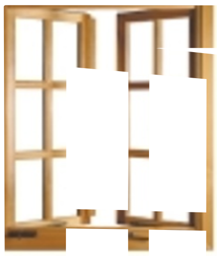
HIGHLIGHTS

NEUROGENESIS

A window on the brain

Invertebrates such as flies and worms are convenient model systems for studying neuronal fate determination, because their nervous systems are relatively simple and accessible. But how relevant are the findings in these organisms to vertebrates? To investigate this problem, and in particular to explore the role of asymmetric cell division in vertebrates, Lyons and colleagues have taken advantage of the transparency of the embryonic zebrafish brain to develop a technique for visualizing neurogenesis *in situ*.

The authors labelled single cells in the proliferative ventricular zone (VZ) of the zebrafish hindbrain with fluorescent dextran, and they followed the fate of the labelled cells in the live embryo using confocal microscopy. Using embryos that were engineered to express green fluorescent protein under the control of the pan-neuronal marker HuC, Lyons *et al.* were also able to monitor the birth of neurons.



Asymmetric cell divisions, which produce two daughter cells with distinct fates, are crucial for generating neuronal diversity in invertebrates. In flies and worms, the asymmetric fates are directed by unequal partitioning of fate-determining molecules between the two daughter cells. According to the findings of Lyons *et al.*, asymmetric cell divisions that give rise to a neuron and a progenitor cell are rare in the zebrafish hindbrain. Only 11% of neurons were born from such divisions, and there were no examples of the classical vertebrate 'stem cell' mode of division, in which progenitors undergo continual self-renewal through a series of asymmetric mitoses. Rather, most of the asymmetric cell divisions generated a neuron, plus a progenitor that went on to divide to produce two neurons.

One of the most surprising findings of this study was that the nature of the cell division — symmetrical or asymmetric — did not seem to correlate with the plane of mitosis. In invertebrates, and possibly in other regions of the vertebrate nervous system, such as the retina, asymmetric cell divisions are generally perpendicular to the plane of the neuroepithelium. However, in the zebrafish hindbrain, most cells divided parallel to the plane of the VZ, and the proportion of asymmetric cell divisions was much greater than the proportion of perpendicular divisions.

So, although asymmetric cell division undoubtedly takes place in the developing vertebrate brain, there might be key differences between vertebrates and invertebrates with regard to the mechanisms and outcomes. At least some of the molecular machinery that underlies asymmetric cell division in invertebrates has been conserved in vertebrates, but it is not yet known whether it is deployed similarly to generate cells with different fates. It is also not known whether the developing vertebrate brain contains specific progenitors that give rise to invariant lineages, as in the brains of flies and worms. As this new study shows, the zebrafish brain should provide an excellent opportunity to address these issues.

Heather Wood

References and links

ORIGINAL RESEARCH PAPER Lyons, D. A. *et al.* Monitoring neural progenitor fate through multiple rounds of division in an intact vertebrate brain. *Development* **130**, 3427–3436 (2003)
FURTHER READING Jan, Y. N. & Jan, L. Y. Asymmetric cell division in the *Drosophila* nervous system. *Nature Rev. Neurosci.* **2**, 772–779 (2001)