

Problem Set: DNA/RNA

Some exam-like questions....

1. Rich remarks that tRNA denatures upon heating, but “snaps back” into the native conformation upon cooling.
 - (a) Propose a method for demonstrating the denaturation of a tRNA molecule.
 - (b) Using the method described in (a), describe the results you would expect if the “snap back” renaturation that Rich mentions is true.
 - (c) Predict the effect of increasing the salt concentration in the buffer on the denaturation observed as in (a).
 - (d) Nowadays, we can isolate the gene for a particular tRNA, and compare the denaturation and renaturation of the tRNA with the denaturation and renaturation of a double-stranded DNA form of the tRNA gene. When this is done, the two are found to be different in small, but reproducible ways. Describe three molecular differences between the two that could give rise to these differences.
2. Consult the paper by Ban et al on the structure of the large ribosomal subunit to answer the following questions.
 - (a) In addition to the primary large rRNA molecule, the large subunit contains a smaller RNA molecule, called 5S RNA. The secondary structure map of this RNA is given in Figure 4D, and the 3D structure is shown in cartoon form in Figure 4L at the bottom of p. 913. Remarkably, this molecule, although it is found in large ribosomal subunits from all organisms examined, is not highly conserved in sequence. Explain why not, and predict where you would expect to find conserved residues, if any are present at all.
 - (b) Is it reasonable to describe the 5S RNA as a domain? Why or why not?
 - (c) Speaking of being conserved, it was remarked in lecture that the amino acids of the tail portions of ribosomal proteins are often more conserved than the amino acids in the globular portion of the molecules. Why is this fact surprising, and what does it say about the function of ribosomal proteins.
 - (d) In an accompanying paper, the Yale group remarks that the exit tunnel for the growing polypeptide chain is largely hydrophilic and water filled. Could an RNA-based structure have had any other character? Explain.