A cellular marker is a molecule, typically a protein, that is expressed on the surface, within the cytoplasm, or in the nucleus of a cell. These markers are used to identify and characterize specific cell types, states, or functions. They are essential tools in research, diagnostics, and therapy, particularly in immunology, oncology, and stem cell biology.

Types of Cellular Markers Surface Markers:

Found on the plasma membrane. Examples: CD molecules (Cluster of Differentiation): CD4 (T-helper cells), CD8 (cytotoxic T cells), CD19 (B cells), CD206 (M2 macrophages). Epithelial markers: EpCAM (epithelial cell adhesion molecule). Mesenchymal markers: CD44, CD90. Cytoplasmic Markers:

Found inside the cell and associated with specific functions or cell states. Examples: Enzymes: Arginase-1 (M2 macrophages), ALDH (stem cells). Cytokines: IL-10, TNF-α. Nuclear Markers:

Found in the nucleus and often related to transcriptional regulation or cell proliferation. Examples: Ki-67: Proliferation marker. FOXP3: Regulatory T cells. p53: Tumor suppressor. Functional Markers:

Associated with cell activity, such as migration, adhesion, or metabolism. Examples: Glucose transporters (GLUT): Cellular metabolism. Integrins (e.g., CD11b): Cell adhesion and migration. Applications of Cellular Markers Cell Identification:

Differentiating immune cells (e.g., CD4 for T-helper cells, CD14 for monocytes). Identifying stem cells (e.g., CD34 for hematopoietic stem cells). Cell State Analysis:

Markers for cell activation (e.g., CD69 for lymphocytes). Markers for apoptosis (e.g., Annexin V). Disease Diagnostics:

Cancer: HER2 (breast cancer prognosis). PD-L1 (immunotherapy response). Autoimmune diseases: FOXP3 (regulatory T cell activity). Infectious diseases: CD38 and HLA-DR (HIV disease progression). Therapeutic Targeting:

Monoclonal antibodies directed against markers (e.g., Rituximab targeting CD20 in B-cell lymphomas). Chimeric Antigen Receptor T-cell (CAR-T) therapy targeting CD19. Cell Sorting and Analysis:

Flow cytometry and fluorescence-activated cell sorting (FACS) use cellular markers for isolating and analyzing specific cell populations. Key Tools for Studying Cellular Markers Immunohistochemistry (IHC): For tissue-based marker localization. Flow Cytometry: For quantitative analysis of cellular markers. Western Blot: To detect specific marker proteins. qPCR: For gene expression of marker-associated mRNA. Immunofluorescence: For visualizing markers in cell cultures.