The needs of the pore

According to a model that has prevailed since the early 1990s, nuclear import complexes need to dock to the cytoplasmic filaments of the nuclear pore complex (NPC) before they can be translocated to the nucleus. On page 63, Walther et al. overturn this idea, demonstrating that cytoplasmic filaments have no essential function in the nuclear import of bulk cargos. The results also provide new insights on the composition of the filaments.

Using the Xenopus egg extract system, the authors analyzed two cytoplasmically oriented nucleoporins, CAN/Nup214 and RanBP2/Nup358. CAN/Nup214 was previously thought to be a component of the cytoplasmic filaments, but in the new work it appears to be located near the entrance to the translocation channel in the NPC. RanBP2/Nup358, however, is an essential component of the cytoplasmic filaments: depleting this protein causes NPCs to form without cytoplasmic filaments. Surprisingly, NPCs lacking cytoplasmic filaments show no deficiency in nuclear import, indicating that the filaments are dispensable for this function.

For a nuclear pore to form, the inner and outer membranes of the nucleus must fuse. This process is thought to involve the integral membrane protein gp210, which has a short COOH-terminal tail extending into the cytoplasm. Drummond and Wilson, reporting on page 53, now provide strong evidence to support this idea and present a new model to help explain nuclear pore formation.

Recombinant gp210 tail polypeptides, or antibodies against the tail, stop nuclear pore formation at an early stage. The polypeptides also cause the accumulation of “mini-pores,” which appear to represent an intermediate that is unable to dilate into a full-size pore. The authors suggest that specific nucleoporins may bind to the gp210 tails around these mini-pores, forming spokes or struts that dilate the pore.

Only one way to organize a movement?

Two reports in this issue identify a strikingly similar pattern of coordination between F-actin and microtubule dynamics, suggesting that such coordination may be a basic mechanism by which cells both direct movement and respond to environmental cues.

Previous work had suggested that microtubules mimic F-actin movements in migrating cells, but technological limitations have made this idea difficult to test. On page 31, Salmon et al., studying migrating epithelial cells from newt lung, used new fluorescence speckle microscopy (FSM) imaging techniques to observe the movement of F-actin and microtubules nearly simultaneously in living cells. F-actin moves differently in four zones of the cell. Microtubules oriented parallel to the leading edge precisely mimic F-actin movements in all four zones, whereas microtubules perpendicular to the leading edge are often uncoupled from F-actin movements in two of the zones. F-actin movement appears to drive much of the dynamic organization of microtubules, and the two proteins seem to interact.

On page 139, Schaefer et al. used FSM to measure actin and tubulin dynamics in neuronal growth cones, and correlated these measurements with motility. As in migrating cells, F-actin structures in the growth cone interact strongly with microtubules. Polarized F-actin bundles in the filopodia act as polymerization guides for a population of highly dynamic microtubules that continuously explores the peripheral P-domain. The filopodial actin also provides retrograde transport for the microtubules. Meanwhile, a separate, less dynamic population of microtubules associates with actin filament arcs in the T-zone, possibly promoting axon elongation. Schaefer et al. propose that the steady-state movement of F-actin and microtubules in the filopodia allows the system to adapt quickly: a slight decrease in retrograde F-actin flow, for example, would drive rapid microtubule advance along the filopodia.