

## Chapter 25

### Evolutionary Aside 25.2--Co-option of a Limb Gene to Make Armor

The *pairedlike homeodomain transcription factor 1* (*pitx1*) is expressed in the hindlimbs of developing mouse embryos, and its homologue is expressed in the pelvic region of the nine-spine stickleback fish (*Pungitius pungitius*). Much like *Brachyury* gene evolution, *pitx1* was co-opted for a new function in tetrapods. Within the sticklebacks, *pitx1* gene expression is different in marine and freshwater populations of the same species, yet the *pitx1* proteins in both populations have identical amino acid sequences. The explanation for the difference can be found in the regulatory regions of the gene that are not translated into protein.

Marine sticklebacks have skeletal armor, including spines, in the pelvic region that protects them from predatory fish. Isolated populations in freshwater have lost the pelvic skeletal armor and do not express *pitx1* in the pelvic region. Loss of gene expression, rather than a change in the protein structure of this transcription factor accounts for the morphological differences between the marine and freshwater sticklebacks.