



B



FIGURE 24.15. Origin of new genes. (A) Schematic diagram of the gene structures of three protein-coding genes including two antifreeze glycoproteins (AFGPs) and trypsinogen. Large boxes correspond to exons and thin boxes to introns. Hatching shows untranslated regions. Signal peptides are stippled. Regions of similar sequence between the genes are in similar colors. Regions of homology between the trypsinogen and AFGP genes from the Antarctic fish *Dissostichus* are connected by dashed lines. It has been proposed that the AFGP of *Dissostichus* evolved from the trypsinogen through an expansion of a DNA sequence element that can encode the protein repeat found in the AFGP protein. The nonhomologous AFGP from another fish is shown below. (B) *Dissostichus mawsoni*.

24.15, redrawn from Logsdon J.M. et al., *Proc. Natl. Acad. Sci.* **94**: 3485–3487, © 1997 National Academy of Sciences, U.S.A.; photo courtesy of Paul A. Cziko