Microfilaments

Of the three types of protein fibers, **microfilaments** are the narrowest. Microfilaments are composed of two intertwined strands of actin. They function in cellular movement and have a diameter of about 7 nm. Microfilaments also provide some rigidity and help form the shape of the cell. They can disassemble and reform quickly, which enables a cell to change its shape and move (Figure 4.14). White blood cells, your body's infection-fighting cells, make good use of this ability. They can move to the site of an infection and neutralize the pathogen.

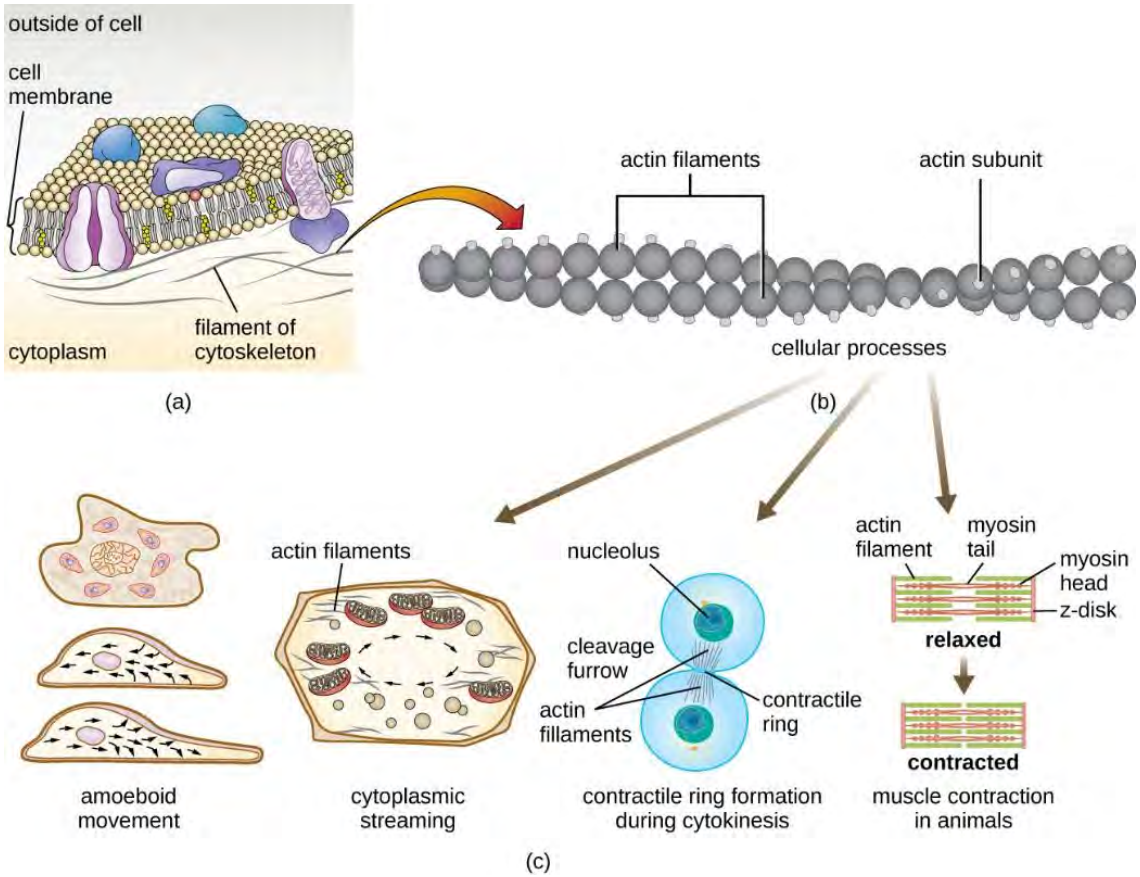

Figure 4.14 (a) A microfilament is composed of a pair of actin filaments. (b) Each actin filament is a string of polymerized actin monomers. (c) The dynamic nature of actin allows microfilaments to be involved in a variety of cellular processes (credit: Parker et al. / Microbiology OpenStax)

CONCEPTS IN ACTION - To see an example of a white blood cell in action, watch a short time-lapse video of the cell capturing two bacteria. It engulfs one and then moves on to the other bacteria.

Intermediate filaments

Intermediate filaments are of intermediate diameter (between microfilaments and microtubules) and have structural functions such as maintaining the shape of the cell and anchoring organelles (Figure 4.15). Keratin, the compound that strengthens hair and nails, forms one type of intermediate filament.

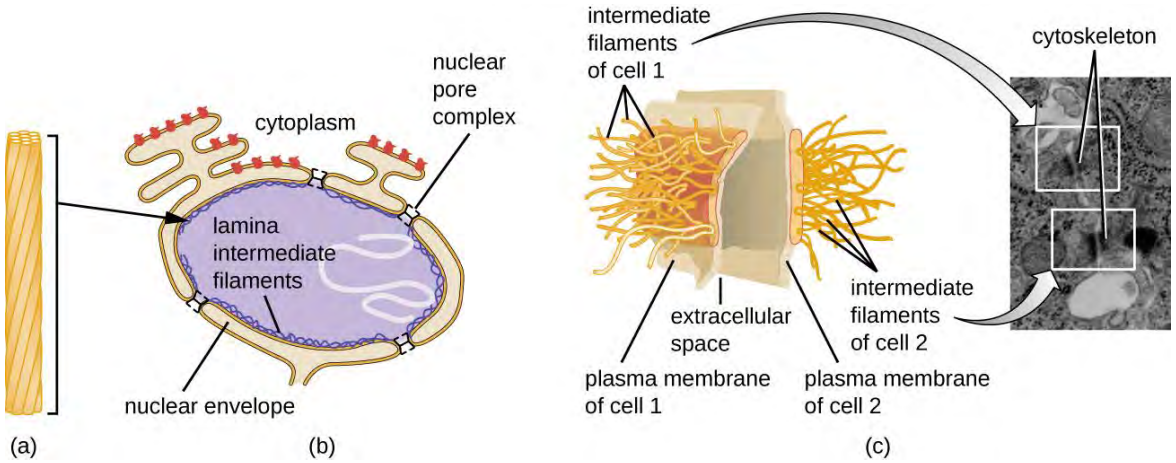

Figure 4.15 (a) Intermediate filaments are composed of multiple strands of polymerized subunits. (b) Intermediate filaments form much of the nuclear lamina. (c) Intermediate filaments form the desmosomes. (credit: c "illustration": modification of work by Mariana Ruiz Villareal / Microbiology OpenStax)

Microtubules

Microtubules are the thickest of the cytoskeletal fibers. These are hollow tubes that can dissolve and reform quickly. Microtubules work with motor proteins to move organelles and vesicles around within the cytoplasm. Also, microtubules are involved in cell division. Microtubules form the mitotic spindle that serves to separate chromosomes during mitosis and meiosis. The mitotic spindle is produced by two **centrosomes**, which are mostly microtubule-organizing centers at opposite ends of the cell. (Figure 4.16).

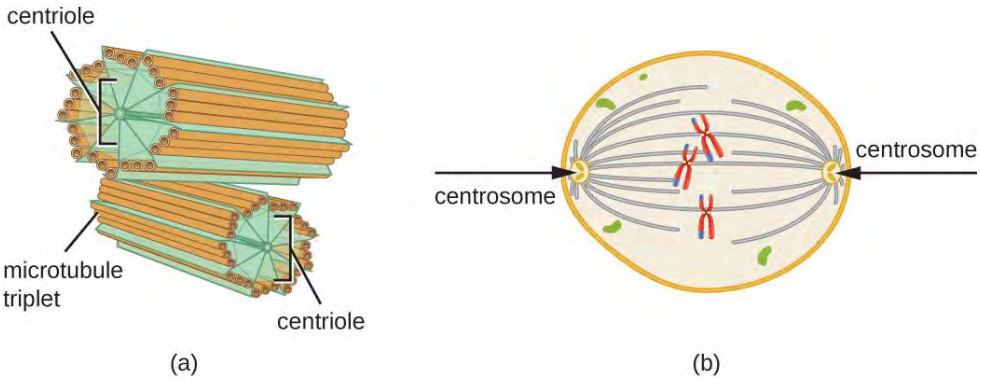

Figure 4.16 (a) A centrosome is composed of two centrioles positioned at right angles to each other. (b) In animal cells, the centrosomes (arrows) serve as microtubule-organizing centers of the mitotic spindle during mitosis. (credit: Parker et al. / Microbiology OpenStax)

Flagella and Cilia

Microtubules are also the structural components of flagella and cilia. **Flagella** (singular = flagellum) are long, hair-like structures that extend from the plasma membrane and are used to move the entire cell, for example, sperm and *Euglena*. When present, a cell may have just one flagellum or a few flagella. When **cilia** (singular = cilium) are present, they are many in number and extend along the entire surface of the plasma membrane. Cilia are short, hair-like structures that are used to move whole cells, for example the *Paramecium* in Figure 4.17 Cilia also move substances along the outer surface of the cell. For example, the cilia of cells lining the fallopian tubes move the ovum (egg) toward the uterus. Cilia lining the cells of the respiratory tract move particulate matter toward the throat where it is then trapped in mucus. These ciliated cells help prevent respiratory infections.

Figure 4.17 The ciliated protozoan *Paramecium caudatum*. (credit: Deuterostome / Wikimedia)