Quorum Sensing

20 points – Not being graded this semester

Many gram-negative and gram-positive are able to **sense their own population density, communicate with each other by way of secreted factors, and behave as a population rather than as individual bacteria**. This is referred to as **cell-to-cell signaling** or **quorum sensing** and most likely plays an important role in pathogenicity for many bacteria.

Quorum sensing involves the production, release, and community-wide sensing of molecules called autoinducers that **modulate gene expression in response to the density of a bacterial population**. When autoinducers produced by one bacterium cross the membrane of another, they bind to receptors in the cytoplasm. This autoinducer/receptor complex is then able to bind to DNA promoters and activate the transcription of quorum sensing-controlled genes.

For example, *Pseudomonas aeruginosa* causes severe nosocomial infections, chronic infections in people with cystic fibrosis, and potentially fatal infections in those who are immunocompromised. Its virulence depends on the secretion of a variety of harmful exotoxins and enzymes as mentioned above. If there was an isolated production of these virulence toxins and enzymes by a small number of *Pseudomonas*, the body's immune responses would most likely be able effectively neutralize these harmful agents with antibodies. However, through **a coordination of the expression of the genes coding for these toxins and enzymes by the entire population of bacteria**, *P. aeruginosa* appears to **only secrete these extracellular virulence factors when the density of bacteria is large enough that they can be produced at high enough levels to overcome body defenses**.

Other quorum sensing-controlled processes in bacteria include **biofilm formation, sporulation, antibiotic production,** and **bioluminescence**.

Go to either one of the web sites listed below.
https://www.ted.com/talks/bonnie_bassler_on_how_bacteria_communicate
YouTube - Bonnie Bassler: The secret, social lives of bacteria
Natural History Magazine - Bonnie Bassler: The secret, social lives of bacteria

Watch the video and answer the following questions:

1. How many bacteria typically live in you and on you? (1 pt)

2. Approximately how much of your body “mass” is composed of bacteria? (1 pt)

3. Research the answer to questions 1&2 and report on the accuracy of these numbers. (2 points)

4. How and when do the *Vibrio fischeri* bacteria know when to make light? What is the process called?
(2 pts)

5. How do invading pathogenic bacteria regulate their virulence attack? (4 pts)

6. How can the next generation of “antibiotics” proposed in the video be useful for treating bacterial infections? (4 pts)

7. This video was produced in 2009. Using the answer to question 6, research the progress that has been on achieving the next generation of “antibiotics” proposed in the video. Report on the successes and failures. (6 pts)