

# What are Haloarchaea?

## HALO - ARCHAEA

"Halo" means salt

"Archaea" means ancient

Haloarchaea are organisms of ancient origin that live in very salty environments

The microbes that the DasSarma Lab works on are here today, all over the world, and they are beautiful, extremely hardy, single-celled organisms that need **10 times more salt than you find in seawater** to survive. They live in places like the Great Salt Lake and the Dead Sea. They can be seen from the space station by NASA astronauts, who have photographed them. They are so tiny that **a million of them would fit on the tip of a pin.**



Through a combination of microbiology, genetics, genomics, bioinformatics, and transcriptomics, we have studied these novel microbes and how they adapt to challenging habitats. We are using them to understand how life exists in extreme environments on Earth, and **how and where life may exist elsewhere.** The purple pigment in its membrane is being used to look for "**biosignatures**" on planets outside our solar system ("**exoplanets**").

## BIO - SIGNATURE

"Bio" means life

"Signature" means a unique ID

A biosignature is a unique substance that helps us identify life forms

## EXO - PLANET

"Exo" means outside

A "planet" orbits a star

Exoplanets are planets in space outside of our solar system

# Why should we study haloarchaea?

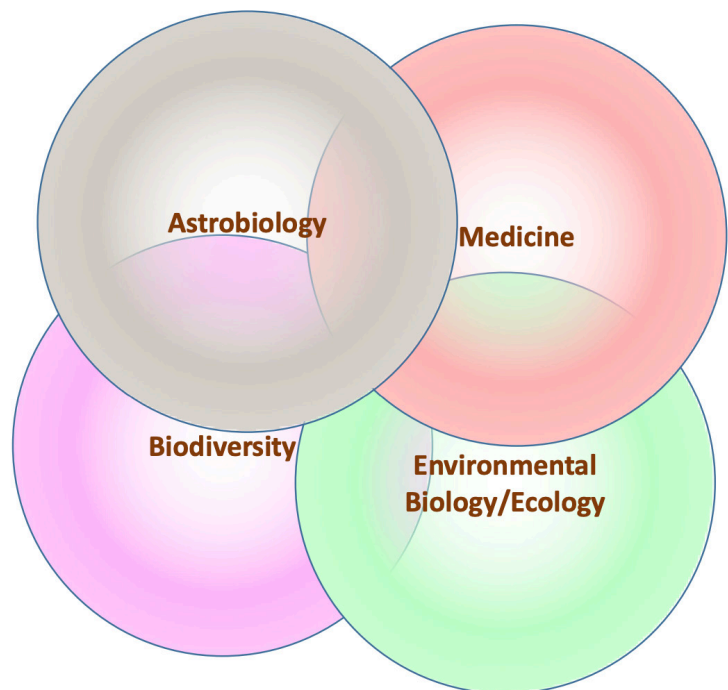
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The DasSarma Lab at IMET collaborates with scientists, educators and students all over the world. Some are in the high Andes in Bolivia. Others are in the beautiful State of Bangalore, India, and the Dead Sea.

Recently, we collaborated with students in Death Valley, California to send the microbes into the closest thing to a Mars-environment – up into Earth’s stratosphere. The students launched the microbes 30 to 35 kilometers , where the conditions are much like those on Mars—where rovers are currently searching for signs of past or present life.

Since the recent discovery of what are predicted to be highly salty seasonal flows on Mars, it is possible that this may be a perfect environment for these salt-loving organisms. The haloarchaea we study can tolerate and survive vast amounts of IR and UV radiation, low oxygen levels, and drying down in salt crystals. **These extreme conditions would kill almost every other forms of Earthlings, but not the salt-loving archaea.** They are members of an ancient kingdom that existed even before Earth had an oxygen atmosphere.

Halophilic microbes have many valuable qualities. They contain hearty enzymes which are used in many practical applications such as in detergents and food processing. They also contain nanoparticles that are being used for biomedical applications such as a vaccine against malaria. These are the two funded projects (from NASA and NIH) in the DasSarma laboratory.



# Was the Earth purple?



You can watch a PBS video on Purple Earth hypothesis by clicking the photo above or visiting [youtu.be/IIA-k\\_bBcL0](https://youtu.be/IIA-k_bBcL0)

Dr. DasSarma's Lab has hypothesized that the early earth may have appeared purple because of the presence of haloarchaea that produce a purple pigment. As we search for life in outer space, we may want to look for purple planets!

Name as many purple life forms you can in 30 seconds:

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Why do you think Earth is sometimes called the "pale blue dot"?

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Why are plants mainly green?

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Why is Mars sometimes called the "red planet"? What would you name a planet that was purple?

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What kind of life do you think you would see there?

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# Create your own extremophile!

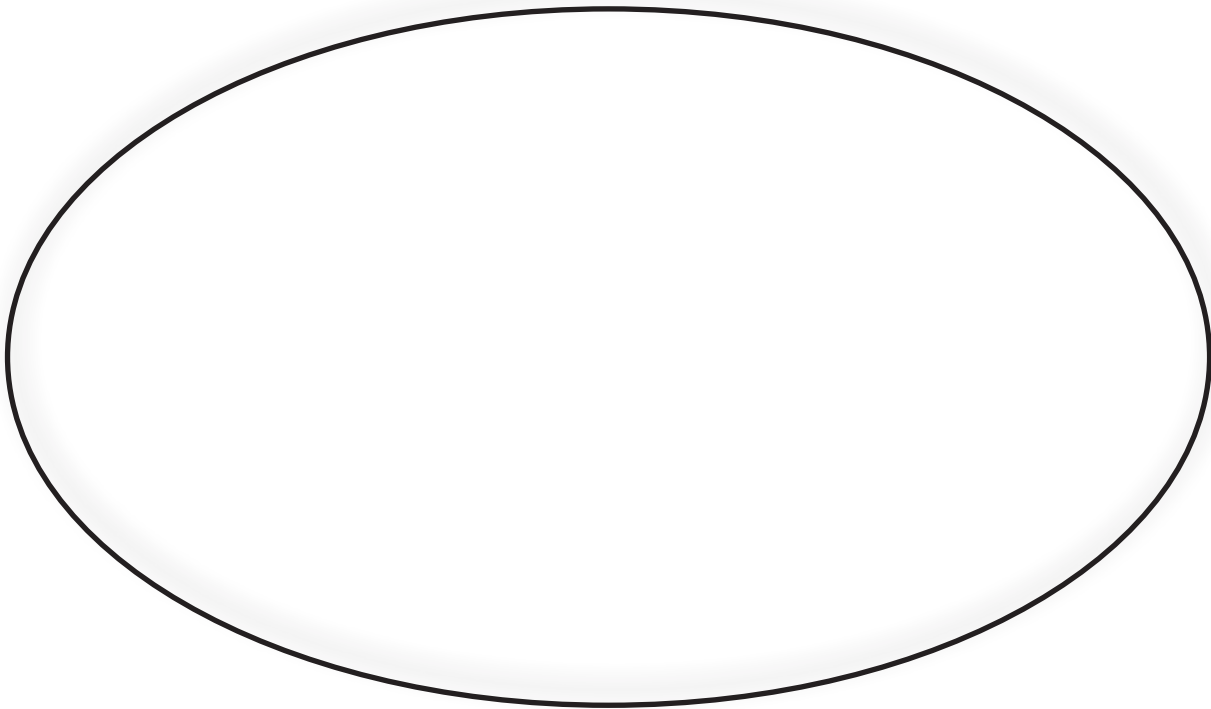
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Haloarchaea are one type of extremophile, life forms that live in unusual and extreme environments. They have amazing properties like surviving buried in rock salt as well as floating at the edge of space. They have enzymes that work in the cold and 'nanoparticles' useful for making vaccines.

Haloarchaea are able to survive a variety of extreme conditions, like:

- Extremely salty environments
- Very dry environments
- Ultra Violet (UV) and Ionizing Radiation (IR)
- Very cold temperatures
- Very warm temperatures
- Presence of toxins like arsenic and perchlorate

Draw your own extremophile and tell us how it can survive extreme conditions



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# Learn more with MolGenT

**MolGenT** is an electronic tutor for teaching and learning concepts in molecular genetics. There are sections on Inheritance, DNA & Genes, Gene Expression, and Biotechnology Applications.


**MolGenT: The Molecular Genetics Tutor**

Teaching Kits HaloWeb DasSarma Lab Donate

**About MolGenT**

MolGenT is an electronic tutor for teaching and learning concepts in molecular genetics. Materials are organized into four sections (see menu at left): Inheritance, DNA & Genes, Gene Expression, and Biotechnology Applications. Each section contains a series of video clips illustrating fundamental concepts in molecular genetics and its application, as well as a quiz on the concepts covered in the video. **MolGenT clips are designed to be experienced using an Android smartphone, PC, or Mac (using Chrome browser). Quizzes are designed for FireFox, Chrome, or Safari browsers.**

**Animal Viruses**



The image shows a screenshot of the MolGenT website. On the left is a vertical navigation menu with orange buttons for various topics: About MolGenT, Inheritance, Evolutionary Tree, Eukaryotic Cells (with sub-links for Cell Cycle, Mitosis, and Meiosis), Prokaryotic Cells (with sub-links for Binary Fission, Transformation, and Conjugation), Viruses (with sub-links for Bacteriophages, Transduction, and Animal Viruses), Model Organisms, and DNA & Genes. The main content area has a purple header and an orange background. It features a title 'About MolGenT', a paragraph of introductory text, and a section titled 'Animal Viruses' with a corresponding 3D diagram of a cell.

Click the image above or go to [halo.umbc.edu/molgent](http://halo.umbc.edu/molgent)