The Physics of Biological Length

There is almost no understanding of how living things determine their lengths. The underlying reason is that length determination is a physical measurement, and protein chemistry is just not very good for making this measurement. The only reasonably clear explanation of length generation is virus self-assembly, which is roughly understandable as a version of crystallization involving complex parts. However, even in that case nobody knows the correct equations of the assembly kinetics, and nagging questions remain about error rate, defect repair, and cessation of growth when the size is right. But the absence of biological meter sticks becomes extremely problematic already at the level of bacterial and mitochondrial shapes and sizes, and it is an overwhelming conceptual problem at the level of eucaryotic cells and functional organs of large pland and animals made from them. Heading my list of candidates for "what is missing" is one or more wave motions of some kind that can be used for length mensuration by the traditional method of fringe counting. The problem is that no such waves are known to exist in the highly viscous medium of cellular matter. I will discuss the current experimental situation.

Prof Robert B Laughlin
Stanford University, USA; Nobel Prize in Physics 1998