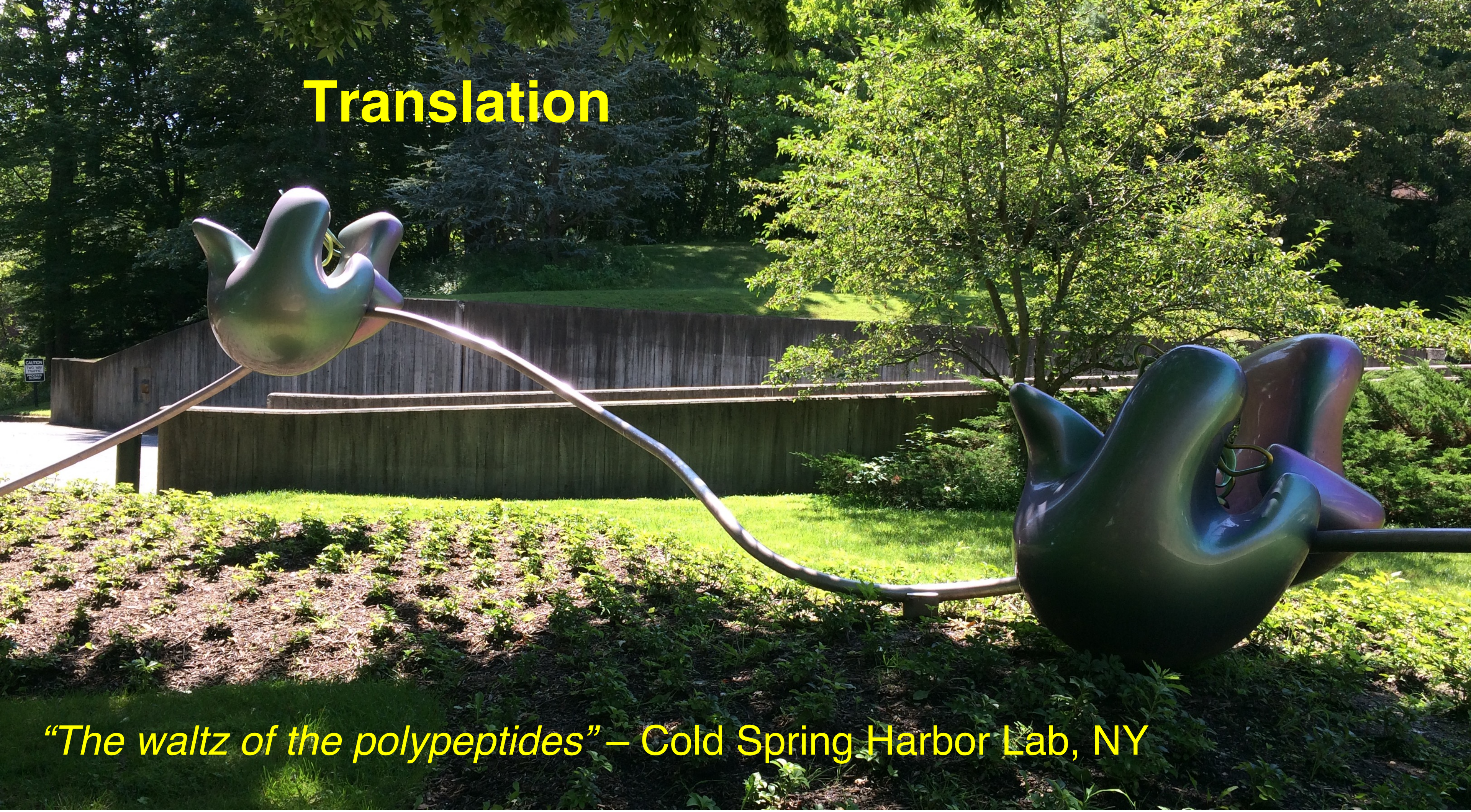
Translation



"The waltz of the polypeptides" – Cold Spring Harbor Lab, NY

Introduction
1-the genetic code
2-tRNAs codon recognition and aminoacylation
3-Translation initiation
4-Translation elongation
5-Peptide bond formation catalysis in the ribosome
6-Translation termination
7-Quality Control of translation

Learning outcomes:
What you need to know/understand after this chapter

Understand how the genetic code works and how tRNA decode codons

Understand aminoacyl tRNA synthetase mechanisms and how their editing activity contributes to translation fidelity

Know the global architecture of ribosome and functional sites

Understand the mechanisms of translation initiation in bacteria vs eukaryotes and how initiation can be regulated

Know the basic mechanism of translation cycle and the mechanism of peptide bond formation

Understand the mechanism of termination and the quality control mechanisms linked to translation termination

The Genetic Code

(almost)
•Universal

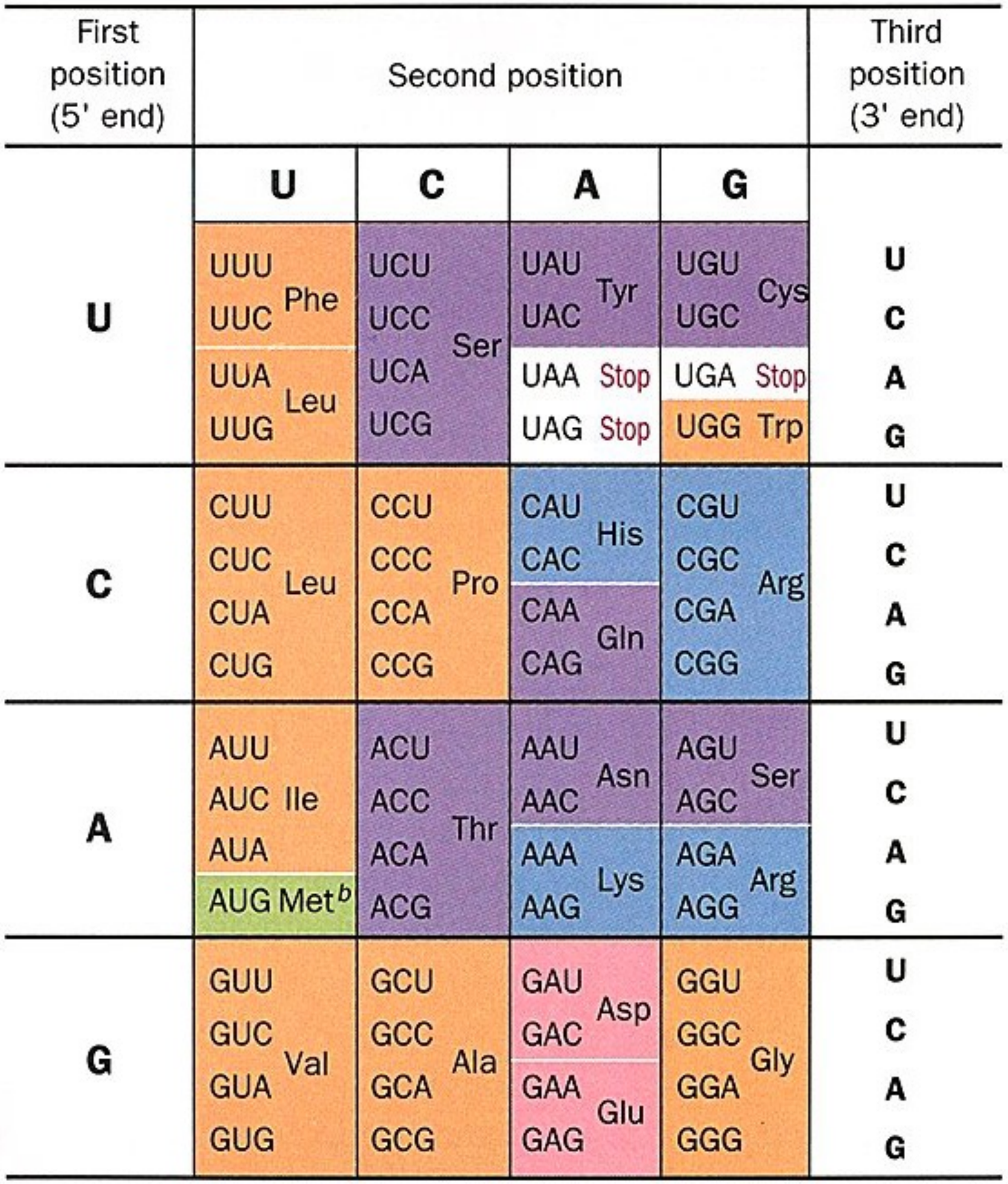
The same genetic code is used in bacterial, plants, fungal or animals genomes (exceptions)

•Degenerate

Multiple sequences code for the same AA

•Non-random

Single mutation of a codon is typically **neutral**
(=> same AA)
or **conservative**
(results in a similar AA)



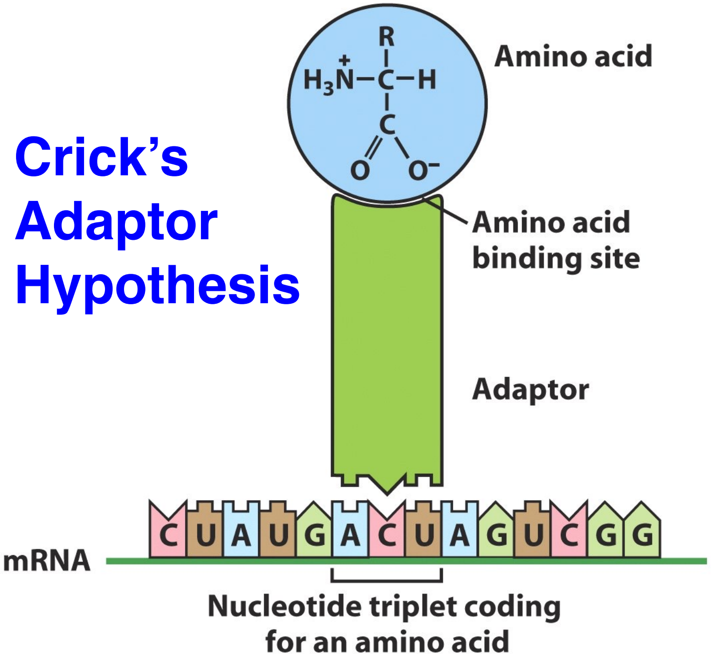
First position (5' end)	Second position				Third position (3' end)
	U	**C**	**A**	**G**	
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	**U**
	UUC	UCC	UAC	UGC	**C**
	UUA Leu	UCA	UAA Stop	UGA Stop	**A**
	UUG	UCG	UAG Stop	UGG Trp	**G**
C	CUU Leu	CCU Pro	CAU His	CGU Arg	**U**
	CUC	CCC	CAC	CGC	**C**
	CUA	CCA	CAA Gln	CGA	**A**
	CUG	CCG	CAG	CGG	**G**
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	**U**
	AUC	ACC	AAC	AGC	**C**
	AUA	ACA	AAA Lys	AGA Arg	**A**
	AUG Met[b]	ACG	AAG	AGG	**G**
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	**U**
	GUC	GCC	GAC	GGC	**C**
	GUA	GCA	GAA Glu	GGA	**A**
	GUG	GCG	GAG	GGG	**G**

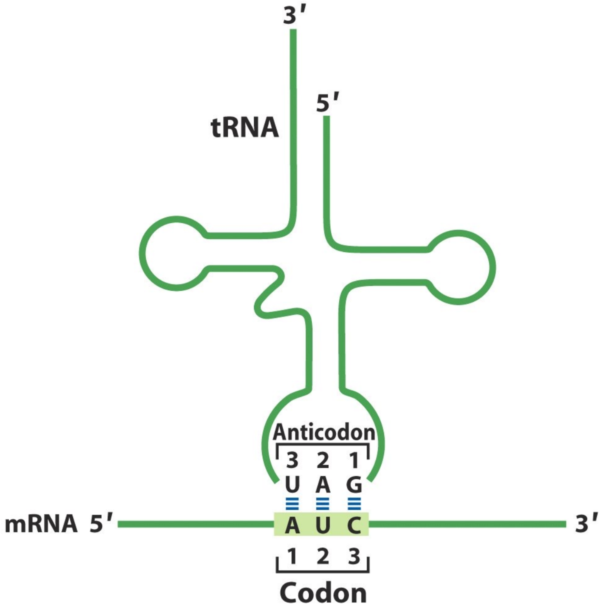
[a] Nonpolar amino acid residues are tan, basic residues are blue, acidic residues are red, and polar uncharged residues are purple.

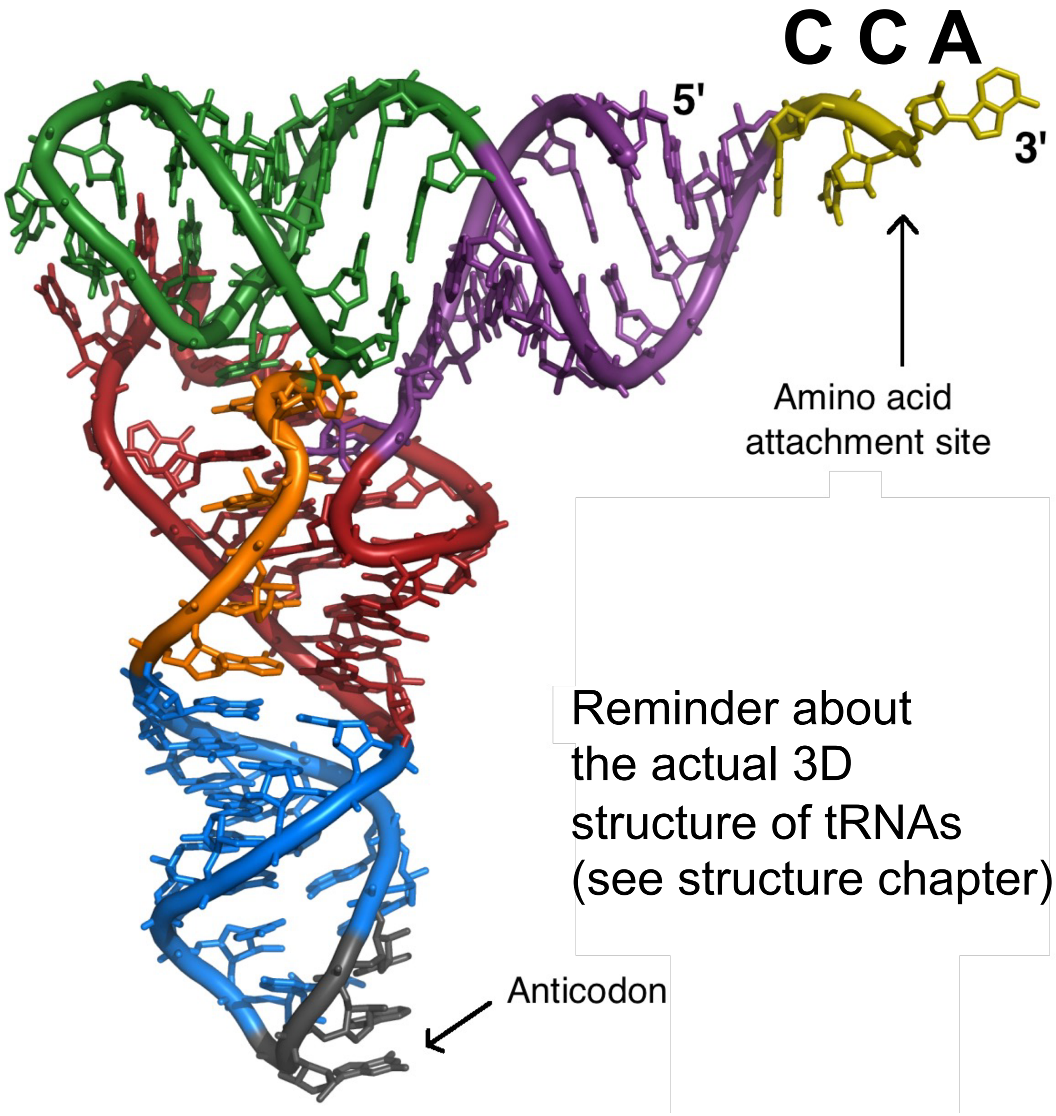
[b] AUG forms part of the initiation signal as well as coding for internal Met residues.

tRNAs are adaptor molecules

Crick's Adaptor Hypothesis





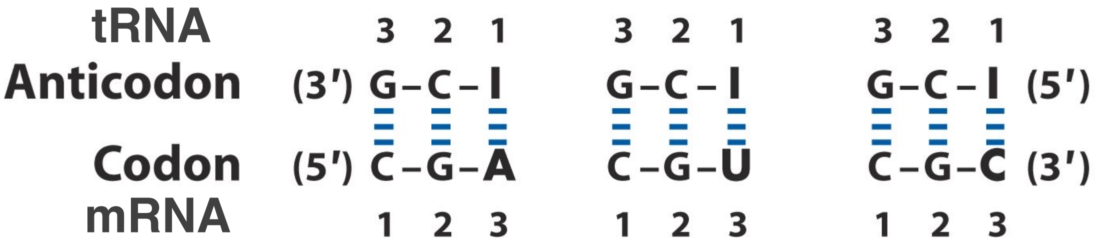


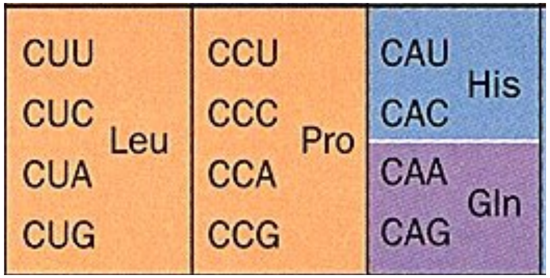
Reminder about the actual 3D structure of tRNAs (see structure chapter)

Khan academy

One tRNA can recognize several codons by flexibility of base pairing (“wobble”) at position 3 of the mRNA codon

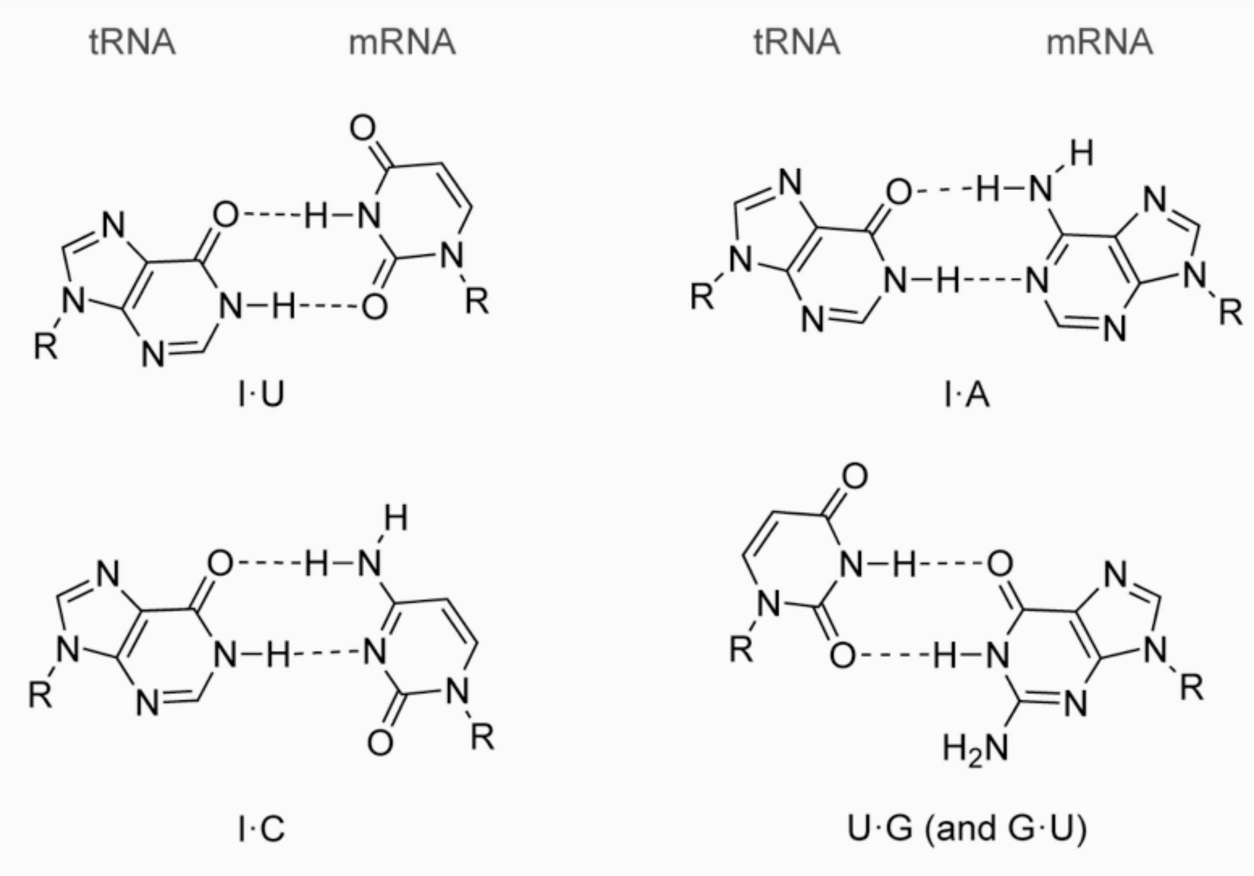
AntiCodon (1) (=tRNA)		Codon (3) (=mRNA)
C	can read	G
A	can read	U
U	can read	A,G
G	can read	C,U
I	can read	C,U,A





CUU	Leu	CCU	Pro	CAU	His
CUC		CCC		CAC	
CUA		CCA		CAA	Gln
CUG		CCG		CAG	

⚠ **The wobble rule only applies to position 3 of the codon NOT to Positions 1 and 2**



I·U

I·A

I·C

U·G (and G·U)