A World within a World: The Rise of Prokaryotes

The majority of the living spectrum of the Earth is unseen. Microscopic bacteria and archaea far outnumber large, macroscopic creatures like ourselves. The Earth really belongs to these creatures, and they have adapted to almost every imaginable habitat.

PRACTICAL SCIENCE WITH PHIL FREDA

In one of my previous articles, we explored the magnificent and wonderful world of plants. In the article, I explained that all animals, including ourselves, are dependent on plants for survival. But what do plants depend on? Where exactly does the food web start?

The most important organisms on the Earth are microscopic! Bacteria and their close relatives thearchaea are the "roots" of the tree of life.
Our evolutionary lineage and the entire food web began with them.

Prokaryotes vs. eukaryotes

You might remember these terms from biology class.

Both bacteria and archaea belong to the Super Kingdom known as Prokarya. All other life including plants, animals, fungi, and protozoa belong to the domain of Eukarya.
The prime difference between these two groups is the appearance of a membrane bound nucleus. We humans are an example of eukaryotes. In every single one of our trillions of cells (except red blood cells), we have a nucleus inside that houses all of our genetic material.

In prokaryotes, however, the genetic material sort of floats around inside of their cells. They do not have a nucleus.

Another minor difference is that most, but not all, eukaryotes are multicellular. This means that the organism is made up of many cells.

In contrast, all prokaryotes are unicellular, which means that the organism, as a whole, only consists of a single cell.

Both bacteria and archaea reproduce through a process called binary fission for the most part. This means that the cells grow to a certain size and literally split into two new cells. Some strains of *E. coli* can reproduce in less than 20 minutes.

Bacteria

Bacteria are the most numerous organisms on the planet.

According to an article on Science A GoGo, the current estimate of the amount of bacteria on the Earth is about 5x10^30.
That's five times 10 to the 30th power, or a **five with 30 zeros** after it!

The article elaborates that if you were to represent each bacterium on the Earth using a penny and stacked them one on top of each other, the stack would be about a trillion light years long!

In case you were wondering, **one** light year is the equivalent of about 6 trillion miles. Furthermore, if you were to put these pennies in a sack, it would have to be the size of the moon (its volume, not just its surface area).

Most people think all bacteria are disease-causers and a nuisance, but that couldn't be farther from the truth.

Bacteria are essential in producing vaccines, important industrial chemicals and food.(Yogurt and cheese are good examples.) In addition, bacteria are very important in the areas of public health, sanitation and bio-remediation (recycling of waste through microorganisms).
It is true that bacteria do cause disease, but the vast majority are actually quite beneficial.

Bacteria form symbiotic relationships with many plants, animals, and even humans. Many different kinds of bacteria live in your gut and aid in food digestion.
Bacteria form important symbiotic relationships with plants (specifically legumes) to provide nitrogen to the plant. In return, the plant provides sugars to the bacteria.
One of the most important roles of bacteria, though, is recycling. When plants and animals die, the organic material must be broken down and reabsorbed into the biosphere. Bacteria fill the majority of this role.

Bacteria are found in almost every habitat on Earth and on almost every square inch of surface.

Bacteria have also mastered many different metabolic techniques like photosynthesis. In fact, present-day green plants owe the presences of their photosynthetic systems to their bacterial ancestors.

Archaea (extremophiles)

Even though the archaea are classified as prokaryotes, they are actually more closely related to eukaryotes than they are bacteria.

Archaea are commonly referred to as “extremophiles” because of their tendency to be found in extreme environments.
Archaea have been found living in the Dead Sea, Antarctica, on the sea floor, on and near geo-thermal vents, in noxious chemicals, in rock and even hot springs.

These prokaryotes have filled almost every imaginable niche on this planet.

In addition, these organisms can live on totally inorganic fuel sources and even in the absence of light and oxygen.

Archaea have been found living in temperatures well above 212 Fahrenheit (the boiling point of water) and also well below freezing. They have also been found in extremely acidic and basic solutions.

Not all archaea fall into the “extremophile” category. Almost on a daily basis, archaea are found living in normal temperatures and habitats.

Significance of the unseen

Even though these amazing creatures are invisible to the naked eye, it does not mean that they aren't important to us, the planet or the ecosystem. The food web is built on these organisms, and life would not be possible without them.

They have succeeded in conquering every possible habitat on the Earth and can out-reproduce any other living thing.

Even if facing starvation, bacteria can produce spores that can remain viable for hundreds of years.
These spores lay in wait for the right conditions to reanimate and grow once again.

It is even currently hypothesized that bacterial spores may be able to survive the rigors of space!

The next time you are alone in your house on a rainy day or lying in bed before sleep, take comfort in the fact that you are never really alone.

Think about it.