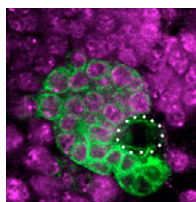


### Teleosts flex their muscles

In amniotes, muscle progenitors develop from the dermomyotome, an epithelium that overlays the somite. These myogenic progenitors bring about muscle growth and are well characterised;

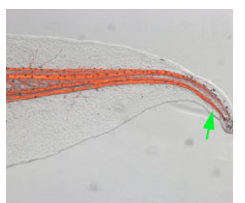
however, in teleosts these precursors have, until now, not been identified. Now, Devoto and colleagues use lineage-tracing and gene-expression studies to identify a population of cells that resides at the anterior border of zebrafish somites as the elusive myogenic precursors (p.1253). Surprisingly, these *pax7*-expressing precursors remain undifferentiated before they migrate to the outer lateral surface of the somite, where they initiate myotome growth. Unusually, anterioposterior somite patterning can, as shown in this study, generate subsequent myogenic precursor mediolateral patterning. While some progenitor cells remain at the surface of the myotome, others penetrate the slow-twitch muscle layer, moving between cells, to contribute to fast-twitch musculature. Even though the occurrence of external myogenic precursors is now shown to be conserved among vertebrate lineages, the origin and movement of the teleost precursor cells is unexpectedly different.



### A gap in the circuit

*Drosophila* embryonic neuroblasts give rise to larval-brain primary neurons, from which secondary adult neurons are subsequently derived. The gap gene *empty spiracles* (*ems*) has a well-known role in *Drosophila* embryonic brain development, whereas

little is known about its function in adult secondary neurons. According to Lichtneckert et al., *ems* is expressed in a single neuroblast in each hemisphere of the adult brain and autonomously determines the number of progeny (as shown by MARCM clonal analysis) in the adult lineage (see p. 1291). Interestingly, *ems* expression persists throughout metamorphosis into adulthood. In *ems* mutant lineages, neurite projections are short and misdirected. This elegant study highlights how neuronal circuitry is established and maintained into adulthood during brain development, and reveals an unexpected role for a gap gene in translating lineage information into cell-number control and into the correct projection of a clonal unit of the adult brain. It also highlights conserved functions of orthologous *ems/Emx* homeobox genes in the early embryo and during later brain development.



### Turning up the voltage on regeneration

In certain contexts, voltage gradients and ion flows are known to regulate developmental patterning, but their precise role has remained ambiguous. Now, Michael Levin and colleagues

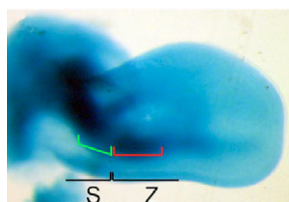
report on the role of the V-ATPase H<sup>+</sup> pump in *Xenopus* tail regeneration. Cells in an uncut tail have normal membrane potential levels. However, following the amputation of the tail, the regeneration bud becomes depolarised (p. 1323). Shortly after, V-ATPase expression is triggered, leading to H<sup>+</sup> flux and to the rapid repolarisation of these cells. The genetic or biochemically induced loss of V-ATPase activity prevents tail regeneration, but not as a consequence of apoptosis. Axon patterning and tail outgrowth are restored if H<sup>+</sup> flux is induced. This fascinating study shows that ion flows do not simply perform housekeeping duties and that, during *Xenopus* tail regeneration, H<sup>+</sup> flux controls both cell number (through membrane voltage) and correct axon guidance (nerves are a known growth-factor source) into the regenerative bud. Ion pumps provide a tantalising target for future biomedical research into regeneration.



### A time to die

Programmed cell death (PCD) is an important developmental process, but how do cells know when it is time to die?

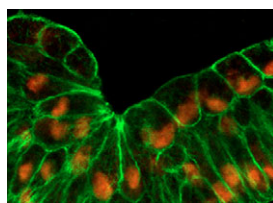
Shai Shaham and co-workers now reveal the role that the transcription factor PAL-1 and the caspase CED-3 play in *C. elegans* tail-spike cell death (p.1357). Cell death in other *C. elegans* cells occurs via the EGL-1-mediated inhibition of CED-9, a BCL-2 protein, which triggers the release of the caspase activator CED-4 to cause CED-3 activation and cell death. The researchers show that PAL-1, independently of CED-9 activity, binds to the *ced-3* promoter to cause its transcriptional induction. This induction immediately precedes cell death, indicating that *ced-3* transcription is the temporal cue for PCD initiation. In *pal-1* mutant worms, *ced-3* is not upregulated and tail-spike PCD is prevented. Because the mammalian homologue of PAL-1 is Cdx2, which, when mutated, can cause intestinal tumours, the authors propose that by modulating *Cdx2* expression, the overproliferation that is associated with intestinal cancers could be targeted.



### Limb development: into the mix

How cells in the developing limb are patterned to form distal or proximal limb structures is a contentious issue. One current model – the prespecification model

– proposes that cells are specified into all regions along the proximodistal axis at an early stage. Now, in contrast to these findings, Tamura and co-workers show that, while the proximal chick limb region is regionalised at an early stage of limb development, the distal region is maintained in an unregionalised condition and consists of intermingling cells (see p.1397). These intermingling cells can adopt either a zeugopod (more proximal) or autopod (distal) fate, as shown by the analysis of *HOXA11* and *HOXA13* expression. Later in development, a clearer boundary can be seen between the autopod and zeugopod regions, but some cell mixing still occurs within the distal autopod region. This study redefines our understanding of cell specification within the developing limb and suggests that each limb structure is likely to be regionalised in a proximodistal direction.



### Shrooming into shape

Cell shape changes brought about by, for example, apical constriction and apicobasal elongation, are a common feature of morphogenesis. But, although the basis of apical constriction is becoming clearer, the

molecules that govern apicobasal elongation remain a mystery. Now, on p. 1431, John Wallingford and colleagues report that Shroom3 – an actin-binding protein – is required for the apicobasal elongation of neuroepithelial cells during *Xenopus* neural tube closure. Surprisingly, Shroom3 redirects the apical distribution of the microtubule (MT) regulator  $\gamma$ -tubulin, causing apicobasal MT arrays to form, although how  $\gamma$ -tubulin interacts with MTs in this setting is unknown. Since Shroom3 is already known to act in apical constriction, it now appears to be required for both types of neuroepithelial cell shape change during neural tube closure. Shroom1 is also shown to direct  $\gamma$ -tubulin redistribution, revealing a conserved function for Shroom proteins. By combining their data with those of earlier studies, the authors propose a model in which epithelial cell shape changes, but not polarity, depend on Shroom3.