

Some procaryotes lack a cell wall. They survive as intracellular parasites of eucaryotic cells. They thus live in cytoplasm not in water so do not face osmotic stress. Without a cell wall, they are resistant to penicillin.

Bacterial flagella. Some bacteria move by rotating flagella. These are 12-18 nm in diameter and made of a single protein, flagellin, in the form of a helical array. They are rotated by a special miniature turbine at the base where they join the cell membrane.

Pili. Pili are tube-like structures about 7 nm in diameter, again composed of a helical arrangement of protein subunits. These threads are used to attach to surfaces such as that of the host cells and to transfer DNA to bacteria of the opposite mating type.

Magnetite. Crystals of Fe_3O_4 are used by some bacteria to orient themselves in the earth's magnetic field.

Eucaryotes. Eucaryotic cells are much larger than procaryotes. A bacterium such as *E. coli* has a mass of about 0.5 pg; a eucaryotic cell 30 μm in diameter has a mass of 14 ng, ca 35,000 larger. Eucaryotes therefore have a surface area to volume ratio more than 10 times lower than that of procaryotes.

Distances inside eucaryotes are relatively longer so diffusion may not always be fast enough to deliver compounds to where they are needed. **Near-equilibrium enzymatic flux transfer systems** are thought to allow the very rapid delivery of a wide range of metabolites to different parts of the cell.