



## Microbes-Dangerously Diverse Life on the Globe

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Microbes are full of diversity with respect to habitat, salt survival ability, temperature tolerance, acid and alkali tolerance, pressure and water stress etc. The metabolism of the microbes is also diverse from heterotrophic to autotrophic and chemolithotrophic. The diversity in metabolism has given them the adaptability to endure extreme environments. The adaptability gave to flourish in certain ecosystems. The extreme diversity is presented to readers in the form of a quiz to the readers. The drama would give the gist of the diversity in microbes.

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It was a bright, cheerful and sunny morning in the last week of March, at the Lonar Crater, a saline soda lake located at Lonar village in Buldhana district, Maharashtra, India. It is a lake renowned for very high alkalinity (pH: 11-12). It served as an ideal place for meetings, because of the serene and peaceful settings, away from the hustle and bustle of human. The place suited as an ideal destination for conferences of micro-organisms, as it served host to a huge population of microbes, with the moist rocks and tree barks. At the centre of a rock in the crater, amidst the lush green water millions of microbes (including species of salt-loving *Halomonas*, hypergravity passionate *Paracoccus*, sticky *Klebsiella*, the fastidious *Slackia*, the multispore producer *Actinopolyspora*, alkali loving *Alkalimonas*, the all-rounder *Pseudomonas*, universally-occurring *Bacillus*, low-water survivor *Methylophaga*, phototropic, brightly-pigmented & single tailed *Rhodobaca*, deep sea diver & high temperature survivor *Idiomarina*, etc) were cheerfully awaiting the great host of the Microbe's Quiz Time (MQT) programme. Beautiful and bright green colored Cyanobacteria, the *Arthrospira* species were standing at the edge of the rock reclining on their elbows of long green filaments. The ambiance on that rock was colorful and jovial.

Indeed the main attraction of the MQT programme was the most graceful host "*Penicillium notatum*", the first fungus ever recorded in the history of Microbiology heralding the era of Antibiotics, starting with Penicillin. Thanks to Dr. Alexander Fleming (1928-London), who identified the potential of microbes, and later a large number of antibiotics were discovered improving the

lives of humans. A "*P. notatum*" strain arrived today at Lonar crater from London for this event. *P. notatum* was charmingly sitting on the lowest twig near the rock facing the huge audience of microbes. And today on the hot-seat was the most versatile gram-negative, bacillary shaped, full body flagellated and any organic matter degrading bacteria called *Pseudomonas aeruginosa*.

The *P. notatum* composed its broom shaped filaments holding spores behind it, away from the audience gaze, and addressed the crowd and *P. aeruginosa*.

- ***P. notatum*:** (With a delighted and commanding voice) My dear microbes, it is my great pleasure to be here at this pristine location to conduct the final round of "MQT". I congratulate "*P. aeruginosa*" for reaching this final round. It gives me pleasure to inform that this show is sponsored by "MyNutrient Agar", "Lactodrinks INC", "Real-alki-juice", "Micro-TSA-Chips", "tangy flavoured sab-chips", and "Sacharodairy". The winner microbe will receive Nutrient gift hampers for one year from all these sponsors.
- ***P. notatum*:** *P. aeruginosa* shall we begin?
- ***P. aeruginosa*:** Hello Sir, *P. notatum* it is my privilege to be with you on this most popular show, The MQT. Sir, you are an inspiration for our microbial community. You have taught us how to be useful to others. As a family not only you produce penicillin but your ~350 cosmopolite cousins are also useful in making cheese, wine industry, manufacture of hydrolytic enzymes & organic acids, and nanoparticle biosynthesis etc. Yes we can begin.

- **P. notatum:** *P. aeruginosa* you seem to have done good homework, Thank you! But nevertheless I must confess that some of my cousins produce powerful mycotoxins which are dangerous to animals and human. OK, here is my first question:

“What terms are used to describe microbes which grow best at temperatures of 80°C or more?” you have 30 seconds to answer and you have only one chance.

- **P. aeruginosa:** (With smile) they are called ‘Hyperthermophile’.
- **P. notatum:** Absolutely correct, wise microbe. You get 5 points. Congratulations for the great start. (A big applause in the audience)

To share more, Hyperthermophiles are present in water-containing volcanically and geothermally heated environments. Several hyperthermophiles exhibit growth at temperatures exceeding 100°C at an increased boiling point of water. *Pyrodicticum occultum*, *Pyrolobus fumarii*, *Mythanopyrus kandleri* can grow even at 110°C, 113°C and 110°C respectively. *Bacillus stearothermophilus* spores can withstand 121°C for up to 12 min, and this has made the organism ideal for testing autoclaves that run on a time-temperature cycle designed to ensure destruction of spores. Let’s go to the next question.

“Which microbe lives at 60-95°C, is related to methane generation, is isolated from oil wells and vents, and uses perchlorate (rocket fuel) to breathe”.

- **P. aeruginosa:** (Nervously) Is it *Archaeoglobus* species?
- **P. notatum:** May I consider it as your final answer? I am afraid I need the complete name including the species.
- **P. aeruginosa:** (pauses for few seconds) It is *Archaeoglobus fulgidus*.
- **P. notatum:** (claps) well done friend. You get 10 points for this. (A loud round of cheer and applaud in the audience). *A. fulgidus* is a sulphur-eating bacteria and grows in an oxygen free environment. (*P. aeruginosa* raised all its body flagella to salute and accept the appreciation)
- **P. notatum:** Now my friend, the next question is for 20 points.

“Which microbe is found in environments that are constantly cold and have an optimum growth temp of 15°C or lower?”

- **P. aeruginosa:** (Cheerfully and with confidence) They are called “Psychrophile” sir.
- **P. notatum:** (with applause) perfect answer my friend! Your total points are 35. I like your confidence. Infact the lowest temperature limit for life seems to be around -20°C, which is the value reported for bacteria living in permafrost soil and sea ice. Some examples of microbes thriving in such areas at temperatures ranging from -20°C to +10°C are your cousins, *Pseudomonas* spp., and species of *Vibrio*, *Cytophaga*, *Flavobacterium*, Bacteriodes, *Coryneforms*, *Arthrobacter* and *Micrococcus*. Some cyanobacteria such as *Oscillatoria*, *Phormidium* and *Nostoc commune* are dominant in most of the Antarctic habitats. Enzymes of such psychrophiles and thermophiles are very useful to humans.
- **P. aeruginosa:** Wow, thank you for this additional information. We microbes are truly diverse in our habitats and flexible in adapting to various environments.
- **P. notatum:** Yes *Pseudomonas* very true. With this let me ask you the next question, for 40 points.

“What is the name of a unique group of microbes which includes both *Shewanella benthica*, and *Moritella marinus*?”

- **P. aeruginosa:** Hmm... this is a tough one sir. From the name it seems to be found in the deep sea.
- **P. notatum:** Good going on. You have 21 seconds left.
- **P. aeruginosa:** Thank you. To the best of my knowledge this group is called ‘Extremely Barophilic Bacteria’. (Still has a curious face)
- **P. notatum:** Excellent my friend. You win 40 points (Thunderous applause from the audience). Extreme barophiles are those bacteria found deep in the sea sediments and can tolerate pressure equivalent to 500 to 990 atmospheric pressure. We are at one atmospheric pressure today here at Lonar. Scientists have been studying these very creatively. Now “*P. aeruginosa*” your points are 75, it’s time for the rapid fire round. In total 30 seconds you have to give correct answers for 5 questions to win. Are you ready?
- **P. aeruginosa:** I am feeling good sir. Let’s start the rapid fire round.
- **P. notatum:** Your time starts now.

“At which pH range do the most extremophilic alkaliphilic microbes grow?”

- **P. aeruginosa:** pH 12-13.
- **P. notatum:** Correct.

"NASA astronauts successfully sequenced the DNA of microbes found aboard the International Space Station, and this was the first time that unknown organisms were sequenced and identified entirely in space. Can you name those microbes?"

- ***P. aeruginosa***: (takes a pause, audience is in stunned silence) *Staphylococcus capitis* and *Staphylococcus hominis*.
- ***P. notatum***: Perfect.

"What is the name of the microbe from space named after Dr. Abdul Kalam by NASA"

- ***P. aeruginosa***: *Solibacillus kalamii*, spore forming bacteria.
- ***P. notatum***: Absolutely right.

"For which type of microbes is The Norris Geyser Basin, a solfatara field in Yellowstone National Park famous for?"

- ***P. aeruginosa***: Extreme acid-loving (growing even at pH 2.6) and extreme thermophiles
- ***P. notatum***: Wonderful and clear answer.

"Give an example of oligotrophic – The microbe which grows at very low nutrient conditions."

- ***P. aeruginosa***: *Staphylococcus sapro*, *Caulobacter* spp.
- ***P. notatum***: Great. You have created history in this MQT programme. Hearty congratulations for your all correct answers. You are the winner of this MQT.

(All microbes in the audience cheered the winner with a loud applause).

- ***P. aeruginosa***: Sir, I am overwhelmed with this. Its proud feeling to accept this MQT-cup-2019 and gift hampers from you. I am feeling proud to accept this MQT-Cup-2019 and gift hampers from you. Feeling privileged to belong to the microbes community that can tolerate all extreme environments across the globe.

*P. aeruginosa*, *P. notatum*, and all other microbes in the audience raised their flagella, pili and spore chains cheering and clapping enthusiastically.



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