Genetic mosaics and mitotic recombination

Genetic mosaics are embryos derived from a single genome but in which there is a mixture of cells with rearranged or inactivated genes. In flies, genetic mosaics can be generated by inducing rare mitotic recombination events in the somatic cells of the embryo or larva. The original method was to induce chromosome breaks using X-rays just after the chromosomes have replicated to form two chromatids; this results in the exchange of material between homologous chromosomes as the break is repaired. Today, mitotic recombination is induced in strains of transgenic flies that carry the gene for the yeast recombinase FLP and its target sequence, *FRT*, on their chromosomes. Activation of the recombinase will result in recombination involving the *FRT* sequence. A mitotic recombination event can generate a single cell with a unique genetic constitution that will be inherited by all the cell's descendants, which in flies usually form a coherent patch of tissue (S9.1).

Easily distinguishable mutations like the recessive *multiple wing hairs* can be used to identify the marked clone; if a cell homozygous for this mutation is generated by mitotic recombination in a heterozygous larva, all of its descendant cells will have multiple hairs (Figure 1). Marked epidermal clones made by this method are usually small, as there is little cell proliferation after the recombination event. Larger clones can be made using the *Minute* technique. The cells in flies carrying a mutation in the *Minute* gene grow more slowly than those in the wild type. By using flies heterozygous for the *Minute* mutation, clones can be made in which the mitotic recombination event has generated a marked cell that is normal because it has lost the *Minute* mutation, and so is wild type. This normal cell proliferates faster than the slower-growing background and thus large clones of the marked cells are produced (see Fig. S8.1). The mitotic recombination technique has many applications. If clones of marked cells are generated at different stages of development, one can trace the fate of the altered cells and thus see what structures they are able to contribute to. This can provide information on their state of determination or specification at different developmental stages. The technique can also be used to study the localized effects of homozygous mutations that are lethal if present in the homozygous state throughout the whole animal.

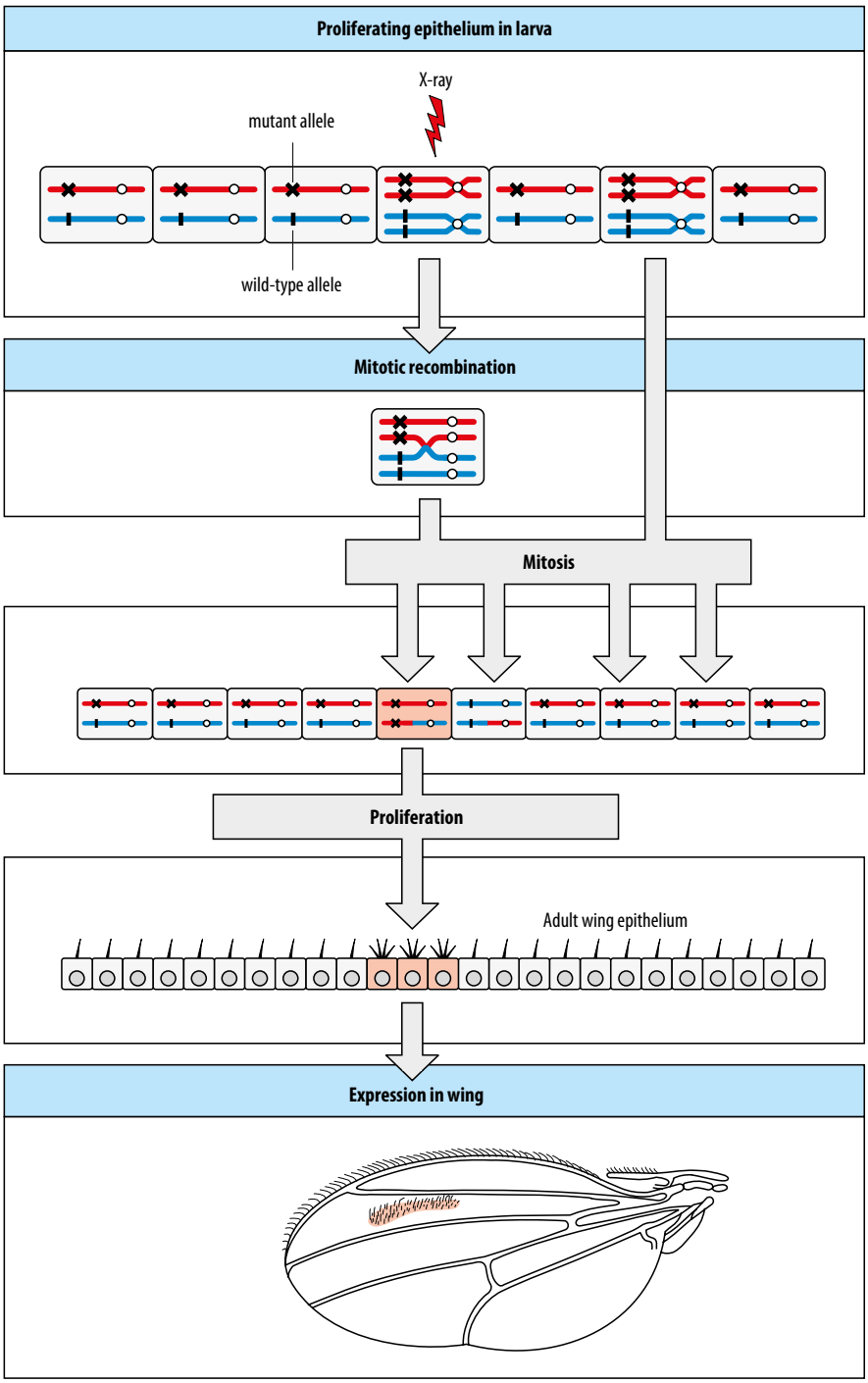

Fig. S9.1 *Illustration after Lawrence, P.:* The Making of a Fly. *Oxford: Blackwell Scientific Publications, 1992.*