Research Roundup

Bugs get decrepit too

There is no escape. Even the lowly *Escherichia coli*, which at first glance seems to go on dividing symmetrically and forever, ages over time, according to Eric Stewart, François Taddei (Inserm, Paris, France), and colleagues.

There was hope for *E. coli* immortality because the bug lacked obvious asymmetries. Organisms that age tend to segregate damaged molecules preferentially into a compromised parent, and that segregation often shows up as a morphological asymmetry. Furthermore, the uncompromised offspring often turns up as a juvenile form that must undergo further development or growth before being competent for reproduction. Signs of such a progression were also lacking in the case of *E. coli*.

Stewart and colleagues undertook a more comprehensive examination of *E. coli* division dynamics, using a custom-made, computerized tracking system that followed *E. coli* divisions as they generated 35,049 cells. Cleavage sites in the middle of the bacterium were defined as “new poles” and those at the distal ends as “old poles.” Thus, as cells divided to form a chain, cells at either end of the chain had particularly “old” poles. These cells had a growth rate 2.2% slower than that of “new pole” cells; they also divided later, produced less biomass, and were more likely to die. The differences increased as poles got increasingly “older” or “younger” (via repeated formation of “new” poles in consecutive divisions).

Stewart says he went into the study agnostic on whether *E. coli* would show its age. “I couldn’t decide myself, in the beginning,” he says. One reason is that “people don’t know to what extent damage can be fixed,” he says. “Perfect repair could be possible but the cost that would be involved would be high.” *E. coli* may instead attempt the kind of sorting of damaged contents that is seen during the generation of everything from budding yeast daughter cells to human germline cells. Stewart hopes to visualize any such sorting in *E. coli*; he is also screening for mutants that age (and thus produce dead cells) more slowly. JCB

Reference: Stewart, E.J., et al. 2005. *PLoS Biol.* doi:10.1371/journal.pbio.0030045.

Chemotaxis by local steering

Chemotaxing cells have a defined front and back. Thus, movement models have always included explanations of how a single cell can integrate information about its surroundings and come up with a single answer about where the “front” is located. But now Cécile Arrieumerlou and Tobias Meyer (Stanford University, Stanford, CA) claim that it is local decisions about lamellar extension that matter.

Meyer says this idea “was really from watching cells in the microscope and seeing how they make direction changes. It was more consistent with stochastic, small turns than the cell knowing where the signal is located.” The biased random walk was driven by local lamellipod extensions, correlated with PI3P pulses, that spanned only a fraction of the total leading edge. Furthermore, the actions of the left and right of the leading edge were not correlated.

The decision to protrude, Meyer believes, is based only on local chemoattractant binding, so that each receptor ligation triggers a local lamellipod that turns the cell by ~2 degrees. The steering, then, is just the stochastic difference between multiple small turns toward the left and right. This system “is running on the top of self-polarization at the front of the cell and helping to guide it,” says Meyer.

The distinct self-polarization process is important, however, in defining the front of the cell as the part of the cell that is responsive to turning and extension signals, and in allowing random walking in the absence of a chemotactic gradient. Such random walking increases the range of cells, so that they can reach the areas where chemotactic signals are present to guide their continued travels.

Meyer believes that the self-polarization does involve a global process, and also involves PIP3, but that the process is distinct from steering. He hopes to isolate components that are necessary locally for chemotactic steering but not globally for self-polarization and random migration. JCB

Reference: Arrieumerlou, C., and T. Meyer. 2005. *Dev. Cell.* 8:215–227.