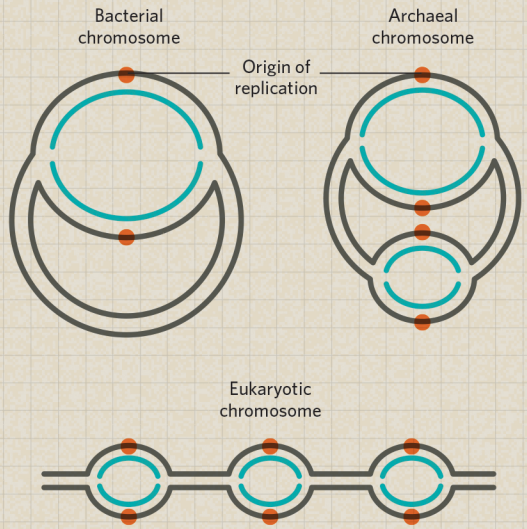
THE WILD BIOLOGY OF ARCHAEA

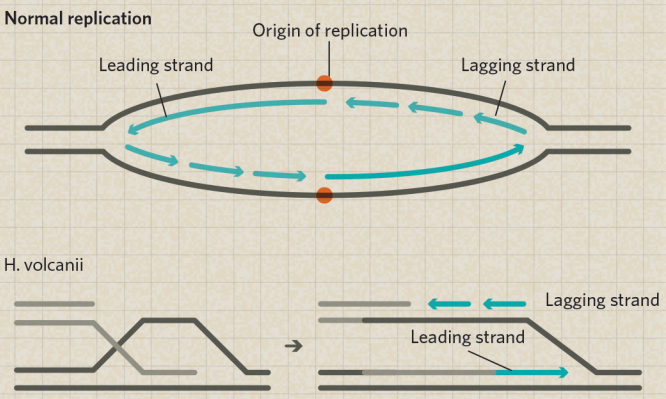
As researchers delve into archaeal biology, they are finding astonishing diversity, even among the most basic functions of life, such as how the microbes organize and copy their genomes, and how the cells divide. These observations stem from only a handful of species that can be cultured in the lab; there may be plenty more oddball examples of archaeal biology among the vast numbers of as-yet unculturables.

DNA Replication

Bacteria typically possess one chromosome with one origin of replication. Eukaryotes have multiple, paired chromosomes with numerous origins on each. Archaea straddle the divide: while they typically have one main chromosome, it often replicates from multiple origins.

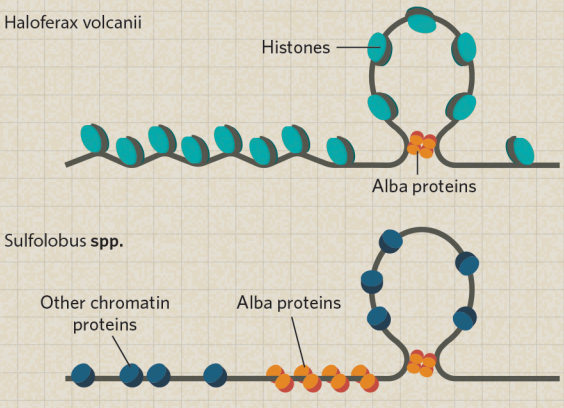


Some archaea also have the unique ability to adopt an alternate version of DNA replication initiation. Across all domains of life, DNA replication starts when initiation proteins bind the origin of replication; deleting the origins typically slows growth or halts cell division entirely. But in the archaeon *Haloferax volcanii*, deleting the origins causes faster growth. *H. volcanii* replicates its genome in a way similar to homologous recombination, in which two matching chromosomes swap strands to create a replication fork, though the details of this process are still being worked out (*Nature*, 503:544-47, 2013).



Genome Organization

Archaea can possess megaplasmids—hundreds of kilobases in size—that contain crucial genes. Some species are haploid like bacteria but many exhibit varying degrees of polyploidy. Many archaea use histones, as eukaryotes do, to organize their genomes, but some rely on alternative Alba proteins.



Modes of Cell Division

Some archaea divide via a mechanism similar to that of bacteria, using the cytoskeleton-like protein FtsZ to form a ring at the eventual division site (left). Others use homologs of eukaryote proteins, such as ESCRTs, to help separate daughter cells (right). Still others lack both of those systems, so they presumably have a distinct, as-yet-unknown mechanism, possibly relying on a form of actin.