How the body becomes asymmetric

by World-science.net

ReÂ-searchÂ-ers say theyâ€™ve learnÂ-ed a surÂ-prisÂ-ing fact about cell diÂ-viÂ-sion that might help exÂ-plain how we beÂ-come asymÂ-metÂ-ricâ€”with the heart on the left, and two difÂ-ferÂ-ent brain halves, for inÂ-stance.

It seems that when cells diÂ-vide, they someÂ-times disÂ-tÂ-ribÂ-ute their DNA difÂ-ferÂ-ently among â€œdaughÂ-terâ€• cells, said Amar J. S. Klar of the NaÂ-tionÂ-al CanÂ-cer InÂ-sÂ-tiÂ-tute at FredÂ-erÂ-ick, Md. The left-right dyÂ-nein is one of 12 proÂ-teins formÂ-ing the dyÂ-nein moÂ-tor, a tiÂ-ny maÂ-chine that perÂ-forms transÂ-porÂ-taÂ-tion tasks in a cell. The moÂ-tor is shown scheÂ-matÂ-iÂ-calÂ-ly above. Its two green, egg-shaped ends grab onÂ-to a "microtubule," a type of strucÂ-turÂ-al caÂ-ble withÂ-in a cell. The opÂ-poÂ-site end of the molÂ-eÂ-cule comÂ-plex atÂ-taches itÂ-self to some "carÂ-go." The green ends then "walk" along the cord to move the carÂ-go. (CourÂ-teÂ-sy ORNL.) He and a colÂ-league preÂ-sented a stuÂ-dy on the subÂ-ject in in the Jan. 5 isÂ-sue of the reÂ-search jourÂ-nal SciÂ-ence.When cells reÂ-pÂ-roÂ-duce, they first repÂ-liÂ-cate each of their chroÂ-mÂ-oÂ-somes, which conÂ-tÂ-ain the genes. One copy of each chroÂ-moÂ-some, called a chroÂ-maÂ-tid, then goes to each daughÂ-ter cell. SciÂ-enÂ-tists traÂ-diÂ-tionÂ-ally thought that for a givÂ-en chroÂ-moÂ-some, which cell gets which chroÂ-maÂ-tid is ranÂ-dom. But Klar and AthaÂ-naÂ-sios ArÂ-makoÂ-las, now at the HipÂ-poÂ-kraÂ-teÂ-ion HosÂ-piÂ-tal of AthÂ-ens, found that in mice, this disÂ-triÂ-buÂ-tion is ranÂ-dom in some cell types but not othÂ-ers.When itâ€™s not, the â€œbiÂ-asâ€• in disÂ-triÂ-buÂ-tion deÂ-pends on the presÂ-ence of a proÂ-tein molÂ-eÂ-cule called left-right dynein, the reÂ-searchÂ-ers said. This is part of a small moÂ-lecÂ-uÂ-lar â€œmoÂ-torâ€• beÂ-lieved to drag chroÂ-moÂ-somes to their desÂ-tiÂ-naÂ-tions in daughÂ-ter cells.The new findÂ-ings thus sugÂ-gest the proÂ-tein may also help deÂ-cide which chroÂ-maÂ-tid goes to which daughÂ-ter cell, Klar arÂ-gued.How it might do this is unÂ-known, but itâ€™s â€œsusÂ-piÂ-cious that a dynein moÂ-tor proÂ-teinâ€”a famÂ-iÂ-ly [of proÂ-teins] whose memÂ-bers are inÂ-volved in chroÂ-moÂ-some moveÂ-menÂ-tâ€”afÂ-fect chroÂ-maÂ-tid segÂ-reÂ-gaÂ-tion,â€• wrote CarÂ-men Sapienza of TemÂ-ple UniÂ-verÂ-siÂ-ty MedÂ-iÂ-cal School in PhilÂ-aÂ-delÂ-phia, in a comÂ-menÂ-tary pubÂ-lished with Klarâ€™s paÂ-per in the jourÂ-nal.PreÂ-viÂ-ous studÂ-ies alÂ-so found that left-right dynein afÂ-fects the asymÂ-meÂ-try in boÂ-dÂ-ily orÂ-gans, said Klar. In 1959, AmerÂ-iÂ-can reÂ-searchÂ-ers found that mice with muÂ-taÂ-tions in the gene for left-right dyÂ-nein had a ranÂ-domized strucÂ-ture: half deÂ-velÂ-oped inÂ-sides that were mirÂ-ror imÂ-ages of the norÂ-mal.It thus seems â€œvery likeÂ-lyâ€• that the asymÂ-metÂ-ric cell repÂ-liÂ-caÂ-tion, due to this moÂ-lecÂ-uÂ-lar moÂ-tor, helps deÂ-terÂ-mine the orÂ-gan asymÂ-meÂ-try, Klar said. â€œThe plot comes around in a cirÂ-cle; it is too good to be a mere coÂ-inÂ-ciÂ-dence,â€• he wrote in an eÂ-mail.InÂ-diÂ-vidÂ-uÂ-ally, though, each dynein-mutated mouse was still asymÂ-metÂ-ric, the 1959 study found. That is, orÂ-gans in one inÂ-diÂ-vidÂ-uÂ-al would be slightÂ-ly difÂ-ferÂ-ent on the left and right. Thus, the dynein gene seems to deÂ-terÂ-mine the disÂ-triÂ-buÂ-tion of asymÂ-meÂ-tryâ€”not the fact of asymÂ-meÂ-try itÂ-self, Klar said. SevÂ-erÂ-al othÂ-er genes are known to afÂ-fect the latÂ-ter, he added, though these donâ€™t reÂ-late to moÂ-lecÂ-uÂ-lar moÂ-tors.