**Genetic Code Problem:** After her adventures in Oz, Dorothy came to TRU and became a biochemist. Soon thereafter, she was summoned back to Oz by the wizard to carry out a special project. The wizard, as it happens, had been dabbling in biochemistry himself. He had determined that all of the basic rules of protein and nucleic acid structure and synthesis are the same in Oz as they are on Earth, with only two apparent exceptions. First, in Oz, only twelve different amino acids could be detected in protein samples (Gly, Pro, Leu, Arg, Phe, Tyr, Glu, Ser, Cys, Gln, and Met). Second, the wizard discovered that the genetic code in Oz was a doublet rather than a triplet code. He wanted Dorothy to solve the genetic code and she agreed to try.

Employing some of the local bacteria, she set up a cell-free protein synthesis system. She then synthesized a number of RNA polymers using both chemical and enzymatic methods. She added the synthetic RNA molecules to her cell-free protein synthesis system and analyzed the amino acid content of the resulting polypeptides. These experiments yielded a complete answer in a few months’ time. Already possessing a perfectly adequate brain, Dorothy demanded hard cash for her efforts. The wizard not only complied, but kept her on the payroll to work on suicide inactivators for wicked witches. Our story ends here, but yours does not!

Dorothy’s results are given below. Use these results to work out the genetic code for Oz and fill in the table provided. Assume that any degeneracy in the code occurs in the second base of the codon (i.e., if two codons code for the same amino acid, the first base of both codons is identical).

Table I. Dorothy’s results

|  |  |
| --- | --- |
| Amino acid composition of synthetic RNA | Polypeptide product |
| poly (A) | Gly 100% |
| poly (U) | Lys 100% |
| poly (C) | Tyr 100% |
| poly (A) with one U at 3/ end | Gly 100% |
| poly (U) with one A at 3/ end | Lys 100% |
| poly (C) with one G at 3/ end | Tyr 96%, Pro 4% |
| AUAUAUAU, etc. | Gly 100% |
| ACACACACA, etc. | 2 peptides, either Phe 100 % or Met 100% |
| 80% U, 20% G | Lys 63%, Leu 16%, Cys 17%, Gln 4% |
| 80% A, 20% G | Gly 65%, Arg 16%, Leu 15%, Gln 4% |
| 80% C, 20% U | Tyr 64%, Ser 16%, Phe 17%, Lys 3% |
| 80% C, 20% G | Tyr 62%, Glu 17%, Pro 18%, Gln 3% |

The Genetic Code of Oz

Second base in codon

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| First base in codon |  | A | C | U | G |
| A |  |  |  |  |
| C |  |  |  |  |
| U |  |  |  |  |
|  | G |  |  |  |  |