

BIO-372 "MICROBIOLOGY" EXERCISES (WEEK 5)

Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

EXERCISE 1 "TRANSPORT ACROSS THE BACTERIAL CELL ENVELOPE" :

1. Bacteria use three types of transmembrane import events: uniport, symport, and antiport. Explain how they work.

2. Bacteria also use three classes of transmembrane importer systems: simple transporters, group translocators, and ABC transporters. Explain how they work.

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3. Transmembrane importer systems can import solutes (such as nutrients) against their concentration gradients, which requires energy. For each of the three types of importer systems, what is the energy source and how does it drive transmembrane transport?

4. Bacteria typically have two different import systems for uptake of essential nutrients. As an example, uptake of inorganic phosphate (Pi) is mediated by the Pit system *and* the Pst system. Compare and contrast these systems. Why are two Pi-uptake systems necessary? In what conditions would Pit-mediated Pi uptake dominate? In what conditions would Pst-mediated Pi uptake dominate?

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5. Bacteria use the phosphotransferase system (PTS) for uptake of sugars (like glucose) from the environment. Why is the PTS necessary? How does the PTS work? What are the sugar-specific and sugar-nonspecific components of the PTS and what are their functions?

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EXERCISE 2 "TRANSPORT ACROSS THE BACTERIAL CELL ENVELOPE" :

1. The Sec system is responsible for secretion of proteins into the periplasmic space (in Gram-negative bacteria) or the extracellular space (in Gram-positive bacteria). Explain how this process works (you may want to use diagrams). Secretion of proteins requires energy; where does this energy come from?

2. The Sec system is also responsible for insertion of transmembrane proteins into the cytoplasmic membrane (in Gram-negative and Gram-positive bacteria). Explain how this process works (you may want to use diagrams). Insertion of proteins into the cytoplasmic membrane requires energy; where does this energy come from?

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3. Exported proteins can be secreted into the periplasmic/extracellular space *or* inserted into the cytoplasmic membrane. How does the cell "decide" whether an exported protein should be secreted or inserted into the cytoplasmic membrane?

4. Transmembrane proteins typically contain distinct domains localized to the cytoplasm, membrane, and periplasmic/extracellular space. How does the cell "decide" where to put each domain of a transmembrane protein?

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5. Some secreted proteins must fold into their final three-dimensional configurations in the cytoplasm prior to export. Examples include proteins that incorporate cofactors that are not available outside the cell and proteins that cannot fold in the oxidizing environment outside the cell. Would the Sec system be useful for exporting such proteins? Why or why not? How do bacteria export such proteins?