Introduction

- The **cytoskeleton** is a network of fibers extending throughout the cytoplasm.
- The cytoskeleton organizes the structures and activities of the cell.

Providing structural support to the cell, the cytoskeleton also functions in cell motility and regulation

- The **cytoskeleton** provides mechanical support and maintains the shape of the cell.
- The fibers act like a geodesic dome to stabilize a balance between opposing forces.
- The cytoskeleton provides anchorage for many organelles and cytosolic enzymes.
- The cytoskeleton is dynamic, dismantling in one part and reassembling in another to change cell shape.
- The cytoskeleton also plays a major role in cell motility.
  - This involves both changes in cell location and limited movements of parts of the cell.
- The cytoskeleton interacts with motor proteins.
  - In cilia and flagella motor proteins pull components of the cytoskeleton past each other.
  - This is also true in muscle cells.
- Motor molecules also carry vesicles or organelles to various destinations along "monorails' provided by the cytoskeleton.
- Interactions of motor proteins and the cytoskeleton circulates materials within a cell via streaming.
- Recently, evidence is accumulating that the cytoskeleton may transmit mechanical signals that rearrange the nucleoli and other structures.

- Microtubules, the thickest fibers, are hollow rods about 25 microns in diameter.
  - Microtubule fibers are constructed of the globular protein, tubulin, and they grow or shrink as more tubulin molecules are added or removed.
- They move chromosomes during cell division.
- They also function as tracks that guide motor proteins carrying organelles to their destination.
- In many cells, microtubules grow out from a **centrosome** near the nucleus.

- These microtubules resist compression to the cell.

- In animal cells, the centrosome has a pair of **centrioles**, each with nine triplets of microtubules arranged in a ring.
- During cell division the centrioles replicate.
- Microtubules are the central structural supports in **cilia** and **flagella**.
  - Both can move unicellular and small multicellular organisms by propelling water past the organism.
  - If these structures are anchored in a large structure, they move fluid over a surface.
    - For example, cilia sweep mucus carrying trapped debris from the lungs.
- A flagellum has an undulatory movement (snake-like motion).
  - Force is generated parallel to the flagellum's axis.
- In spite of their differences, both cilia and flagella have the same ultrastructure.
  - Both have a core of microtubules sheathed by the plasma membrane.
  - Nine doublets of microtubules arranged around a pair at the center, the "9 + 2" pattern.
  - Flexible "wheels" of proteins connect outer doublets to each other and to the core.
  - The outer doublets are also connected by motor proteins.
  - The cilium or flagellum is anchored in the cell by a **basal body,** whose structure is identical to a centriole.

- Microfilaments, the thinnest class of the cytoskeletal fibers, are solid rods of the globular protein **actin**.
- Microfilaments are designed to resist tension.
- With other proteins, they form a three-dimensional network just inside the plasma membrane.
- In muscle cells, thousands of actin filaments are arranged parallel to one another.
- Thicker filaments, composed of a motor protein, **myosin**, interlock with the thinner actin fibers.
  - Myosin molecules walk along the actin filament, pulling stacks of actin fibers together and shortening the cell.