Endocannabinoids have a generally depressive activity at adult synapses, but one of their receptors, CB1, is also expressed in the embryonic nervous system. On page 481, Williams et al. report a possible function for these CB1 receptors—they may respond to signals produced by FGF receptor activation. Several cell adhesion molecules promote axon outgrowth via activation of the FGF receptor, and the new work is the first demonstration of cross-talk between this and the endocannabinoid system.

The FGF receptor signaling cascade stimulates the hydrolysis of diacylglycerol (DAG), which is followed by calcium influx and axonal growth. Williams et al. focus on how DAG hydrolysis leads to calcium influx. As the first step of DAG hydrolysis produces the CB1 receptor agonist 2-arachidonylglycerol, the authors focused on the endocannabinoid system as a possible link. They found that, in rat neurons, CB1 antagonists inhibit the FGF2-stimulated neurite outgrowth response, and CB1 agonists stimulated neurite outgrowth in a manner that required calcium influx, indicating cross-talk between the two systems.

The mediation of tyrosine kinase receptor signals might be a general function of the endocannabinoid system during development. Several CB1 receptor agonists are already being tested as drugs for their neuroprotective activity, and the new results suggest that, in addition to preventing neuronal death, these compounds might also be able to stimulate axonal regeneration following an injury.

Unlike organelles with single membranes, chloroplasts must import proteins through both an outer and an inner membrane. Schleiff et al., reporting on page 541, have now isolated and characterized a protein complex from the chloroplast outer membrane, revealing a translocon with an unusual structure.

Previous work identified four proteins important for translocation across the outer chloroplast membrane, but the architecture of the translocon remained unknown. In the new work, the authors purified a core complex containing the translocon proteins Toc75, Toc34, and a fragment of Toc159, and found that this complex can recognize and translocate chloroplast precursor proteins. The absence of Toc64 in the functional complex suggests that this protein only transiently associates with the core translocon. Electron microscopy and image analysis reveals that the core complex has a toroidal shape, with a finger-like domain dividing a central cavity into four curved channels.

The complex is able to bind to four precursor proteins at a time, though the curved shape of the channels suggests that they might not be able to translocate simultaneously. The structure of the complex is consistent with an earlier model, in which Toc34 is the initial receptor for precursor proteins while Toc159 drives translocation through the pore.

Endocannabinoids promote neurite outgrowth.

Proteins enter chloroplasts through a four-channeled translocon.

Four channels, but only one program