Dr. Bonnie Bassler: Queen of Quorum Sensing

Dr. Bonnie Bassler, or, who I want to be when I grow up, is a decorated researcher with a focus in quorum sensing. She is the 2018 recipient of the Dickson Prize in Medicine, touted as the highest honor the University of Pittsburgh School of Medicine awards. With this prestigious award comes the invitation to be the keynote speaker at the University of Pittsburgh Science convention, where I had the joy of attending. In one short hour, Dr. Bassler was able to present an enormous amount of complex information, without alienating her non-expert audience.

Dr. Bassler began her talk with the idea that bacteria were once considered unsophisticated and simple, yet were unexplainably able to synchronously fluoresce. This mechanism was unknown and uncharacterized, but contradicted the idea that these microscopic organisms were nothing special. The study of how *Vibrio fischeri* created bioluminescence was called autoinduction and that term was changed to “quorum sensing” in 1994 (1). Quorum sensing is a means of communication between bacteria, where bacteria send chemical signals into their environment to sense the population density and composition. This information allows the bacteria to regulate what genes are being expressed in response to the environment. The signals, or autoinducers, that are sent out in quorum sensing relate to “self” or “non-self.” Dr. Bassler explained that non-self autoinducers are further divided to same genus versus completely different. She likened this to twins, cousins, or enemies, and explained that bacteria will share information and resources differently depending on the population composition. If the bacteria send out autoinducers but receive none in return, they are likely alone, since there was enough space for the molecules to drift away.

*Vibrio cholerae* has caused disease in humans for decades and colonizes the human gut, forming a biofilm as part of its pathogenicity. Similar to its cousin, *V. fischeri*, *V. cholerae* is capable of quorum sensing. Dr. Bassler explained that if *V. cholerae* receptors CqsS and LuxPQ detect no autoinducers, it stimulates the virulence traits and the production of biofilms. However, if the autoinducers CAI-1 and AI-2 are detected, *V. cholerae* will begin to remove itself from the host, in hopes of infecting someone new. With her entire audience enraptured, Dr. Bassler mentioned the most interesting part; VqmR, a protein associated with the repression of biofilm formation, was not affected by the absence either autoinducer. VqmR, which was only present at high cell density, was activated by a transcription factor called VqmA. She did note that while VqmA was always present, it was only active at high cell density. This conundrum implied that there was an unknown autoinducer that was able to change the biofilm activity of *V. cholerae*. The novel autoinducer was determined to be 3,5-dimethylpyrazin-2-ol, or DPO, formed by circularizing alanine and threonine (2). Many bacteria eat mucin, which is made of 33% threonine, which later creates

![Vibrio Quorum Sensing](https://www.hhmi.org/scientists/bonnie-l-bassler)
DPO. DPO essentially defends the host from developing symptoms of cholera, since DPO indicates that there is high cell density. This indicates that rather than forming a biofilm, *V. cholerae* should prepare for dissemination (2). The virulence factors are then turned off and protect the host.

Dr. Bassler further explained how a phage (VP882) that also produces VqmA is able to hijack the DPO-mediated dissemination to allow itself to propagate. VP882 has the ability to lyse various *Vibrio* species (3). VP882 takes advantage of DPO as well; when *Vibrio cholerae* begins to disseminate, it can cause the cell to lyse, and therefore spread itself to new hosts. DPO activated the C1 protein, which in turn activated the Q protein, and led to lysis. She talked about how this could be used to create “kill switches” that worked across the kingdoms of life to moderate the pathogenicity of many bacteria. Dr. Bassler specifically mentioned that *Salmonella* was killed using this method. Quorum sensing could be the answer to limiting pathogenicity of different bacteria, especially in the age of antibiotic resistance. If scientists can trick bacteria into killing themselves, without harming the host, we may reach a new golden age of medicine.

Overall, I thoroughly enjoyed seeing Dr. Bassler talk. There was not a boring moment during her presentation, especially for Thursday at 11am. I was amused when I later realized she has been my main teacher for quorum sensing, since I watched her Ted Talk as part of an undergraduate class. I hope to have the chance to see her speak again in the future.