

primordial eukaryotic cell that was a predator, living by capturing other cells and eating them (Figure 1–32). Such a way of life requires a large cell with a flexible plasma membrane, as well as an elaborate cytoskeleton to support and move this membrane. It may also require that the cell's long, fragile DNA molecules be sequestered in a separate nuclear compartment, to protect the genome from damage by the movements of the cytoskeleton.

Modern Eukaryotic Cells Evolved from a Symbiosis

A predatory way of life helps to explain another feature of eukaryotic cells. Almost all such cells contain mitochondria (Figure 1–33). These small bodies in the cytoplasm, enclosed by a double layer of membrane, take up oxygen and harness energy from the oxidation of food molecules—such as sugars—to produce most of the ATP that powers the cell's activities. Mitochondria are similar in size to small bacteria, and, like bacteria, they have their own genome in the form of a circular DNA molecule, their own ribosomes that differ from those elsewhere in the eukaryotic cell, and their own transfer RNAs. It is now generally accepted that mitochondria originated from free-living oxygen-metabolizing (aerobic) bacteria that were engulfed by an ancestral eukaryotic cell that could otherwise make no such use of oxygen (that is, was anaerobic). Escaping digestion, these bacteria evolved in symbiosis with the engulfing cell and its progeny,

Figure 1–30 The major features of eukaryotic cells. The drawing depicts a typical animal cell, but almost all the same components are found in plants and fungi and in single-celled eukaryotes such as yeasts and protozoa. Plant cells contain chloroplasts in addition to the components shown here, and their plasma membrane is surrounded by a tough external wall formed of cellulose.

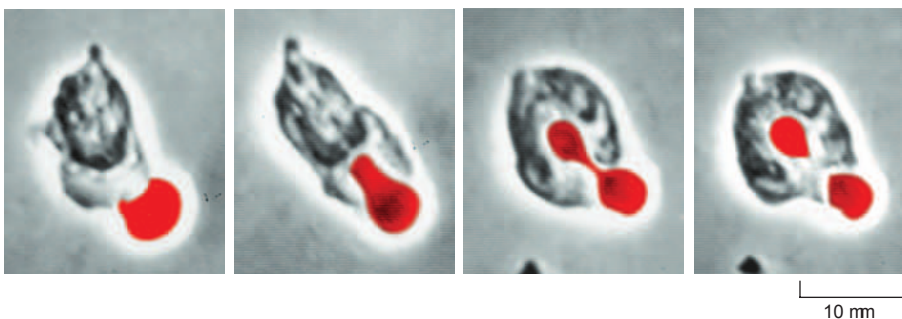


Figure 1–31 Phagocytosis. This series of stills from a movie shows a human white blood cell (a neutrophil) engulfing a red blood cell (artificially colored red) that has been treated with antibody. (Courtesy of Stephen E. Malawista and Anne de Boisfleury Chevance.)