Magnetotactic bacteria orient in the magnetic field of the earth with the help of a chain of magnetic organelles. These organelles are called magnetosomes and contain magnetic nanoparticles [typically built from magnetite, Fe₃O₄], enclosed by membranes. Based on model for the intracellular dynamics of magnetosomes and comparison to experiments with iron-starved cells, we argue that the magnetic attraction of aligned magnetosomes has to be coordinated with active transport of magnetosomes for the formation of the magnetosome chain. Active transport is likely driven by the polymerization or depolymerization of a cytoskeletal structure. Furthermore, we discuss the response of immobilized cells to external magnetic fields.