Module 8 / Active Transport

Distinguish between facilitated diffusion and active transport.	Describe why the process requires energy.	Describe a typical source of energy (general and specific examples).

In some cases it is necessary to move molecules against a gradient. The eukaryotc cell, a typical mammalian cell, has many compartments within the cell each surrounded by a lipid bilayer membrane. In most cases the environment within the compartment is different than that in the cytoplasm. An example is the lysosome, a degradative organelle (membrane bound compartment within the cell) whose function is to digest macromolecules delivered either from the outside of the cell or from other compartments within the cell. To carry out this function the lysosome maintains a much lower pH inside the lysosome relative to the cytoplasm. At equilibrium, the concentration of protons would be equal on both the inside and outside of the lysosome.

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To make the lumen of the lysosome (the part enclosed by the lysosomal membrane) more acidic than the cytoplasm, in which direction would protons need to flow? Why?

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To decrease the pH inside of the lysosome, the concentration of protons will need to be greater inside the lysosome than in the cytoplasm. To accomplish this protons will need to move from a low concentration to a high concentration. This is a non-spontaneous process and requires the cell to do work to move the ions up-hill against the gradient. To do work, the cell must expend energy and actively move (pump) the ions. This process is referred to as active transport. The source of energy for this process in most biological systems is the hydrolysis of ATP.

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Why does the process described in the last question need to be a continuous process? Why doesn't the process just stop once the correct pH in the lumen is reached?

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The following animation depicts another example of active transport; the sodium-potassium ATPase. This active transport system moves three sodium ions out of the cell and two potassium ions into the cell, each against a gradient.

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If ATP hydrolysis provides the energy for the conformational change to move sodium out, what provides the energy for the conformational change required to move the potassium in?

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Transport Proteins

Transport Proteins

Facilitated diffusion and active transport both require channels or ports in the membrane through which the generally non-permeable molecules can pass. These protein transporters contribute to the mosaic character of the fluid mosaic character of the biological membrane. There are a variety of different structures associated with transport proteins and at the same time many transport proteins that carry out similar functions (e.g. ion channels) have structural similarities while maintaining their ability to discriminate between molecules. Thus transport proteins have been classified both by structure and by function. For the purposes of this course, the classification will be that of function though similarities in structure will be observed in the examples chosen.

There are three classifications of transport proteins based on mechanism of transport: **Uniport**, **Symport** and **Antiport**. The animations on the following pages will demonstrate the three classes of proteins with examples of each.