How cells make measurements

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A fundamental problem of cell biology is to understand how cells make measurements and then make behavioral decisions in response to these measurements. The full answer to this question is not known but there are some underlying principles that are coming to light. The short answer is that the rate of molecular diffusion contains quantifiable information that can be transduced by biochemical feedback to give control over physical structures.

In this talk, this principle will be illustrated by two specific examples of how rates of molecular diffusion contain information that is used to make a measurement and a behavioral decision.

Example 1: Bacterial populations of P. aeruginosa are known to make a decision to secrete polymer gel on the basis of the size of the colony in whch they live. This process is called quorum sensing and only recently has the mechanism for this been sorted out. It is now known that P. aeruginosa produces a chemical whose rate of diffusion out of the cell provides information about the size of the colony which when coupled with positive feedback gives rise to a hysteretic biochemical switch.

Example 2: Salmonella employ a mechanism that combines molecular diffusion with a negative feedback chemical network to "know" how long its flagella are. As a result, if a flagellum is cut off, it will be regrown at the same rate at which it grew initially.