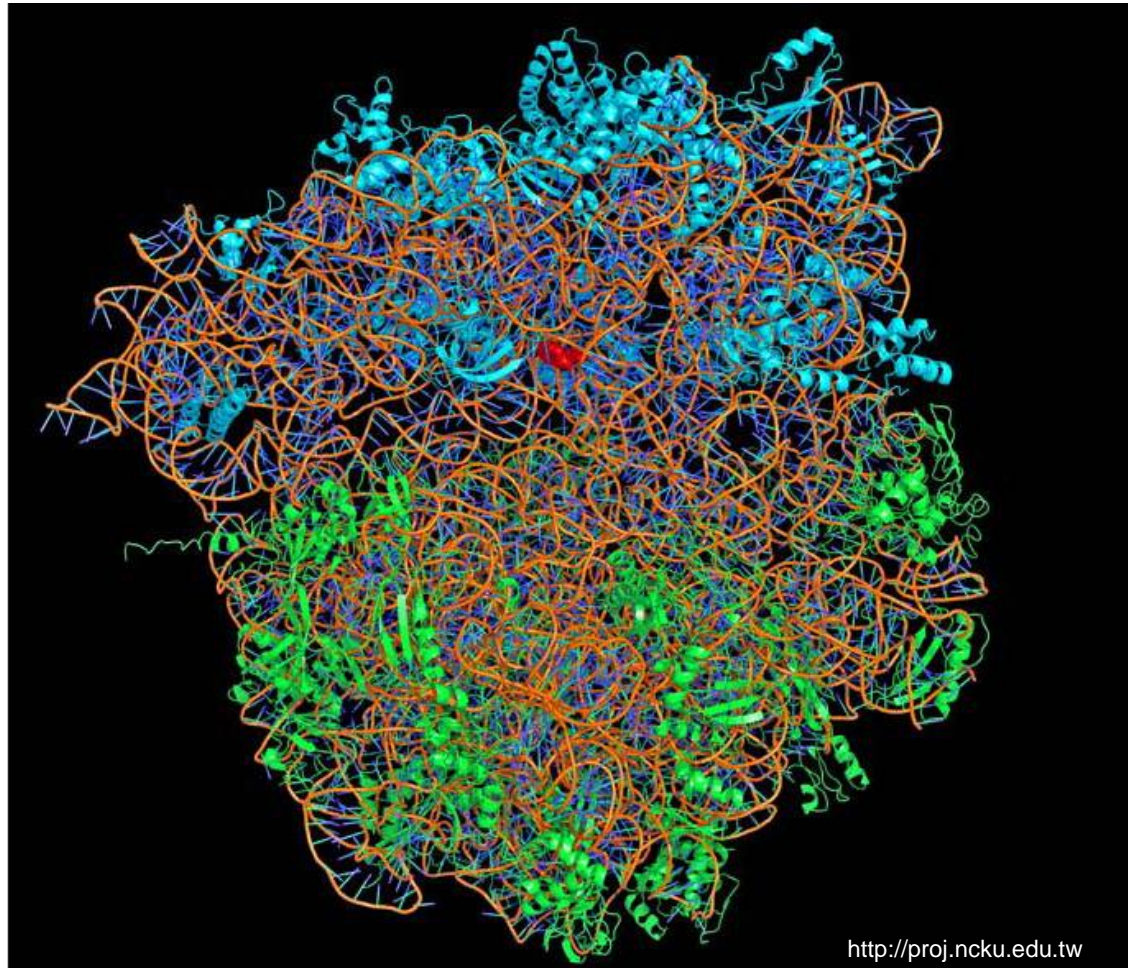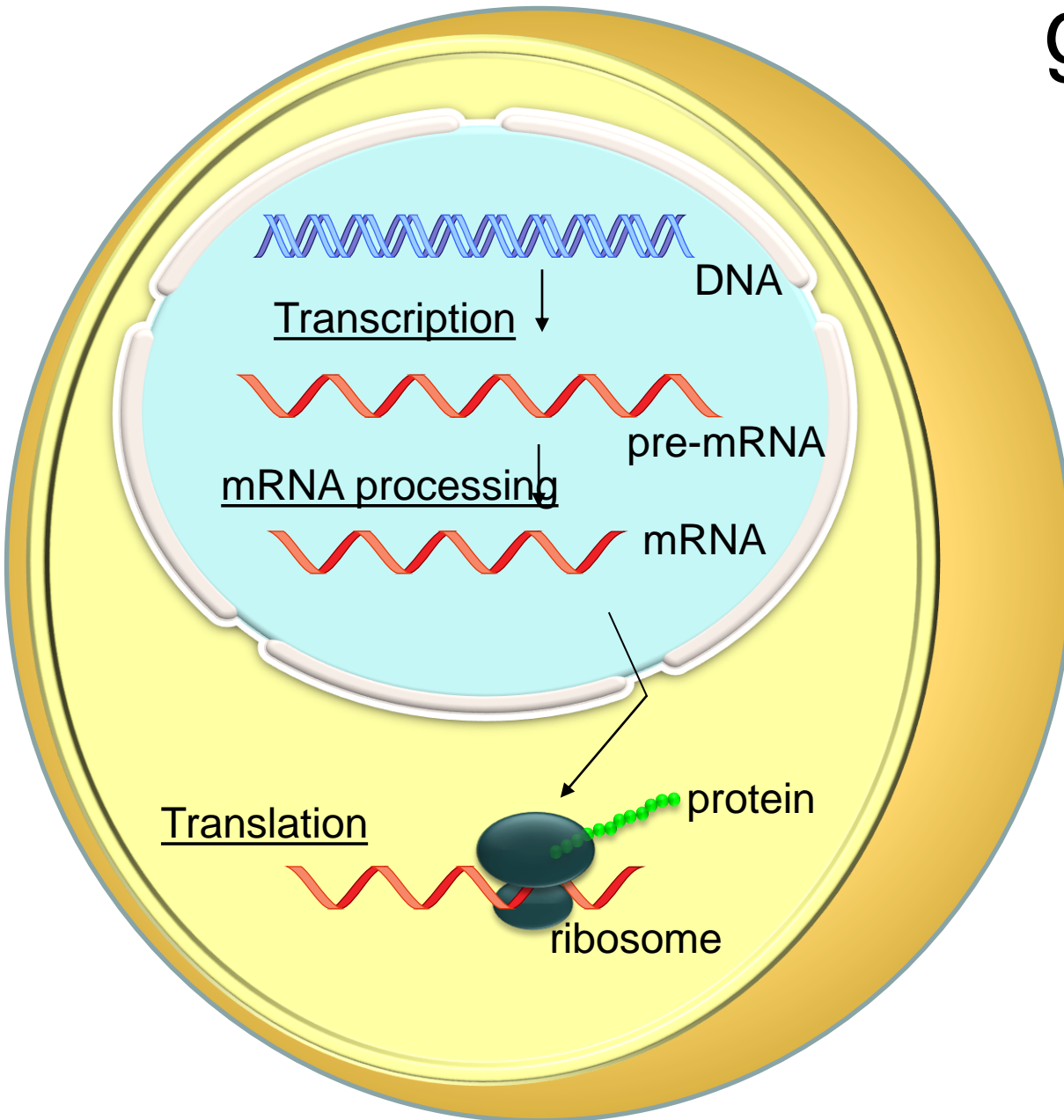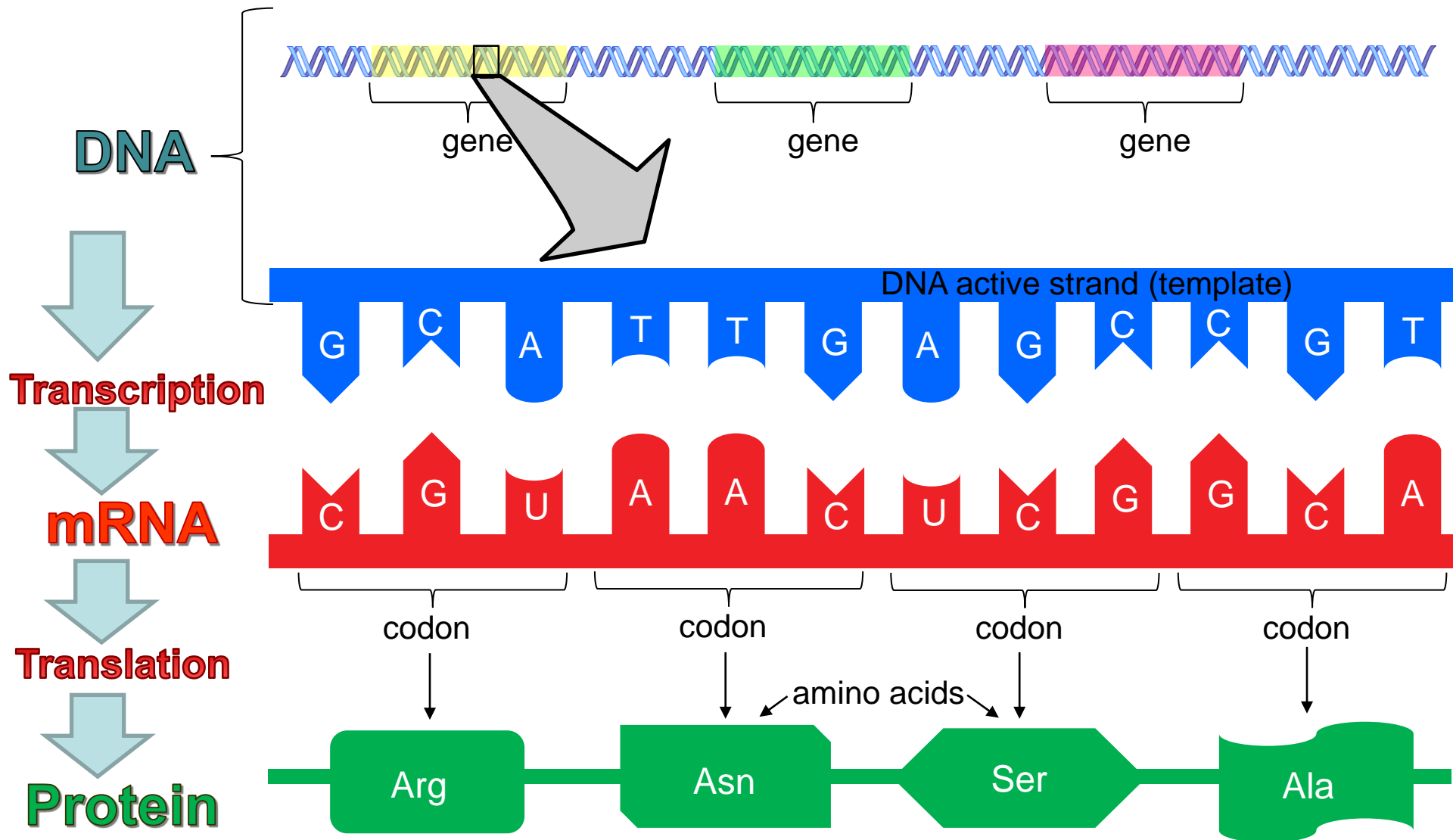# Translation:
The genetic code

ribosome

The flow of genetic information: the genetic code

The genetic code : the information for building up proteins- the information which shows what the amino acid sequence of a protein will be.

The flow of genetic information: the genetic code

DNA

gene   gene   gene

Transcription

DNA active strand (template)

G C A T T G A G C C G T

mRNA

C G U A A C U C G G C A

codon   codon   codon   codon

Translation

amino acids

Protein

Arg   Asn   Ser   Ala

The features of the genetic code

1. It is a **triplet** code: 3 nucleotides (bases) code 1 amino acid.

   - The triplet which is coding the amino acid on the mRNA is called **codon**.

   - 4 bases form the triplets → $4^3 = 64$ combinations are possible.

   - Only 61 code amino acids: sense codons

   - there are 3 STOP codons (= shows where translation should stop)

   - To code for the 20 amino acids a sequence of 2 bases would not be enough ($4^2=16$)

The features of the genetic code

Second letter

First letter

Third letter

		U	C	A	G	
U	UUU UUC	Phenyl-alanine (Phe)	UCU UCC UCA UCG — Serine (Ser)	UAU UAC — Tyrosine (Tyr)	UGU UGC — Cysteine (Cys)	U C
	UUA UUG	Leucine (Leu)		UAA UAG — STOP	UGA — STOP	A
					UGG — Tryptophan (Trp)	G
C	CUU CUC CUA CUG	Leucine (Leu)	CCU CCC CCA CCG — Proline (Pro)	CAU CAC — Histidine (His)	CGU CGC CGA CGG — Arginine (Arg)	U C
				CAA CAG — Glutamine (Gln)		A G
A	AUU AUC AUA	Isoleucine (Ile)	ACU ACC ACA ACG — Threonine (Thr)	AAU AAC — Asparagine (Asn)	AGU AGC — Serine (Ser)	U C
	AUG	Methionine (Met) and START		AAA AAG — Lysine (Lys)	AGA AGG — Arginine (Arg)	A G
G	GUU GUC GUA GUG	Valine (Val)	GCU GCC GCA GCG — Alanine (Ala)	GAU GAC — Aspartic acid (Asp)	GGU GGC GGA GGG — Glycine (Gly)	U C
				GAA GAG — Glutamic acid (Glu)		A G

The features of the genetic code

2. <u>Degenerate (redundant)</u>: 1 amino acid can be coded by multiple codons.

(20 amino acids are coded by 61 sense codons)

The features of the genetic code

3. <u>Unambiguous</u>: 1 codon codes only one amino acid.

The features of the genetic code

4. Continuous: There is no "comma" or overlapping between the codons.

Common nucleotides→overlap

codon 1 2 3 4 5 6 7

mRNA   AUUCGUGAUGCAUCUG

Unused nucleotides= „comma"

codon1   2   3   4

mRNA   AUUCGUGAUGCAUCUG

continuous

codon1   2   3   4   5
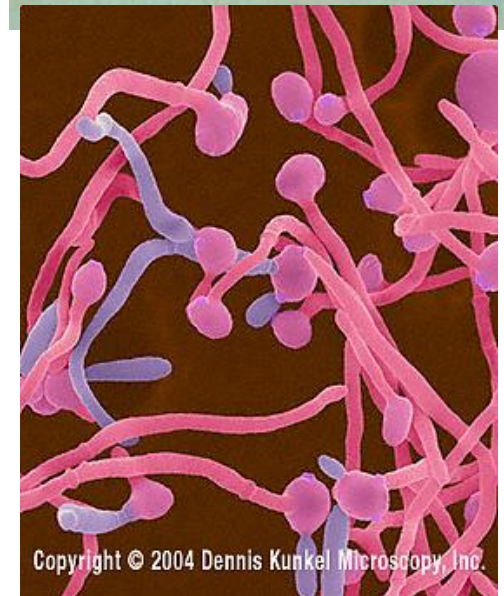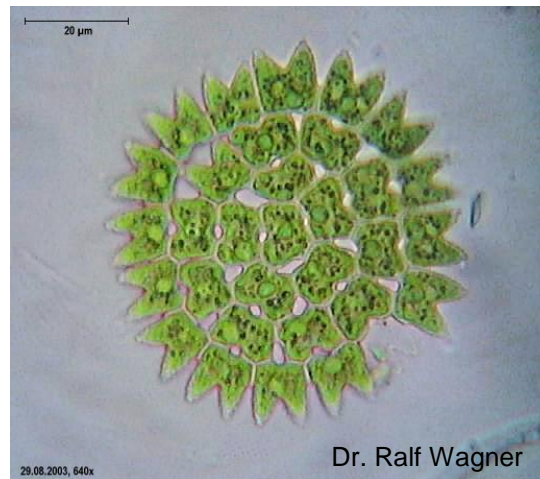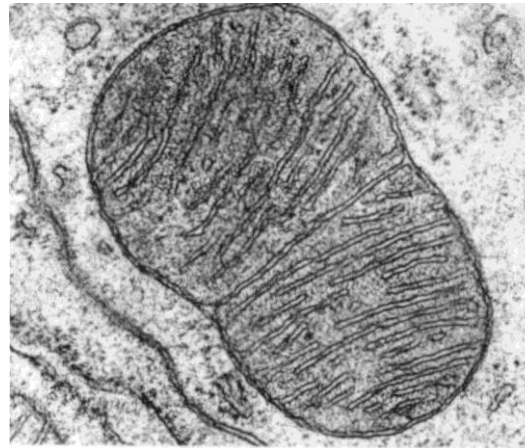
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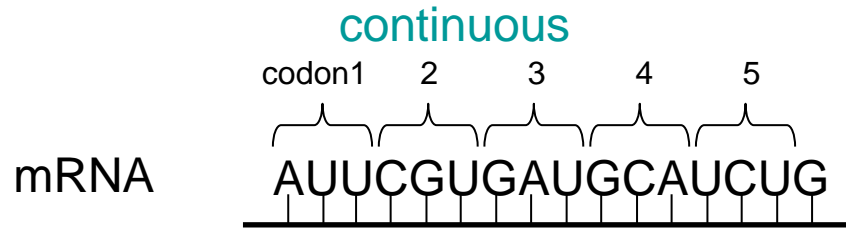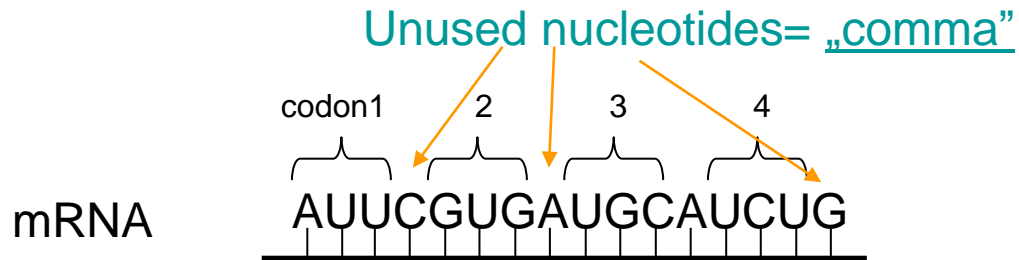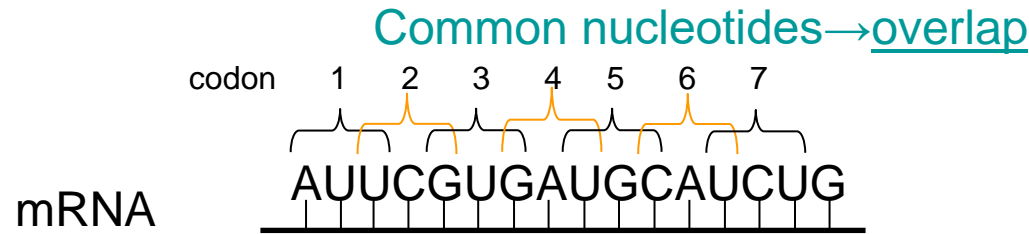
The features of the genetic code

5. <u>Universal</u>: valid in the whole living world on the planet.

There are exceptions, with minor alterations, eg.:

Mitochondria, ciliates, green algae, some fungi

03.04.02; 1000x
Dr. Ralf Wagner

20 µm
29.08.2003, 640x
Dr. Ralf Wagner

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The reading of the genetic code

- ORF: Open Reading Frame

- the sequence which codes 1 polypeptide chain.

- Starts with a start codon (AUG) and ends with a STOP codon.

The discovery and deciphering of the genetic code

- Nirenberg and Khorana, 1960s
1. *In vitro* translation of synthetic polynucleotides
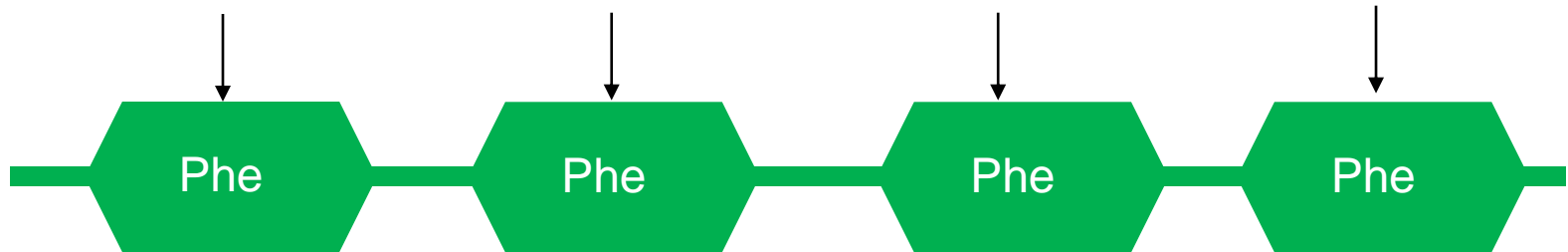
Eg. poly-U → Poliphenylalanine
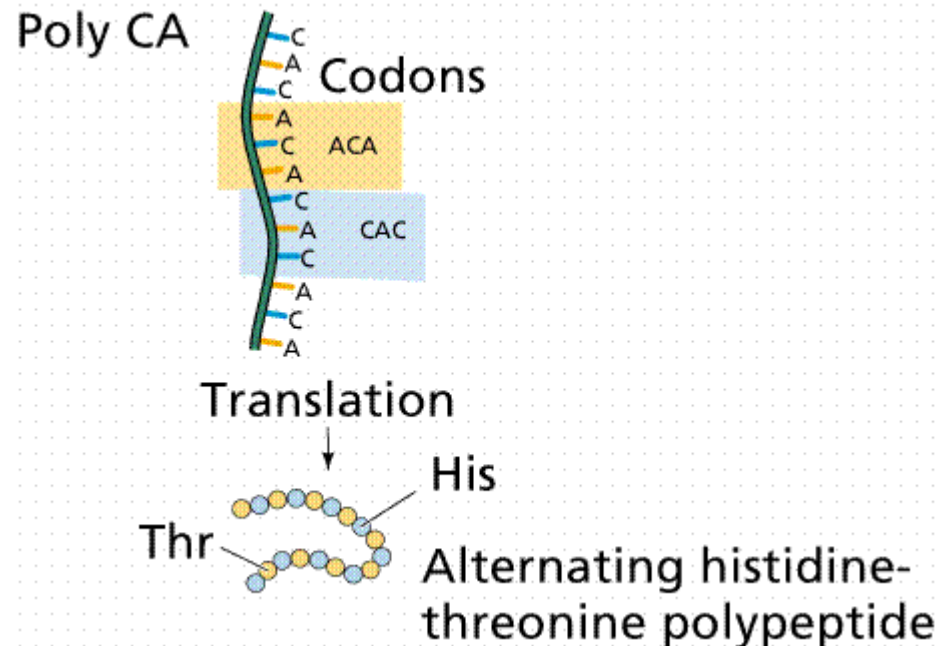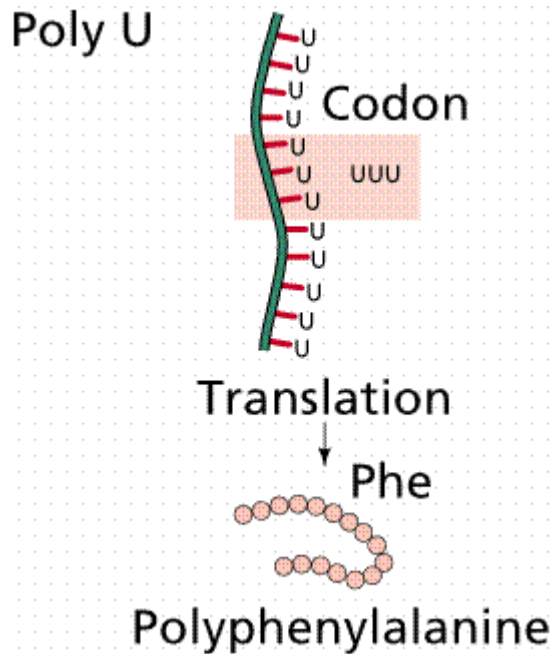
The discovery and deciphering of the genetic code

- Nirenberg and Khorana, 1960s
1. *In vitro* translation of synthetic polynucleotides

The discovery and deciphering of the genetic code

2. Aminoacil-tRNA binding assay