Pierce Jackson
Bodewits
Astrobiology – Essay 2

What is the Minimum Size of a Cell?

I believe the minimum size of a "free-living" cell must be around 200nm in diameter. To further investigate the question of 'what is the minimum size of a cell,' we will first need to determine what constitutes a cell and what the minimum requirements are for the cell to function. A cell is commonly defined as the smallest component of 'life.' To quote the text, "Cells are the packages that hold life together… In biology, the cell refers to the structure that encloses the apparatus that allows for the growth and reproduction of organisms." Continuing, Cockell describes the three basic components essential for an organism to function, "(i) a membrane to hold the cell contents in, (ii) an information storage system to direct molecular synthesis and ultimately reproduction of the cell itself and (iii) an energy system for gathering energy from outside." So, with the basic requirements in mind, how does a cell carry out and maintain these functions? They use their information storage system (DNA, for example) to produce chains of amino acids that form proteins. The amount of different proteins that a cell requires is dependent upon the cell's needs. Though, because we are trying to determine the minimum size, we will minimize functionality to a bare minimum. According to *Size Limits of Very Small Microorganisms: Proceedings of a Workshop* (the study mentioned in the prompt), a

> realistic assumption of 300 essential non-ribosomal protein species, the diameter would be 262 nm. If each protein were present in 1,000 copies, the diameter would be 231 nm for 100 protein species and 303 nm for 300 species. Thus, the minimum diameter of a spherical cell compatible with a system of genome expression and a biochemistry of contemporary character would appear to lie somewhere between 200 and 300 nm, probably closer to the latter.

From this information, I would suspect that the lower end of the possible size spectrum is around the 200nm diameter. By minimizing the amount of proteins, ribosomes, and organelles within a spherical shape, the size could be reduced to around 200nm.

Another area that could be explored is the minimum sizes of viruses, though viruses are not "free-living" as they require a host. Hepatitis B, for example is spherical and only about 22nm in diameter[1]. Though whether viruses count as "living" is still under debate.

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2809016/