Many important processes in the cell are mediated by microtubule polymers, their interactions with their environment, and the active motor proteins moving on them. This includes the transport of subcellular structures (nuclei, chromosomes, organelles), and the self-assembly and positioning of the mitotic spindle. Little is understood of these processes, all of which are fascinating problems in cell mechanics, and the physics of active matter. Microtubules and motor proteins are also the building blocks of new biosynthetic active materials driven by motor-protein activity. These reduced systems can be probed—and modeled—more easily and have their own aspects of self-assembly and dynamics that shed light on biological processes. I review recent work modeling such systems as fluid-structure interaction problems and as internally-driven multiscale complex fluids.