

Insulators: Protecting Genomic Areas from Transcription Factor Binding

The boundaries within which enhancers act are set by DNA sequences called **insulators**. Insulators “insulate” a promoter from being activated by another gene’s enhancers. Some insulator DNA regions have been found to bind a zinc-finger transcription factor called CTCF,ⁱ which functions to alter the three-dimensional conformation of chromatin and thereby separate (or insulate) enhancer elements from the promoter (Yusufzai et al. 2004; Kim and Kaang 2015). CTCF is ubiquitously expressed in eukaryotes and has been charted to bind tens of thousands of sites on the genome (Chen et al. 2012). Mechanistically, CTCF physically interacts with cohesin, a ring-shaped complex of multiple subunits that function to stabilize chromatin loop structures (see the discussion of the Mediator complex in Further Development 3.4 online). It is hypothesized that CTCF uses its 11 zinc-finger domains to selectively bind DNA, often insulator elements, to create loop structures that distance enhancers from promoters.

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ⁱ CTCF stands for *CCCTC-binding Factor*. Although we highlight its role as an insulating factor, CTCF can also contribute to chromatin architecture and in some cases activate transcription by bringing enhancers in contact with promoters. (See Kim and Kaang 2015.)