

BIO-372 "MICROBIOLOGY" EXERCISES (WEEK 6)

Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

EXERCISE 1 "BIOMECHANICS OF MICROBIAL SURFACE APPENDAGES" :

1. Under tensile stress, Type IV pili undergo extension by:

- ☐ Stretching.
- ☐ Uncoiling.
- ☐ Both stretching and uncoiling.
- ☐ Neither stretching nor uncoiling.

Explain:

2. Under tensile stress, Type I pili undergo extension by...

- ☐ Stretching.
- ☐ Uncoiling.
- ☐ Both stretching and uncoiling.
- ☐ Neither stretching nor uncoiling.

Explain:

3. Draw the force vs. strain curves for Type IV pili and Type I pili.

4. Which of the following statements is/are true:

- ☐ Type IV pili behave like Hookean springs.
- ☐ Type IV pili behave like non-Hookean springs.
- ☐ Type I pili behave like Hookean springs.
- ☐ Type I pili behave like non-Hookean springs.

Explain:

5. Which type of pili (Type IV pili or Type I pili) works better to distribute tensile stress equally among the individual pili and why is this advantageous?

- ☐ Type IV pili work better than Type I pili.
- ☐ Type I pili work better than Type IV pili.
- ☐ Type IV pili and Type I pili work equally well.

Explain:

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EXERCISE 2 "BIOMECHANICS OF MICROBIAL SURFACE APPENDAGES" :

Bacteria produce a variety of pilus-associated "adhesins" that mediate attachment of the cell to surfaces. These adhesins may mediate "slip-bond" adhesion or "catch-bond" adhesion.

1. Slip-bond adhesion means that:

- ☐ As shear force increases the adhesion strength/lifetime increases.
- ☐ As shear force increases the adhesion strength/lifetime decreases.
- ☐ As shear force increases the adhesion strength/lifetime stays the same.

Explain:

2. Catch-bond adhesion means that:

- ☐ As shear force increases the adhesion strength/lifetime increases.
- ☐ As shear force increases the adhesion strength/lifetime decreases.
- ☐ As shear force increases the adhesion strength/lifetime stays the same.

Explain:

3. Draw the force vs. adhesion strength/lifetime curve for slip-bond adhesion.

4. Draw the force vs. adhesion strength/lifetime curve for catch-bond adhesion.

5. In class we examined one example of a catch-bond adhesin: the FimH protein located at the tip of Type I pili. Explain (in mechanical terms) how this protein mediates catch-bond adhesion.

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EXERCISE 3 "BIOMECHANICS OF MICROBIAL SURFACE APPENDAGES":

The Type III secretion system (T3SS) is essential for the pathogenesis of many bacterial pathogens that infect animals or plants.

1. How many membranes does the T3SS cross? Name them.
2. What is the function of the T3SS?
3. The “measuring cup model” has been proposed to explain how the size (length) of the T3SS “needle” is controlled. Explain how this model works.
4. The “molecular ruler model” has also been proposed to explain how the size (length) of the T3SS “needle” is controlled. Explain how this model works.
5. If you decrease the size of the T3SS basal structure (C-ring), would you expect the needle to get shorter or longer? Explain. If you increase the length of the ruler protein, would you expect the needle to get shorter or longer? Explain.