

## Chapter 9

### Evolutionary Aside 9.1--The GPCR Gene Superfamily

GPCR gene family is one of the largest gene families in vertebrate genomes. It is usually referred to as a superfamily since it can be broken down to five subfamilies. It is also an excellent example of the possible fates of gene families over evolutionary time. The expansion of this family in vertebrates is striking, but there is also both expansion and contraction in specific vertebrate lineages as well.

The members of the five subfamilies are all present in the urochordate *Ciona intestinalis*, which diverged from the lineage leading to vertebrates approximately 520 MYA. This divergence predates two doubling events that are thought to have occurred in the vertebrate lineage. These two doubling events may have provided the evolutionary material that then allowed the expansion and diversification of the GPCR family.

The most conserved part of the GPCR protein is the characteristic seven transmembrane domain region. The external and internal portions of the protein involved in ligand binding and signal transduction have diverged to produce a wide variety of functions among the members of this superfamily. The expansion of the superfamily appears to have been produced by gene duplication events of either single genes or regions of the genome. In addition to the expansion of the gene family within vertebrates, many lineage-specific changes have occurred in different classes of vertebrate. Many of these appear to be due to duplications within specific chromosomes of the type produced by errors in recombination.

Duplicated genes can have opposite evolutionary fates: diversification leading to new function, or loss of function leading to pseudogenes. Both of these fates can be seen in the GPCR family, illustrated by the expansion of receptors types involved in chemoreception seen in the rat, with the same subfamily losing members in the human lineage.