VAST comet sightings

less is more when it comes to actin-fueled propulsion. Julie Plastino, Stéphane Olivier, and Cécile Sykes (Institut Curie, Paris, France) show that hollow actin comets propel beads faster than a more filament-packed comet.

Actin comets, which drive bead or bacteria movement, are thought to depend strongly on Arp2/3–built, branched actin networks. Now, Plastino et al. show that another actin polymerizer, VASP, builds comet tails that are less dense overall and hollow in the center, but nevertheless led to bead speeds that were seven times that of Arp2/3–built tails. “It’s not about having as much polymer as possible,” says Plastino. “It’s how the geometry of filaments affects movement.”

VASP is thought to weaken interactions between actin filaments and the membrane or bead. The first filaments to be detached would be those at the center back of the bead, as these bead–filament attachments produce the strongest pulling force on the moving bead. This hollowing out of the comet reduces friction between the bead and the comet and speeds the bead on its way. This model also supports the idea that actin squeezes the sides of beads to move them forward rather than pushing beads from behind.

VASP-built tails were aligned in the direction of movement, not angled like the branched Arp2/3 networks. The aligned arrangement resembles that of actin in filopodia, where VASP is prevalent. One speculation proposes that the inside surface of membrane invaginations at the leading edge of fibroblasts may be somewhat rounded like beads and similarly squeezed forward by actin filaments. Others have shown that VASP slows overall cell movement but quickens the protrusion of small membrane fluctuations. These bursts of speed are perfect for the exploratory nature of filopodia. JCB

Reference: Plastino, J., et al. 2004. Curr. Biol. 14: 1766–1771.

Insulin keeps time

Insulin hastens or delays differentiation so that it keeps pace with growth rates, according to results from Joseph Bateman and Helen McNeill (Cancer Research UK, London, UK).

Insulin is the perfect candidate to decide when cells should differentiate, as it is a well-known growth regulator. Along with the Tor pathway, which senses amino acid levels, insulin turns up ribosome synthesis to match increased nutrient availability. Bateman and McNeill now find that insulin and Tor also control neuronal tissue differentiation. Whereas the identities of cell fates were unaffected by changes in insulin signaling, the fates were acquired at inappropriate times.

The aberrant timings were easily seen in the developing fly eye, whose 800 photoreceptor clusters differentiate in a wave pattern that makes timing mutants easy to identify. While using the eye to find patterning mutants, the authors found that cells lacking TSC1, a negative regulator of Tor, differentiated prematurely compared with neighboring TSC1-containing clusters. Dampened insulin or Tor signaling, in contrast, delayed differentiation. Thus, when growth was delayed by factors resulting in low insulin levels, differentiation was also delayed appropriately.

The altered timings were measured by changes in the appearance of definitive transcription factors such as Elav and Prospero. But the Ras/MAPK pathway, which turns on these transcription factors, was not affected by tsc1. As it does with ribosomal proteins, insulin signaling may activate the translation of a differentiation factor that lies downstream of or parallel to Ras/MAPK.

Insulin’s control was independent of absolute cell size, thus allowing cell types of varying sizes to time differentiation via the same mechanism. Tsc1 had no effect on differentiation timing outside the nervous system, however. Neurons may depend on this insulin system because they are particularly sensitive to timing miscues given the precision required to make distant synaptic connections. JCB

Reference: Bateman, J.M., and H. McNeill. 2004. Cell. 119:87–96.