

BIO-372 "MICROBIOLOGY" EXERCISES (WEEK 11)

Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

EXERCISE 1 "GENETIC NETWORKS IN BACTERIAL SPORULATION" :

1. Bacterial spores are metabolically inactive. However, the cytoplasm of bacterial spores is densely packed with ribosomes, which are more abundant in spores than in actively growing cells. Explain why.

2. The *spoIIA* operon encoding *spoIIAA* (anti-anti- σ), *spoIIAB* (anti- σ), and *spoIIAC* (σ F) is located next to the chromosomal replication *terminus*. Explain how this chromosomal location contributes to activation of σ F in the forespore but not in the mother cell.

3. Sporulation involves a “sigma (σ) factor cascade”. This motif is common in differentiation programs in bacteria. Explain: what are sigma factors, what is their primary biochemical and biological function, and what is a “sigma factor cascade”?

4. If you mutate (inactivate) the gene encoding anti-anti- σ F, what effect do you predict this would have on σ F activation in the prespore? Explain.

5. Positive feedback loops are common genetic network motifs in differentiation programs like sporulation. Do positive feedback loops generate graded responses (“all the same”) or threshold responses (“all-or-nothing”) to a signal such as nutrient starvation? Explain.

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EXERCISE 2 "GENETIC NETWORKS IN BACTERIAL SPORULATION" :

1. Draw a diagram of the “coherent feed-forward loop” genetic network motif and identify each component.

2. Does the “coherent feed-forward loop” increase or decrease the time for a genetic network’s output to reach the steady-state expression level following a stimulus? Explain.

3. Draw a diagram of the “incoherent feed-forward loop” genetic network motif and identify each component.

4. Does the “incoherent feed-forward loop” increase or decrease the time for a genetic network’s output to reach the steady-state expression level following a stimulus? Explain.

5. The “incoherent feed-forward loop” can also function as a “pulse generator”. Explain how this works.