**This worksheet is divided into *tasks* 8-11 and is accompanied by a rubric that totals 100 points**

**Task 8: Things fall apart**

Mutations aren’t magic. They’re chemistry, and they’re the engine of evolution. What is the relationship between chemical alterations of the base structures and change in ‘information’ (mutation)? First, let’s compare a base and its ‘decayed’ derivative.

Click the ‘Just Look’ checkbox at the lower right of the screen. Select Adenine on the *left* and Hypoxanthine in the right window.

**?What are the chemical differences between Ade and HypX? How do you think hypoxanthine arises in cells?**

What’s going on here? Just water. It’s an easy chemical reaction that’s going on in your cells *right now*. Rungs in the ladder of your DNA are undergoing ‘plastic surgery’ and changing their faces. To consider the consequences, do the following…

Uncheck the ‘Just look’ checkbox again. Put hypoxanthine in the **LEFT** window and *cytosine* in the right. Once you’ve ‘marked’ the basepairing positions on hypoxanthine, see what you can achieve with pairing.

Click the ‘Add Pairing’ button (adds **HC**).

**Task 9: Worse than Ade => HypoX: Cyt to Ura!** Hypoxanthine is dangerous because it is derived from Ade, but pairs with Cyt. But you can imagine a machine that patrolled the DNA for hypoxanthine, which is clearly an alien (indeed, you have such a machine, and dozens of others like it). But a more insidious event can take place through the same chemistry. In this case, *cytosine* is deaminated to *uracil*. If your nucleic acid were RNA (and we have every reason to believe it’s the more ancient nucleic acid), both of these are legitimate members of the code--the error would not create an ‘alien’. Click the checkbox at lower right to enter ‘Just Look’ mode and pull up cytosine and uracil, and confirm that the differences are again an -NH2 group becoming replaced by an oxygen =O, accompanied by a shift in double bonds.

**Task 10: One ‘letter’ becomes another**Deamination events such as the one you observed with adenine ‘can happen to anybody’. That one changes a ‘legit’ member of the genetic code of DNA to a clear faker: hypoxanthine isn’t one of the four ‘letters’ used in DNA (A,G,C,T). The RNA code set, however, is A, G, C and uracil (U). Deamination of cytosine creates uracil--not something uracil-like; **URACIL**. Who is uracil’s pairing partner?

\*\*\*In MCB184 This will be the topic of in-class lecture\*\*\*

**?Consequences in RNA:** What bases are ‘legit’ components of RNA found in cells (including the copy of DNA sent out to the cytoplasm as protein-building instructions)? Could you distinguish a ‘factory original’ uracil from one accidentally derived from cytosine via deamination? What happens in cases where C => U?

**Task 11: Extracting meaning (20 points!!!** Be brief, but concrete and *thoughtful* **)**

**?Summary:** Under what circumstances would the sequence of nucleotides in the starting pair of strands give rise to ‘descendent’ strands that did not have identical bases?

As a specific example, imagine starting with

ACTGT  
TGACA

and describe, using information you have learned/studied above, how it could give rise to two descendent double strands that were *not* identical (though one may match the original)