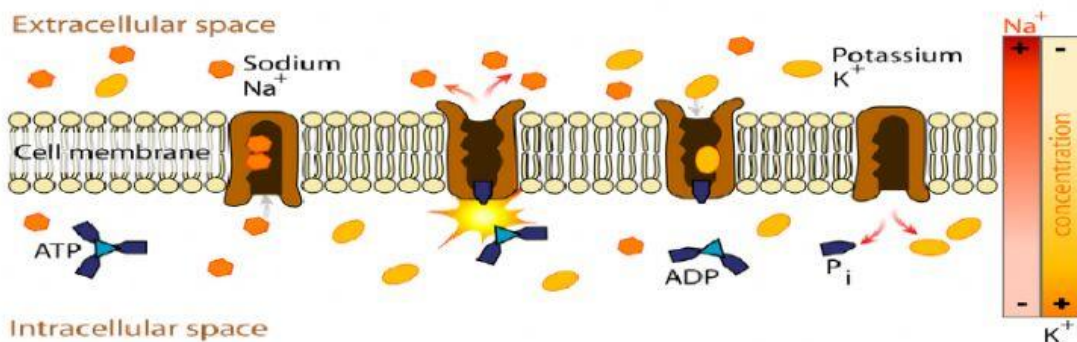


## Worksheet: Active Transport

**Active transport** uses energy (ATP) to move solutes against their gradients. Substances are moved against their concentration gradient – that is, from the side where they are less concentrated to the side where they are more concentrated. This type of transport requires energy, usually in the form of ATP. A common example of active transport is the sodium-potassium pump. This transmembrane protein pumps sodium out of the cell and potassium into the cell. The sodium-potassium pump is necessary for proper nerve transmission and is a major energy consumer in the body. The inside of the cell is negatively charged compared with outside of the cell. The difference in electric charge across a membrane is expressed in voltage and termed the membrane potential. Because the inside of the cell is negatively charged, a positively charged ion on the outside, like sodium, is attracted to the negative charges inside the cell. Thus, two forces drive the diffusion of ions across a membrane:

- A chemical force, which is the ion's concentration gradient, and
- A voltage gradient across the membrane, which attracts positively charged ions and repels negatively charged ions

This combination of forces acting on an ion forms an **electrochemical gradient**.



### Endocytosis and Exocytosis:

There are two types of bulk transport, exocytosis and endocytosis, and both require the expenditure of energy (ATP). In **endocytosis**, molecules that are too large to be transported by other means are engulfed by an *invagination* of the cell membrane and carried into the cell surrounded by a vesicle.

There are three forms of endocytosis:

- **Pinocytosis** is a form of endocytosis in which the cell engulfs fluids (liquids).
- **Phagocytosis** is a form of endocytosis in which the cell takes in larger particles, such as a white blood cell engulfing a bacterium.
- **Receptor-mediated endocytosis** allows the cell to take in very specific molecules (ligands) that pair up with specific receptors on the cell surface.

Exocytosis is the reverse of endocytosis. **Exocytosis** is a form of active transport in which a cell transports molecules (such as proteins) out of the cell (exo- + cytos) by expelling them in an energy-using process.

## Active Transport Reading Comprehension & Application Questions

Word Bank (Note: a word may be used more than once)

concentration gradient  
exocytosis

endocytosis  
phagocytosis

energy  
pinocytosis

1. Active transport can move substances against their \_\_\_\_\_.
2. Materials are released from a cell in a process called \_\_\_\_\_.
3. The difference between active and passive transport is that active transport requires \_\_\_\_\_, while passive transport does not.
4. Materials are taken in by a cell in a process called \_\_\_\_\_.
5. \_\_\_\_\_ is the movement of solutes or fluids into a cell.
6. \_\_\_\_\_ is the movement of large particles into a cell.
7. Phagocytosis and pinocytosis are types of \_\_\_\_\_ transport.
9. Label the diagrams below – Exocytosis, Endocytosis, Pinocytosis, Phagocytosis.

