Energy forces at work in multi loops

by Eli Fisker

Here is a demonstration of how different types of basepairs work in multiloops, and why direction of those pairs do matter. I painted in arrows, to demonstrate which way I think the energy forces are at work in the multiloops.

The first example is with the strong GC-pair:

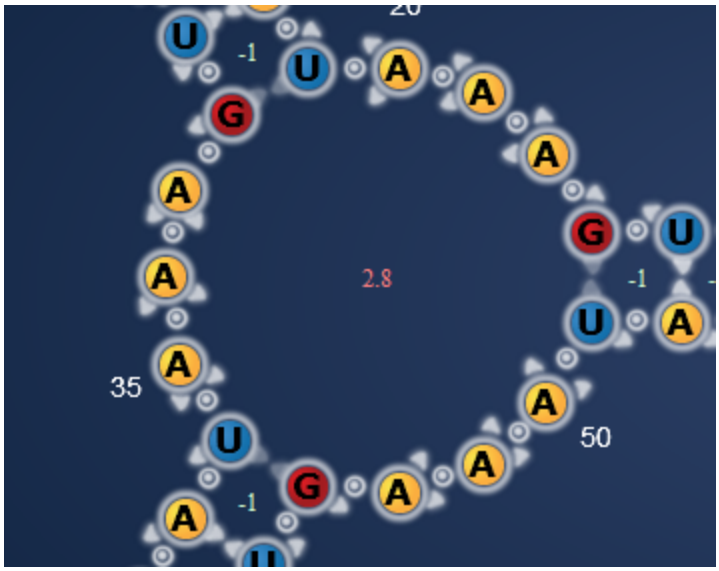
Notice the difference in energy level inside the multiloop above and below. This is how much energy difference there is, depending on which way the GC-pairs turn. In multiloops, negative energy is good, as it helps keeping the structure together. So in the picture below, the multiloop structure is much weaker.

Remember, place the red nucleotide to the right side, when putting GC-pairs in multiloops. (In lab, in some types of puzzles, the GC-pair in the multi loop connecting to the neck, can sometimes turn in both direction) Both of these two examples are stable when it comes to the structure. But the bottom one won't stand much energetic pressure from elsewhere in the design.

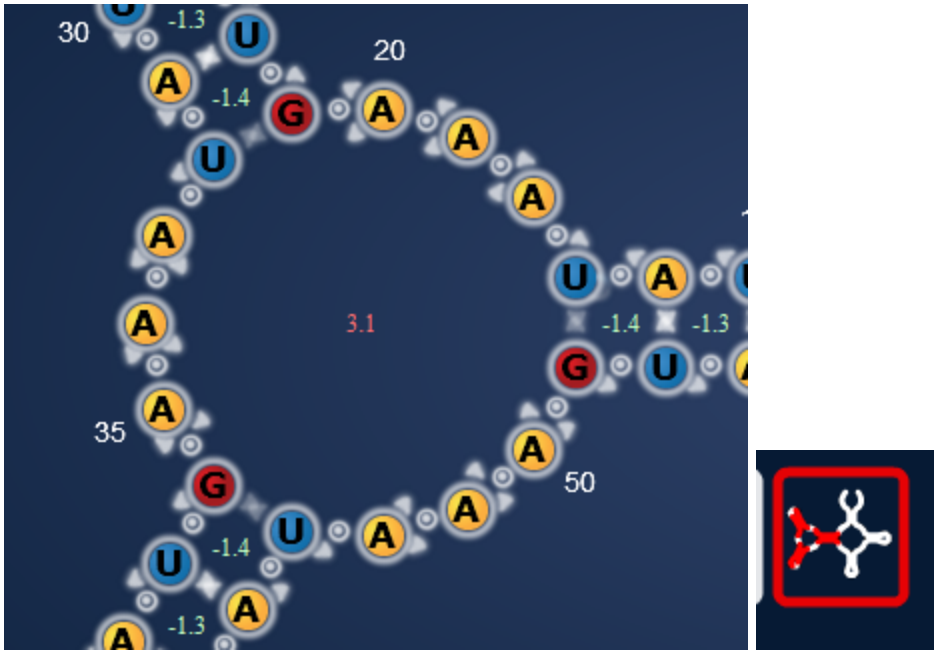
Here is why it is generally a good idea to have GC-pairs in junctions. Notice the high amount of positive energy inside. It will make the structure fall apart.

Even here direction of the base pairs matter, but not as much, as when it comes to GC-pairs.

The weakest base pair GU is making even more trouble than an AU-pair. None of these two multiloops are stable in the lab. In puzzles however these can be stable in designs using few or none GC-pairs.



Funny enough the amount of energy inside is the same no matter if AU or GU pairs are used here.



The pictures are taken of different mods of my design “robot arm” which I made to make a demo of this.

Written July 2011