Cytoskeleton: Definition Structure and Function

Cytoskeleton Definition

The cytoskeleton is a network of filaments and tubules that extends throughout a [cell](https://biologydictionary.net/cell/), through the [cytoplasm](https://biologydictionary.net/cytoplasm/), which is all of the material within a cell except for the nucleus. It is found in all cells, though the proteins that it is made of vary between organisms. The cytoskeleton supports the cell, gives it shape, organizes and tethers the organelles, and has roles in [molecule](https://biologydictionary.net/molecule/) transport, [cell division](https://biologydictionary.net/cell-division/) and [cell signaling](https://biologydictionary.net/cell-signaling/).

## Structure of the Cytoskeleton

All cells have a cytoskeleton, but usually the cytoskeleton of eukaryotic cells is what is meant when discussing the cytoskeleton.

## The eukaryotic cytoskeleton consists of three types of filaments, which are elongated chains of proteins: microfilaments, intermediate filaments, and microtubules.

## Microfilament Definition

Microfilaments, also called actin filaments, are polymers of the protein actin that are part of a [cell](https://biologydictionary.net/cell/)’s [cytoskeleton](https://biologydictionary.net/cytoskeleton/). The cytoskeleton is the network of protein filaments that extends throughout the cell, giving the [cell structure](https://biologydictionary.net/cell-structure/) and keeping organelles in place. Microfilaments are the smallest filaments of the cytoskeleton. They have roles in cell movement, [muscle](https://biologydictionary.net/muscle/) contraction, and [cell division](https://biologydictionary.net/cell-division/).

## Microfilament Structure

Microfilaments are composed of two strands of subunits of the protein actin (hence the name actin filaments) wound in a spiral. Specifically, the actin subunits that come together to form a microfilament are called globular actin (G-actin), and once they are joined together they are called filamentous actin (F-actin). Like microtubules, microfilaments are polar. Their positively charged, or plus end, is barbed and their negatively charged minus end is pointed. Polarization occurs due to the molecular binding pattern of the molecules that make up the microfilament. Also like microtubules, the plus end grows faster than the minus end.

Microfilaments are the thinnest filaments of the cytoskeleton, with a diameter of about 6 to 7 nanometers. A microfilament begins to form when three G-actin proteins come together by themselves to form a trimer. Then, more actin binds to the barbed end. The process of self-assembly is aided by autoclampin proteins, which act as motors to help assemble the long strands that make up microfilaments. Two long strands of actin arrange in a spiral in order to form a microfilament.



## Functions of Microfilaments

### **Muscle Contraction**

One of the most important roles of microfilaments is to contract muscles. There is a high concentration of microfilaments in muscle cells, where they form myofibrils, the basic unit of the [muscle cell](https://biologydictionary.net/muscle-cell/). Actin is an indispensable protein for muscle movement, and microfilaments are often called actin filaments because actin is so prominent in the [muscular system](https://biologydictionary.net/muscular-system/) of the body. In muscle cells, actin works together with the protein myosin to allow the muscles to contract and relax. Here, neither actin nor myosin can work properly without the other, and they form a complex called actomyosin. Groups of actomyosin are found in sarcomeres, the basic unit of [muscle tissue](https://biologydictionary.net/muscle-tissue/).

### **Cell Movement**

Microfilaments play a role in causing cells to move. This occurs throughout the body and it is also very important for organisms whose entire body consists of one cell, such as amoebae; without microfilaments, they would not be motile. Actomyosin plays a role here just as it does in muscle cells. In order for cells to move, one end of a microfilament must elongate while the other end must shorten, and myosin acts as a motor to make this happen.

Microfilaments also have a role in cytoplasmic streaming. Cytoplasmic streaming is the flow of [cytoplasm](https://biologydictionary.net/cytoplasm/) (the contents of the cell, including the fluid part called [cytosol](https://biologydictionary.net/cytosol/) and cell organelles) throughout the cell. It allows nutrients, waste products, and cell organelles to travel from one part of the cell to another. Microfilaments can attach to a cell [organelle](https://biologydictionary.net/organelle/) and then contract, pulling the organelle to a different area of the cell.

### **Cell Division**

Another important function of microfilaments is to help divide the cell during [mitosis](https://biologydictionary.net/mitosis/) (cell division). Microfilaments aid the process of [cytokinesis](https://biologydictionary.net/cytokinesis/), which is when the cell “pinches off” and physically separates into two [daughter cells](https://biologydictionary.net/daughter-cells/). During cytokinesis, a ring of actin forms around the cell that is separating, and then myosin proteins pull on the actin and cause it to contract. The ring gets narrower and narrower around the cell, dragging the [cell membrane](https://biologydictionary.net/cell-membrane/) with it, until it splits into two cells. Afterward, the microfilaments depolymerize, or break down, into actin molecules, causing the ring to dissemble when it is no longer needed.