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Fish Signals Are Like Amphibian Signals

Like amphibians, fish induce the epidermis by BMPs (especially BMP2B) and Wnt proteins (especially Wnt8) made in the ventral and lateral regions of the embryo (see Schier 2001; Tucker et al. 2008). The notochords of both zebrafish and *Xenopus* secrete factors (the homologues of *chordin*, *noggin*, and *follistatin*) that block this induction, thereby allowing the ectoderm to become neural (Dal-Pra 2006). As in amphibians, FGFs made in the dorsal side of the embryo also inhibit BMP gene expression (Fürthauer et al. 2004; Tsang et al. 2004; Little and Mullins 2006). In the caudal region of the embryo, FGF signaling is probably the predominant neural specifier (Kudoh et al. 2004). And as in *Xenopus*, insulin-like growth factors (IGFs) also play a role in the production of the anterior neural plate. Zebrafish IGFs appear to upregulate *chordin* and *goosecoid* while restricting the expression of *bmp2b*. Although IGFs appear to be made throughout the embryo, during gastrulation the IGF *receptors* are found predominantly in the anterior portion of the embryo (Eivers et al. 2004). Also, Wnt inhibitors appear to play roles in head formation. When antisense morpholinos are used to downregulate Wnt3a and Wnt8 throughout gastrulating zebrafish embryos, the trunk structures become anteriorized (Shimizu et al. 2005b).

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