In transcription, we make different forms (RNA from DNA) of the same chemical language: nucleic acids. But the next step, translation, involves a much more dramatic change. Getting back to our music analogy, think about how different it is to write notes on sheet music compared with actually playing that music. The notes are the instructions but the song we hear is the real functional outcome, what actually moves our emotions.

Just as written notes on a page help us enjoy music, or as the Rosetta Stone helped us to translate between hieroglyphics and classic Greek, the genetic code helps us to translate from the nucleic acid language to the amino acid language. Using this code, we can read each mRNA codon and know exactly which amino acid should be inserted into a protein, the functional outcome of gene expression.

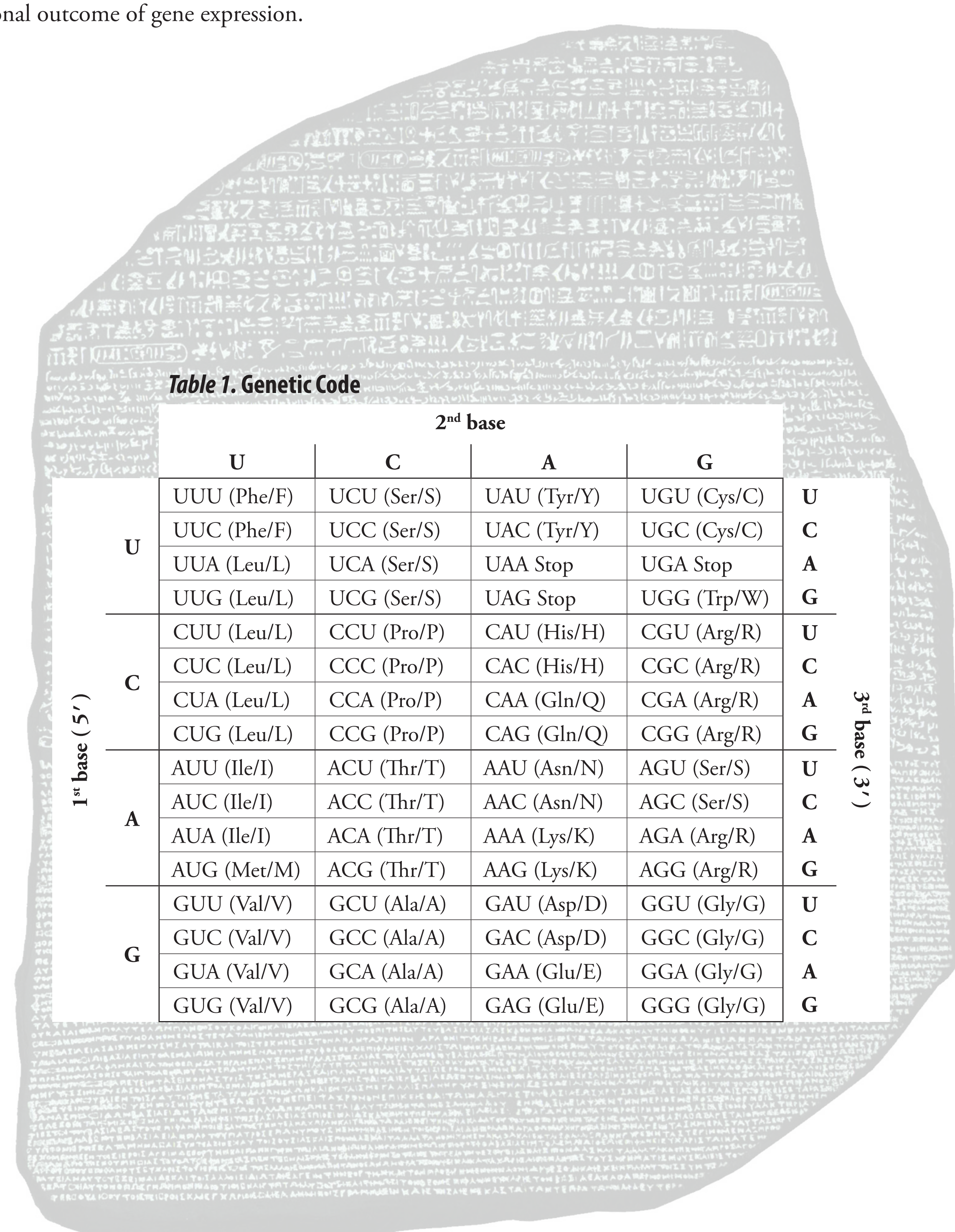

***Table 1*. Genetic Code**

		2nd base				
		U	**C**	**A**	**G**	
1st base (5′)	**U**	UUU (Phe/F)	UCU (Ser/S)	UAU (Tyr/Y)	UGU (Cys/C)	**U**
		UUC (Phe/F)	UCC (Ser/S)	UAC (Tyr/Y)	UGC (Cys/C)	**C**
		UUA (Leu/L)	UCA (Ser/S)	UAA Stop	UGA Stop	**A**
		UUG (Leu/L)	UCG (Ser/S)	UAG Stop	UGG (Trp/W)	**G**
	C	CUU (Leu/L)	CCU (Pro/P)	CAU (His/H)	CGU (Arg/R)	**U**
		CUC (Leu/L)	CCC (Pro/P)	CAC (His/H)	CGC (Arg/R)	**C**
		CUA (Leu/L)	CCA (Pro/P)	CAA (Gln/Q)	CGA (Arg/R)	**A**
		CUG (Leu/L)	CCG (Pro/P)	CAG (Gln/Q)	CGG (Arg/R)	**G**
	A	AUU (Ile/I)	ACU (Thr/T)	AAU (Asn/N)	AGU (Ser/S)	**U**
		AUC (Ile/I)	ACC (Thr/T)	AAC (Asn/N)	AGC (Ser/S)	**C**
		AUA (Ile/I)	ACA (Thr/T)	AAA (Lys/K)	AGA (Arg/R)	**A**
		AUG (Met/M)	ACG (Thr/T)	AAG (Lys/K)	AGG (Arg/R)	**G**
	G	GUU (Val/V)	GCU (Ala/A)	GAU (Asp/D)	GGU (Gly/G)	**U**
		GUC (Val/V)	GCC (Ala/A)	GAC (Asp/D)	GGC (Gly/G)	**C**
		GUA (Val/V)	GCA (Ala/A)	GAA (Glu/E)	GGA (Gly/G)	**A**
		GUG (Val/V)	GCG (Ala/A)	GAG (Glu/E)	GGG (Gly/G)	**G**

3rd base (3′)

Partner Sheet for Part II

7. Write the DNA sequence complementary to your mRNA here (the same DNA sequence written *carefully* from Question 6) and then give this page to your partner to complete.

3′_______________________________________5′

8. Transcribe and translate the DNA sequence/gene in the space above. Use the one-letter abbreviations for the protein sequence.
9. How many *codons* does this gene contain, including the stop codon? ______
10. How many *nucleotides* does this gene contain, including the stop codon? ______
11. Why did we choose song titles that begin with the letter "M"?

12. If you and your partner had chosen the same song title, could you have generated different DNA sequences? Why or why not?

Part III – Wrong Notes

Even the best musicians sometimes play a wrong note. And even the best enzymes sometimes make mistakes. We can think about mutations in the DNA as "wrong" notes, as we heard in the huntingtin example. This could be broadly applied to many other genes. If you play the music from a wild-type protein at the same time as a mutant protein, you would be able to hear the mutations—the places in the music where the notes don't match. If you did this with the fully functional hemoglobin *A* allele and the sickle-cell anemia causing hemoglobin *S* allele, you would hear only one chord changed, but at a crucial spot.

Questions

1. Have your partner introduce a point mutation (a single nucleotide change) into the DNA sequence from your peptide song title. Transcribe and translate it below to see if you can determine what type of mutation (missense, frameshift, nonsense, or silent) and where it occurred. Does the song title stay the same or change?

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