

Long-range Shh message dispatched

The secreted morphogen sonic hedgehog (Shh) and other hedgehog (Hh) proteins control many aspects of normal development through short- and long-range signalling. But, before being released from its source cells, two lipid moieties are added to Shh that probably make it insoluble, so how does Shh signal over long distances? Henk Roelink and colleagues report that dispatched 1 (Disp1, a twelve-transmembrane protein that resembles the Shh receptor patched 1, Ptch1) plays a role in long-range Shh signalling in vertebrate cells (see p. 133). In polarised epithelial cells, they report, Disp1 function is required for the basolateral secretion of Shh, and Ptch1 on adjacent cells is required for Shh uptake. By measuring the Shh response in neuralised mouse embryoid bodies with and without Disp1 function, they show that the Shh signalling range is shortened in *Disp1*^{-/-} tissue, even when Shh is produced by co-cultured Disp1-expressing cells. Together, these results suggest that reiterated Disp1-dependent Shh secretion, coupled to Ptch1-dependent Shh uptake, distributes Shh through tissues rather than long-range diffusion.



Mediating timely radial patterning of plants

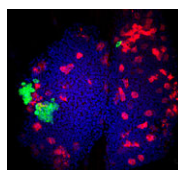
Pattern formation involves temporally and spatially regulated changes in gene expression but the temporal component of pattern formation is poorly understood.

On p. 113, Scott Poethig and colleagues begin to fill this knowledge gap by reporting that two newly identified genes – *GRAND CENTRAL* (*GCT*) and *CENTER CITY* (*CCT*) – are involved in the temporal regulation of radial polarity in *Arabidopsis* embryos. They show that mutations in *GCT* and *CCT* delay the specification of the central and peripheral domains of *Arabidopsis* embryos without affecting their initial growth rate or eventual pattern. They identify *GCT* and *CCT* as the *Arabidopsis* orthologues of MED13 and MED12, respectively; these conserved proteins repress transcription by inhibiting core Mediator, a complex that allows transcription factors to activate RNA polymerase II. The researchers suggest, therefore, that *GCT*/MED13 and *CCT*/MED12 regulate pattern formation during *Arabidopsis* embryogenesis by transiently repressing the transcription of genes that would otherwise interfere with radial pattern formation, thus revealing a novel temporal regulatory mechanism in plant embryogenesis.



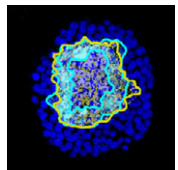
Genomic imprinting from good housekeeping

Maternal effect genes, which affect the next generation when they are maternally inherited, are important in the early development of many animals. The maternal contribution to early plant development is less clear but maternal effects in plants have been attributed to the restricted expression of maternal alleles through genomic imprinting. Now, Frédéric Berger and colleagues report that, in *Arabidopsis*, the housekeeping gene *DNA LIGASE 1* (*AtLIG1*), which mends DNA single-strand breaks, exerts a maternal effect on seed development by being involved in a pathway that controls imprinting (see p. 73). They show that maternal inheritance of loss-of-function *AtLIG1* mutations disrupts the development of the endosperm, the seed tissue that nurtures embryonic development. Additional experiments suggest that the maternal effect associated with mutant *AtLIG1* could arise because *AtLIG1* usually repairs the DNA single-strand breaks caused by *DEMETER* (*DME*), a DNA glycosylase that transcriptionally activates the maternal allele of imprinted genes by removing methylated cytosine residues. Whether similar events occur during imprinting in animals awaits further investigation.



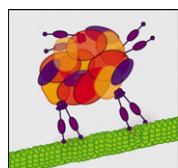
Elusive fly haematopoietic stem cell found

Haemocytes, the immune system cells of *Drosophila*, are produced during larval development by the fly's lymph gland, a structure that is established by mid-embryogenesis. Now, for the first time, Svetlana Minakhina and Ruth Steward identify *Drosophila* haematopoietic stem cells (HSCs) in the lymph glands of embryos and young larvae (see p. 27). They use lineage analysis to show that single lymph gland cells give rise to large, persistent clones (indicative of the presence of stem cells that can both self-renew and produce pluripotent daughter cells) or to smaller, transient clones (indicative of non-stem cells). Interestingly, even single cells marked very early in lymph gland development can form both types of clones, challenging the long-held belief that all the cells in embryonic primordia form stem cells. Finally, the researchers show that the conserved zinc finger protein Zfp8/PDCD2 is essential for the maintenance of the HSCs but not of their pluripotent daughter cells. This factor, they suggest, might play a similar role in vertebrate haematopoiesis.



Networking to segregate the endomesoderm

Early in animal development, most of the endoderm and the mesoderm segregate from the endomesoderm. In sea urchin embryos, a gene regulatory circuit that includes the Delta/Notch signalling pathway (which is expressed in the micromeres, precursors of the skeletal mesoderm) and the transcription factors Gcm and FoxA (which are expressed in the mesoderm and the endoderm, respectively) controls endomesoderm segregation. Now, on p. 83, Jennifer Croce and David McClay describe how Delta, Gcm and FoxA interact temporally and spatially to control this important process. Their combined lineage and gene expression analyses indicate that, shortly before hatching, Gcm and FoxA are co-expressed in the most vegetal endomesoderm descendant cells (Veg2L cells). At hatching, Gcm expression continues in these cells, whereas FoxA expression is downregulated in the Veg2L cells and activated in the cells lying directly above. Delta/Notch signalling in the micromeres is needed for at least 2.5 hours to maintain Gcm expression and mesoderm fate in the Veg2L cells. Together, these results provide new insights into the mechanisms that underlie endomesoderm diversification.



bicoid mRNA localisation: Swallow flies in

The localisation of *bicoid* mRNA to the anterior of the *Drosophila* oocyte, which is required for the patterning of the embryo's anteroposterior axis, involves the movement of *bicoid* mRNA transport particles along microtubules. Elizabeth Gavis and co-workers have been investigating how the *bicoid* mRNA localisation factors Staufén and Swallow act in *bicoid* mRNA transport and, on p. 169, they report that these proteins play direct and indirect roles, respectively. By carefully studying the distribution of Swallow, Staufén, dynein and *bicoid* mRNA during late oogenesis, the researchers show that Swallow and *bicoid* mRNA are transported independently and are not colocalised at their final destination. By contrast, Staufén, dynein and *bicoid* mRNA form non-membranous, electron-dense particles at the oocyte anterior. Given these and other results, the researchers propose that Swallow is transported independently by dynein to the oocyte plasma membrane, where it contributes indirectly to *bicoid* mRNA localisation by organising the cytoskeleton, whereas Staufén plays a direct role in dynein-dependent *bicoid* mRNA transport.

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