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Macrophages are present in all body compartments, including cancerous tissues, and their functions are profoundly affected by signals from the microenvironment under homeostatic and pathological conditions. Tumor-associated macrophages are a major cellular component of cancer-related inflammation and have served as a paradigm for the plasticity and functional polarization of mononuclear phagocytes. Tumor-associated macrophages can exert dual influence of cancer depending on the activation state, with classically activated (M1) and alternatively activated (M2) cells generally exerting antitumoral and protumoral functions, respectively. These are extremes in a continuum of polarization states in a universe of diversity. Tumor-associated macrophages affect virtually all aspects of tumor tissues, including stem cells, metabolism, angiogenesis, invasion, and metastasis. Progress has been made in defining signaling molecules, transcription factors, epigenetic changes, and repertoire of microRNAs underlying macrophage polarization. Preclinical and early clinical data suggest that macrophages may serve as tools for the development of innovative diagnostic and therapeutic strategies in cancer and chronic nonresolving inflammatory diseases.