Actin cytoskeleton

The actin cytoskeleton is a dynamic network of actin filaments (also known as microfilaments) that plays a fundamental role in cell shape, motility, division, intracellular transport, and mechanotransduction. It's one of the three main components of the cytoskeleton, along with microtubules and intermediate filaments.

 Key Features of the Actin Cytoskeleton: Structure Composed primarily of F-actin (filamentous actin), which is polymerized from G-actin (globular actin) monomers.

Filaments are polarized with a plus (barbed) and minus (pointed) end, allowing for directional growth.

⚙ Functions Cell Shape & Structure

Provides mechanical support to maintain or change cell morphology.

Forms cortical actin under the plasma membrane.

Cell Motility

Drives lamellipodia, filopodia, and invadopodia formation during cell migration.

Essential in wound healing, immune responses, and metastasis.

Intracellular Transport

Interacts with myosin motors to transport organelles and vesicles.

Cell Division

Forms the contractile ring during cytokinesis.

Signal Transduction

Transduces mechanical and chemical signals.

Linked to pathways like Rho GTPases, PI3K/Akt, and MAPK.

 Actin-Associated Proteins Arp2/3 complex: nucleates branched actin networks (e.g., in lamellipodia).

Formins: promote unbranched filament growth.

Cofilin: severs actin filaments.

Thymosin-β4: sequesters G-actin to regulate polymerization.

Fascin, filamin, α-actinin: crosslink filaments into bundles or networks.

 In Disease and Research: Cancer: Alterations in actin dynamics facilitate invasion and metastasis.

Neurodegeneration: Actin plays a role in synaptic plasticity and neurite outgrowth.

Infection: Many pathogens hijack actin for cell entry or movement (e.g., Listeria, Shigella).

Proteomics: Changes in actin cytoskeleton proteins can be used as biomarkers of disease or targets for therapy.