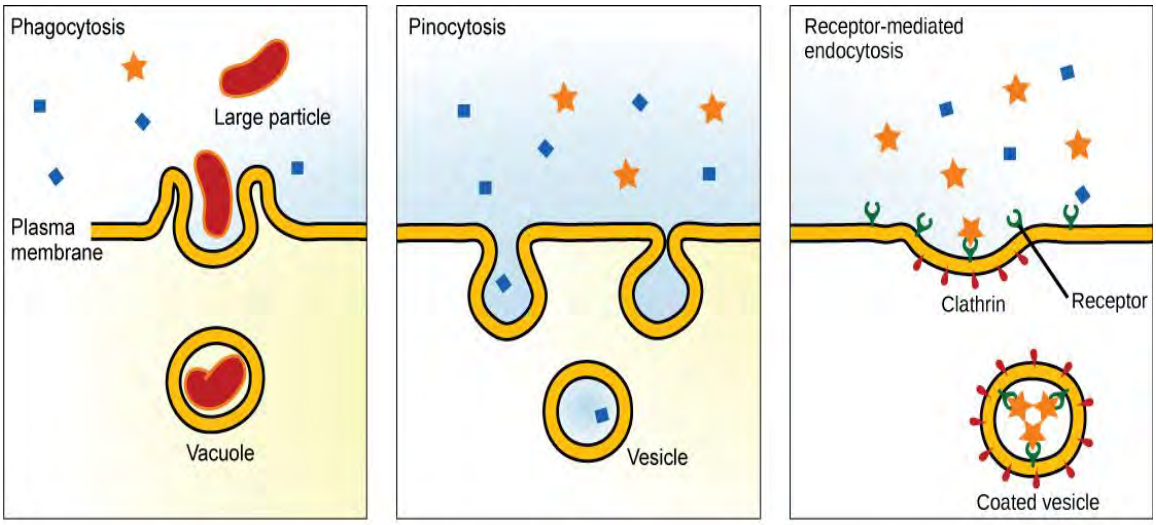

Figure 5.15 Three variations of endocytosis are shown. (a) phagocytosis (b) pinocytosis (c) receptor-mediated endocytosis (credit: modification of work by Mariana Ruiz Villarreal / Concepts of Biology OpenStax)

Phagocytosis

Phagocytosis is the process by which large particles, such as cells, are taken into the cell. For example, when microorganisms invade the human body, a type of white blood cell called a neutrophil removes the invader through this process of phagocytosis. The neutrophil surrounds and engulfs the microorganism (Figure 5.15a). The microorganism, which is now contained in a vacuole, will fuse with a lysosome and be destroyed by the digestive enzymes.

Pinocytosis

Another variation of endocytosis is called **pinocytosis**. The word pinocytosis means "cell drinking" and was named at a time when the assumption was that the cell was purposefully taking in extracellular fluid. In reality, the cell is taking in solutes that it needs from the extracellular fluid (Figure 5.15b).

Receptor-mediated endocytosis

The third variation of endocytosis, **receptor-mediated endocytosis**, involves binding specific substances to receptor proteins in the plasma membrane (Figure 5.15c). The substances bind to the receptor proteins, the plasma membrane invaginates, and both the specific material and the receptor proteins are brought into the cell. For example, the form of cholesterol termed low-density lipoprotein or LDL, also referred to as "bad" cholesterol, is removed from the blood by receptor-mediated endocytosis. In the human genetic disease familial hypercholesterolemia, the LDL receptors are defective or missing entirely. People with this condition have life-threatening levels of cholesterol because their cells cannot remove the lipid from their blood.

CONCEPTS IN ACTION - See receptor-mediated endocytosis animation in action**.**

Exocytosis

Exocytosis is a type of active transport that allows the cell to expel materials into the extracellular fluid. This process works by enclosing the materials within a vesicle, which then fuses with the interior of the plasma membrane. This fusion opens the vesicle to the exterior of the cell, and the particle is expelled into the extracellular fluid (Figure 5.16).

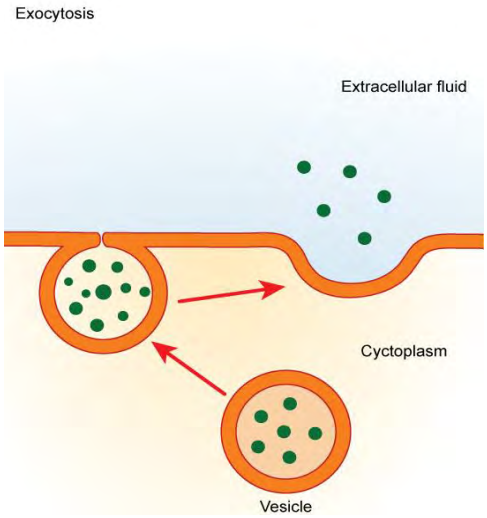

Figure 5.16 In exocytosis, a vesicle migrates to the plasma membrane, binds, and releases its contents to the outside of the cell. (credit: modification of work by Mariana Ruiz Villarreal/ Concepts of Biology OpenStax)

Check your knowledge

An amoeba uses pseudopods to engulf a paramecium for lunch. Will it use exocytosis or endocytosis?

Answer: endocytosis

Section Summary

Active transport uses energy stored in ATP to fuel transport. Active transport uses integral proteins to move the material either into or out of the cell against their concentration gradients. One of the most common types of active transport involves proteins that serve as pumps.

Endocytosis is a type of active transport that moves large molecules into the cell. These large molecules, which can include cell parts and foreign cells, cannot be moved in through integral proteins because of their large size. There are three different variations of endocytosis: phagocytosis, pinocytosis, and receptor-mediated endocytosis. The cell expels waste and other particles through the reverse process, exocytosis.

Exercises

1. Which statement best describes active transport.
    a. Active transport always requires the use of an integral protein.
    b. Active transport moves materials from an area of high concentration to an area of low concentration.
    c. Active transport always requires energy.
    d. Active transport is used to move water into the cell.
2. Compare and contrast the three types of endocytosis.

Answers

1. (c)
2. There are different variations of endocytosis, but all share a common characteristic: The plasma membrane of the cell invaginates, forming a pocket around the target substance. The pocket pinches off, resulting in the material being contained in a newly created vacuole. Phagocytosis is the process by which large particles, such as cells, are taken in by a cell. Pinocytosis takes in solutes that the cell needs from the extracellular fluid. Receptor-mediated endocytosis involves binding specific substances to receptor proteins in the plasma membrane.

Glossary

active transport: the method of transporting material that requires energy

endocytosis: a type of active transport that moves substances, including fluids and particles, into a cell

exocytosis: a process of passing material out of a cell

phagocytosis: a process that takes macromolecules that the cell needs from the extracellular fluid; a variation of endocytosis

pinocytosis: a process that takes solutes that the cell needs from the extracellular fluid; a variation of endocytosis

receptor-mediated endocytosis: a variant of endocytosis that involves the use of specific binding proteins in the plasma membrane for specific molecules or particles