{24}kg

Present biological condition of Mars:

1.Atmosphere:

Constituent	Colour	Pressure	Re-distribution	Absorb
↓	↓	↓	↓	↓
N_2, Ar, CO_2, O_2, CO	Orange brown	6 milibar	Sun light	Temperature

Constituent: Very thin atmosphere of Mars is dominated mainly by carbon dioxide. In addition, the atmosphere also contains argon, trace amount of water vapour (0.1%), nitrogen, trace amount of free oxygen, trace amount of methane (**Figure 1**).As Ozone layer absent on atmosphere, ultraviolet rays directly reaches the soil unhindered.**Colour:**The atmosphere is quite dusty, giving orange red colour, due to reddish iron oxide prevalent on its surface.

Atmospheric pressure: The atmospheric pressure of Martian surface average 6 milibar, about 0.6% of earth's mean sea level pressure of 1.013 bar. Observed value by Viking 1 was 0.69 kpa to 0.9 kpa. Martian atmospheric pressure is well below the **Armstrong limit** for the unprotected human body.

Temperature: Average temperature on Mars being -63°C. Surface temperature may reach up to +35°C and lowest temperature is -143°C (**Figure 2**). Measurement by Viking lander site, the temperature range was -17°C to -107°C. The highest temperature estimated by the Viking Orbiter was 27°C. The NASA'S Spirit rover recorded a maximum daytime air temperature in the shade of 35°C, but regularly recorded temperature well below above 0°C.

Wind and dust: Due to low atmospheric density loads produced by wind will be very low. Dust carried by wind changes the quantity of sunlight, and it decrease the distribution of sunligh radiation. On mars atmosphere, finer materials than Martian soil, the fraction which is less than 30 micrometres in diameter are known to as dust.

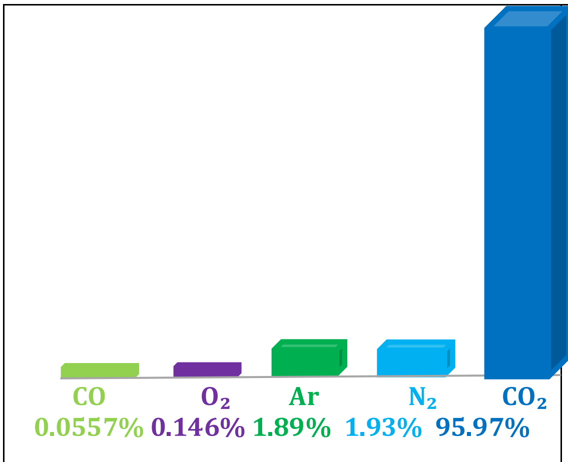

Figure 1: Atmosphere constituent of Mars

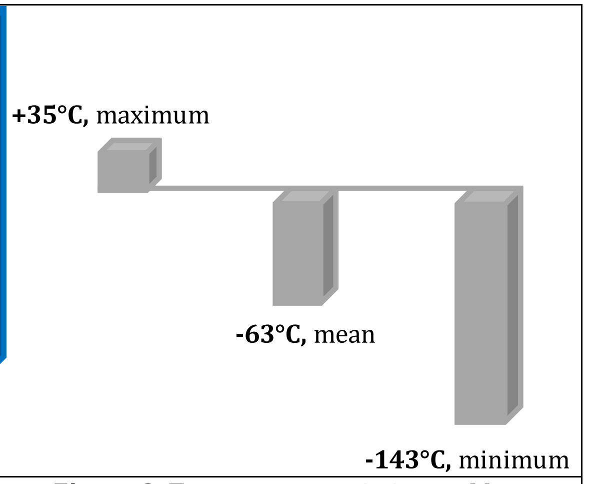

Figure 2: Temperature variation on Mars

2.Light: Light, the most vital and essential abiotic physical factors without which no life exists, depends on the synthesis of food by green plants, which in turn supports all living beings.In Mars atmosphere has no ozone layer. Thereby directly UV fluxes are much higher on the Mars surface. And for the thin atmosphere sufficient solar energy is not utilized, and therefore temperature is fall in low and makes the Mars as uninhabitable zone.Although light levels on Mars are enough to tolerate plant growth.

3.Soil: "The specialized name for the shallow upper layer of the land-surface of the Earth, which by weathering of underlying rocks, intimate association with organic matter and with living organisms has becomes a suitable habitat for plants and animal"(*Allee, Park and Park*, 1965).

In case of earth, the basic components of soil are minerals, organic matter, water and air. Earth's typical soil consists of approximately 45% mineral, 5% organic matter, 20-30% water, and 20-30% air. In contrast Martian soil is the fine fraction ofregolith (Regolith is a layer of loose, heterogeneous superficial deposits covering soil rock, includes dust, soil, broken rock etc. found in earth, moon, mars and other terrestrial planets and moons). Returned information fromphoenix lander(examined on Arctic's ice-rich soil in 2008) showed that, Martian soil is toxic due to the presence of perchlorates, and also showed that soil is slightly alkaline and containing elements such as magnesium, sodium, potassium, chlorine, and the basic pH is of 7.7. Curiosity rover, on February 10, 2013, obtained the first deep rock samples ever taken from another planetary body. It also discovered that Mars's soil contains between 1.5% to 3% water by mass.

4.Magnetic field: Earth's magnetic field which extends from the Earth's interior out into space, deflects most of the solar wind and protects the Earth from harmful UV-rays. Unlike earth, Mars has no inner dynamo to create a major global magnetic field. The magnetosphere of Mars is far simpler and less extensive than of the Earth.

5.Surface geology: Alike EarthMars is terrestrial planet consists of mineral, and containssilicon, oxygen, metals and other elements. Mars surface is composed of **tholeiitic basalt**. Large surface of this planet is covered by iron oxide, and thus gave red brown colour.

List of somereturned information from Mars:

Spacecraft		Returned information
Mariner 4	:	Performs the first successful flyby of the planet mars, returning the first close-up pictures of the Martian surface.
Mariner 9	:	Its cameras were the first to capture the gamut of Martian geology. It captured Mars polar caps, the vast Valles Marineris canyon and the Martian moons. It also discovered that water had flowed on the planet in the ancient past.
Spirit	:	Found extensive evidence of carbonate and hematite, minerals that are associated with water environments.
Opportunity	:	Find the presence of standing water on Mars for long periods. The rover uncovered the presence of hematite, gypsum and other rocks on Mars.
Curiosity	:	Uncovered the existences of methane.
Insight lander	:	Recorded the sound of wind flow.

List of operational mission, present on Mars:

Spacecraft	**Launch date**	**Mission**	**Carrier rocket**
Mars Odyssey	7.4.2001	Orbiter	Delta II 7925
Mars express	2.6.2003	Orbiter	Soyuz-FG/Fregat
Mars Reconnaissance Orbiter	12.8.2005	Orbiter	Atlas V 401
Curiosity	26.11.2011	Rover	Atlas V 541
MAVEN	18.11.2013	Orbiter	Atlas V 401
ExoMars Trace Gas Orbiter	14.3.2016	Orbiter	Proton-M/Briz-M
Insight and MarCO	5.5.2018	Lander and 2 Cubesats flyby	Atlas V 401

Housing Model for Mars:

Life and environment are interdependent. The plant and living creature is affected by various environmental factors and in return they modify their environment in various ways. To prepare the Mars for human exploration, it is essential to create an environment artificially on Mars at first. As open environment system is not possible, therefore establishment of a protected housing model is essential (figure 3).

Figure 3: Probable Housing model for Mars

Description of model (figure 4**):**

1. **UV-protected cover:** As there is no ozone layer on atmosphere, UV-ray will directly damage the developmental process occur inside the colony. Therefore, to overcome the harmful effect of UV-radiation, use of UV-protected cover is mandatory.
2. **Pressure controlling device:** As Martian atmospheric pressure is well below the Armstrong limit, for the purpose of maintain the pressure for developmental activity, artificial Pressure controlling device essential.
3. **Circulation pathway:** To maintain the equilibrium of air constituent, pressure, temperature it is essential to interconnect each compartment with other.
4. **Door:** Door construction is essential for input, output purpose.

❖ Measurement of each compartment is not specific. They will small for the purpose of research activities, and large for start succession.

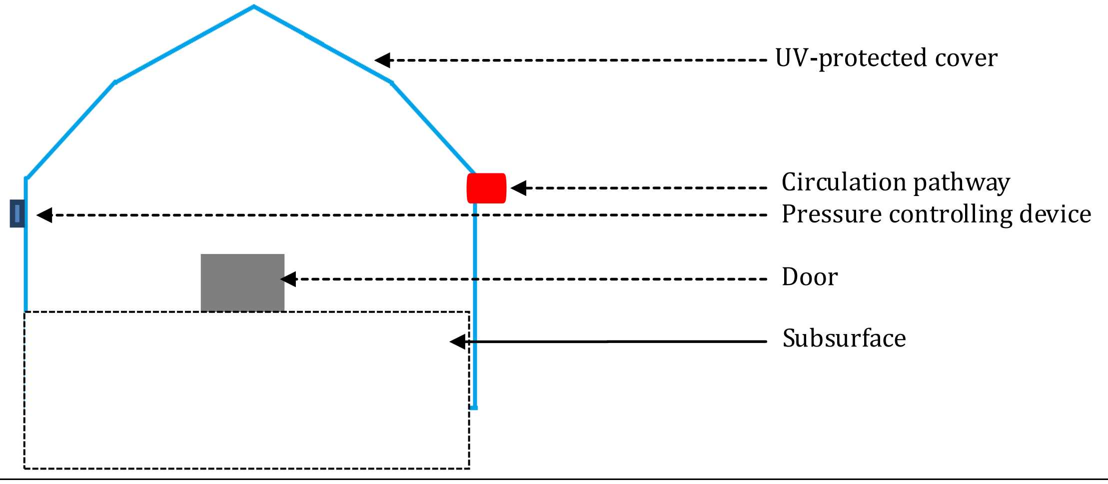

Figure 4: Diagrammatic sketch of each compartment

Due to low environmental temperature, the **Greenhouse effect** is the main elements responsible for the maintenance of global heat budgets at a nearly steady value. In case of earth, various greenhouse gases act as glass panes that maintain the heat budget (figure 5). In contrast, on Mars due to absence of similar gases it is essential to construct greenhouses (figure 6).

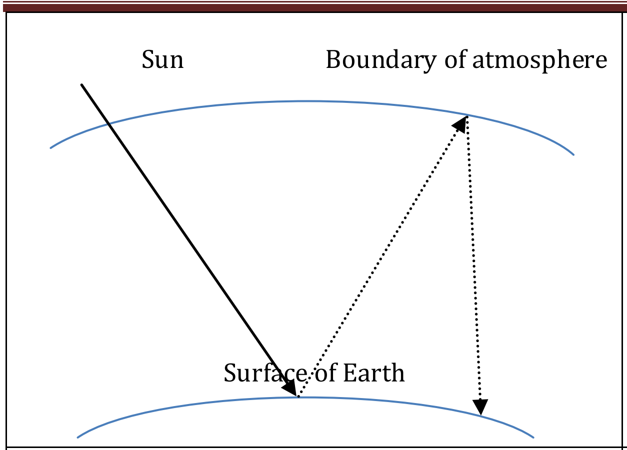

Figure 5: Greenhouse gases act as glass panes on Earth

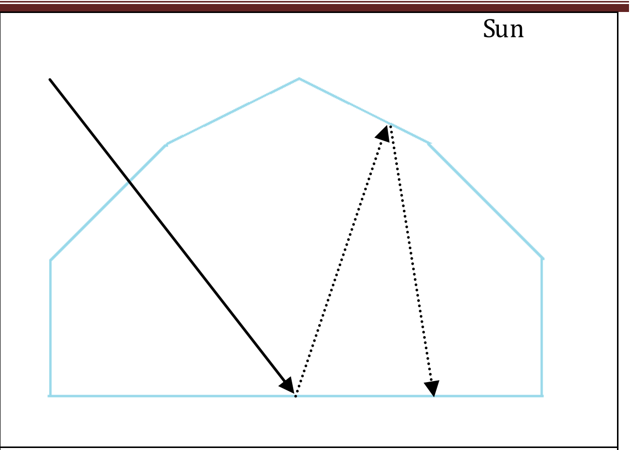

Figure 6: UV-protected cover, that will act as glass pane on Mars

Since biological systems are probabilistic; the presented models activity is probabilistic.

For surviving of living organisms; ecosystem development is necessary."The basic functional unit of ecology in which both biotic communities and abiotic environment influences each other, is called ecosystem" (Odum,1963).Basic requirements of an ecosystem are, **1.** Inorganic nutrients (CO_2, N_2, H_2O), **2.** Producers (plants), **3.** Decomposes (bacteria and fungi), **4.** Sun.

Essential artificial activity within the presented housing model: 1) Artificial input of polar ice on colonized area. **2)** Artificial transfer of Ammonia is essential to serve as nitrogen source. **3)**Creation of favourable ecosystem on each ground. **4)**Transmission of *Pseudomonas aeruginosa*.

Polar ice will give sufficient water when compartment's temperature will increase. Nitrogen; will make that area lightly favourable.For surviving of *Pseudomonas aeruginosa,* minimum favourable ecosystem creation is necessary. *Pseudomonas aeruginosa,* a very common type of bacteria grows in zero gravity and in low nutrient environment, experiment performed by **NASA's** scientists. Microorganisms has ability to adapt with respect to physical and chemical condition, play the major role in various biogeochemical cycle, such as carbon cycle nitrogen cycle, sulphur cycle, etc.

Illustration of biological activity in each compartment:

1. Setup the housing model.
2. Specific amount of ice pieces can be set in each compartment.
3. Due to imputation of sunlight through UV-protected cover temperature will rise at a rate.
4. Melting of ice will occur, that will give free water. Water also reacts with CO_2, that will form H_2CO_3.
5. To create artificial ecosystem in each compartment, it is necessary to use basic requirement of an ecosystem.
6. Transfer of *Pseudomonas aeruginosa*. As Mars gravity is 3.711 m/s^2so it will support the growth of *Pseudomonas aeruginosa.*
7. In that ecosystem they will grow and survive and start breeding.
8. After completing few generation, they will form colony. Populations will overcome the Carrying capacity, and death of bacteria will occur.
9. Death and decay matters will accumulate on soil, and release their own cell constituent.
10. As physical and environmental condition of compartments are not likely Earth's own natural factors, bacterial body composition and activity will change in respect to that environment.
11. Death products apart into smaller micro molecules into soil.
12. Artificial Input of Ammonia for Nitrogen.
13. H_2CO_3 will mix with rocky material of soil and loose rock particles, which then mixed with decay bacterial body and make soil more favourable (Reaction=H_2O + decaying material + Martiansoil + H_2CO_3 = more suitable soil).
14. As bacteria will grow in respect to gravity and other environmental factors Genetic variation will occur, and amino acids constituent will change in respect to Mars gravity.
15. Then transfer of other microorganisms will occur, sequentially based on complexity of cell structure.
16. After passing certain generation transfer of C3 plants will occur, that are anaerobic, and will fix carbon.
17. And finally step by step each compartment will fill up with population. And make the zone for starting the food chain.

Model organism for testing the environment: Common **fruit fly,** can be used as model organism for testing the environmental condition when research activity will complete. Charles W. Woodworth's (American entomologist,1865-1940) was the first person to breed the model organism designated fruit fly (*Drosophila melanogaster*) in captivity and to suggest to early genetic researchers at Harvard its use for scientific research. Thomas Hunt Morgan's (American evolutionary biologist, geneticist, embryologist, 1866-1945) **Nobel Prize biography** says that Woodworth suggested to William E. Castle that Drosophila might be used for genetically work.

Conclusion:

Model work has been an attempt to making Martinatmosphereinhabitable, by a housing model. But the major problem is gravitational force of Mars, which is incredible to overcome through this model. By this paper's model some problem will overcome, such as (1) Protection from UV-ray; (2) Protection from hazardous and dusty environment; (3) Overcome the problem of low temperature; (4) Reduce the CO_2 level from 95.97% by using C3 plants.It is possible to study the mars clearly with suitable model to make it habitable, but further investigation by advanced rover is essential.

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Reference:

1. Christopher P. McKay, Owen B. Toon and James F. Kasting, Making Mars habitable.
2. R.A. Bucklin, P.A. Fowler, V.Y. Rygalov, R.M. Wheeler, Y. Mu, I. Hublitz and E.G. Wilkerson. Greenhouse Design for the Mars environment: Development of a prototype, Deployable Dome.
3. Stinner, A., & Begoray, J. (2005). Journey to Mars: The Physics of Travelling to The Red Planet. Physics Education, 40(1), 35.
4. Mission to mars, www document, Accessed on 9 January 2019, (www.planeraty .org)
5. https://en.m.wikipedia.org/wiki/Terraforming
6. https://en.m.wikipedia.org/wiki/Mars
7. https://nssdc.gsfc.nasa.gov/planetary/mars/mariner.html
8. https://www.space.com/18439-mariner-9.html
9. https://www.space.com/37402-mars-life-soil-toxic-perchlorates-radiation.html
10. http://www.space.dtu.dk/english/Research/Universe_and_Solar_System/magnetic_field
11. https://en.wikipedia.org/wiki/Charles_W._Woodworth
12. https://en.wikipedia.org/wiki/Thomas_Hunt_Morgan
13. https://www.nasa.gov/centers/ames/news/2013/bacteria-sent-into-space.html
14. https://www.jpl.nasa.gov/missions/mars-science-laboratory-curiosity-rover-msl/
15. https://www.jpl.nasa.gov/missions/insight/
16. https://www.jpl.nasa.gov/missions/mars-exploration-rover-spirit-mer-spirit/
17. https://www.jpl.nasa.gov/missions/viking-1/
18. https://www.jpl.nasa.gov/missions/viking-2/