STUDY GUIDE - *Ch. 7.4 - Active Transport uses Energy to Move Solutes Against their Gradients.*
- Ch. 7.5 - Bulk Transport Across the Plasma Membrane Occurs by Exocytosis and Endocytosis

NAME: _____

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** *Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** *AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie.** *Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** ***First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced..*

1. Distinguish between the **Passive Transport vs Active Transport** of solutes across a membrane using transport proteins.

   In passive transport:

   In active transport:

2. a. **Both carrier and channel proteins are used in facilitated diffusion.** This isn't the case in active transport. Which of these two types of **transport proteins is used in active transport**?

   b. Why can the other type of **transport protein NOT work for active transport**?

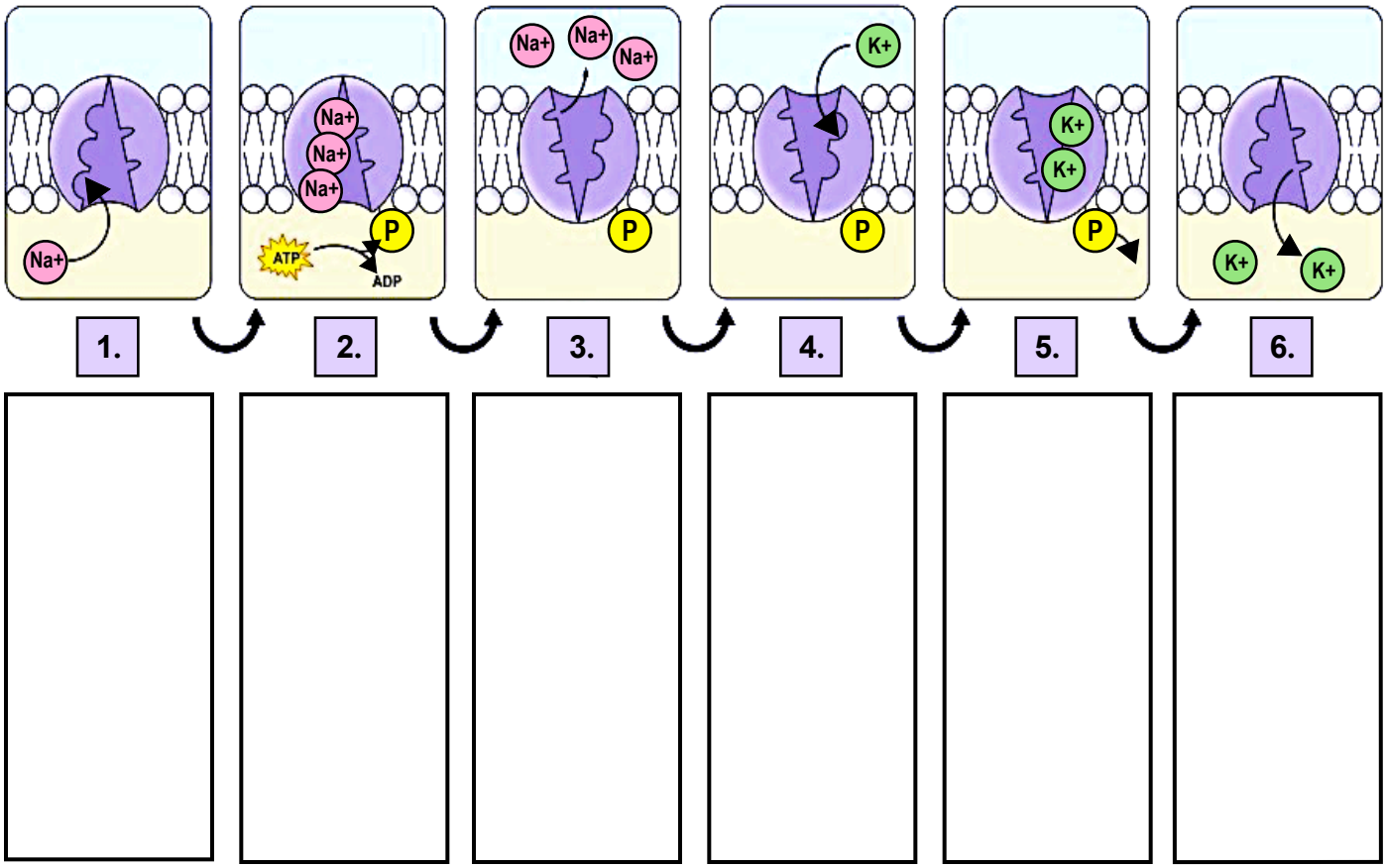
3. a. Review carefully Figure 7.17. **Active transport**, unlike passive transport, is a non-spontaneous process, meaning it **requires additional energy** and is considered work. Where does the required energy for active **transport with a carrier protein come from**?

   b. Why does a phosphate being transferred from ATP to a carrier protein help it pump solutes across a membrane?

4. The **Sodium-Potassium Pump** is an important system you must know! Through this process, an anti-porter protein pumps both sodium ions (Na^+) and potassium ions (K^+) in opposite directions across a membrane, **against** each of the these ions' solute gradients. Study Figure 7.16 well. When you feel like you have memorized and can explain the entire process, take a look at the figure below.

a. Label on image 1, the **region of high and low Na^+ concentration** [Na^+] **and high and low K^+ concentration** [K^+].

b. **Summarize how the Sodium-Potassium Pump works** by explaining each figure in the box below it.



c. **With the help of ATP phosphorylation, a total of _____ number of sodium ions are pumped out of the cell for every _____ number of potassium ions pumped into the cell per cycle of the Sodium-Potassium Pump.**

d. The act of covalently bonding, to another molecule, temporarily, a phosphate group derived from ATP is called phosphorylation. What **enzyme is responsible for catalyzing phosphorylation**? *(Review Figure 7.16 again if needed).*

5. a. **All cells have a voltage across their plasma membrane.** What is **voltage**?

b. What **causes this voltage to exist across a cell's plasma membrane**?

c. In biology, what **term is used to refer to this voltage that exists across a cell's plasma membrane**?

d. What location of the cell (immediately to its interior or its exterior) tends to be positive and tends to be negative?

Positive Region of a Cell =

Negative Region of a Cell =

e. The voltage can be measured. What is the **typical membrane potential of a cell**?

6. a. Ions don't actually just move down their chemical concentration gradients, but down their **Electrochemical Gradients.** Explain what this means. *(**Explain the two forces that drive the diffusion of ions across membranes**).*

   1.

   2.

   b. The **Sodium-Potassium Pump** is an example of an electrogenic pump, the main one found in animal cells. What are **Electrogenic Pumps**?

   c. Explain in detail **how the pump Sodium-Potassium Pump does not just build concentration gradients of Sodium and of Potassium ions, but actually helps build voltage** *(and so helps store potential energy by creating a membrane potential)* **across the plasma membrane of animal cells?**

   d. The Sodium-Potassium Pump is the main electrogenic pump of animal cells. Study Figure 7.18. What is the **main electrogenic pump in the plasma membranes of plant, fungal, and bacterial cells**?

   e Explain **how the pump you highlighted in 6.d. above helps build voltage** *(helps store potential energy by creating a membrane potential)* **across the plasma membrane of plant, fungal, and bacterial cells?**

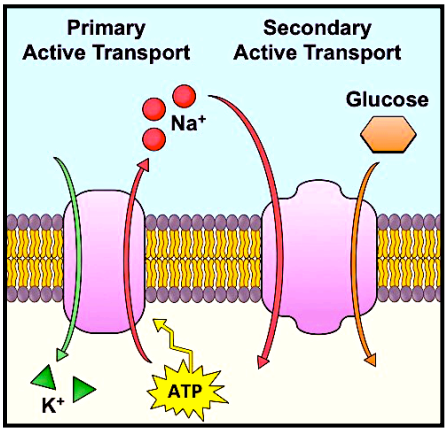
   f. What is the **benefit of electrogenic pumps and generating voltage across a membrane**?

7. a. What is **Cotransport**?

b. Study Figure 7.19, in which the active transport of H^+ ions (**primary active transport**, *which uses the energy from ATP directly)* is used to generate a proton gradient across the membrane. **The high concentration of protons on the outside of the cell, relative to the inside of the cell, stores potential energy, which can be used to do work.** The work to be done, in Figure 7.19, is the pumping (**secondary active transport)**, *through the use of the energy stored in the electrochemical proton gradient,* of sucrose from the outside of the cell, where it is in low concentration, to the inside of the cell, where it exists in high concentration. **The potential energy released when the protons are allowed to diffuse passive back into the cell is used to actively pump sucrose into the cell at the same time.**

Let's look at one example of secondary active transport that occurs in the epithelial cells that line the human small intestines that allows glucose to be pumped into a cell even against its concentration gradient. Explain step-by-step how this process occurs by discussing, in the space provided, the following items...

1. The relative concentrations of sodium ions in **and** out of the cell:



2. The role of the sodium-potassium pump in primary active transport **and** the establishment of a sodium ion gradient:

3. Where energy is stored before **and** at the end of primary transport: *(Remember, energy cannot be created or destroyed)*.

4. The relative concentrations of glucose in **and** out of the cell:

5. How the stored potential energy in sodium's electrochemical gradient is later released to be used to **pump** glucose into the cell against glucose's concentration gradient.

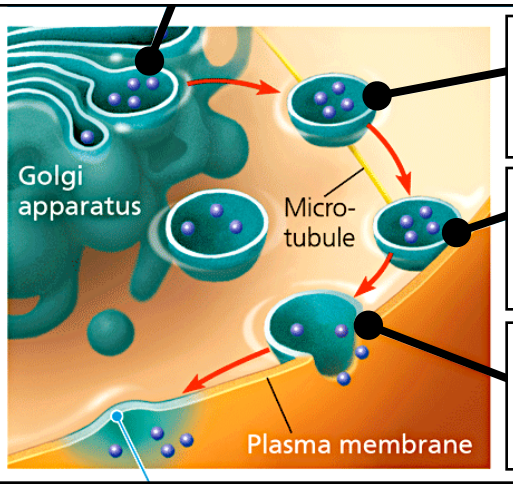
8. Review the characteristics of the lysosome in Ch.6.4. Lysosomes are packed with hydrolytic enzymes that can catalyze hydrolysis reactions to break down various large biological molecules. Given the internal environment of a lysosome, what transport protein might you expect to see in its membrane?*(Check your answer by going to the **Ch.7.4 Concept Check Question #3** answer in Appendix A)*

9. **While small solutes like ions, small molecules like water, and various monomers of macromolecules can cross a membrane with the help of transport proteins, large structures, like polymers (such as proteins & polysaccharides), or cannot! They are just too big to pass through or be carried through by one protein. They move through membranes instead by processes known as endocytosis and exocytosis.**

Are the processes of **endocytosis and exocytosis** active or passive, and why do you say so?

10. Explain the steps involved in the process of **exocytosis**.

1.



2.

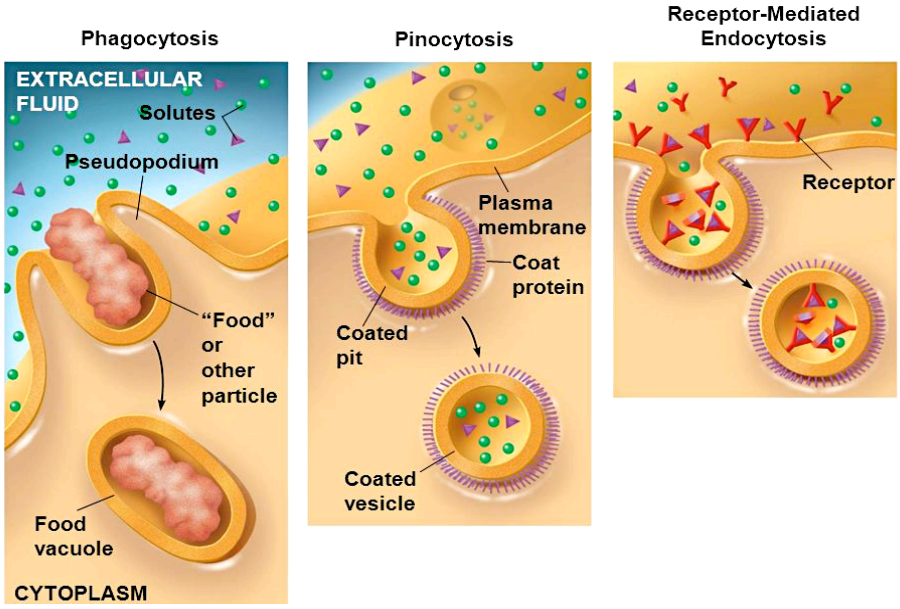
3.

4.

5.

11. Explain the steps involved in the process of **endocytosis**.

12. Study Figure 7.21 well. Endocytosis can be divided up into three types: **Phagocytosis, Pinocytosis, and Receptor-Mediated Endocytosis**. Explain, on the following page, how each types occurs **AND** what the benefit is to the cell for engaging in that type of endocytosis.



1. **Phagocytosis** =

2. **Pinocytosis** =

3. **Receptor-Mediated Endocytosis** =

13. When a cell grows in size, its plasma membrane must expand. Does this happen via endocytosis or exocytosis? Explain. *(Check your answer by going to the **Ch.7.5 Concept Check Question #2** answer in Appendix A)*

14. How would being able to engage in endocytosis and exocytosis help a cell maintain a steady plasma membrane surface area?

15. Test your knowledge by taking the **Self Quiz** located at the end of your chapter. *Do your best to try to answer these from memory first in order to test how well you grasped the material before. If you are unsure, return to the relevant section of your chapter and restudy any pertinent material to refresh your memory. (Check your answer by going to the **Ch.7 Test Your Understanding** answers in Appendix A)*

1. _____ 2. _____ 3. _____

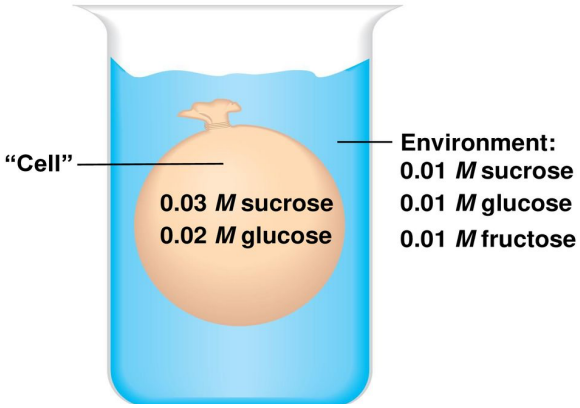
4. _____ 5. _____

6. a. Draw as requested.

   b. **Solution outside is** _____.

   c. Draw as requested.

   d. **The artificial cell will become more** _____.



e. **Explain why**.

8. a. **Hypothesis** *(explanatory statement)***:**

b. **Prediction:**

Explanation of Prediction:

9. *(Make sure you use the proper terminology you learned in this chapter)*

11. *(Make sure you use the proper terminology you learned in this chapter)*