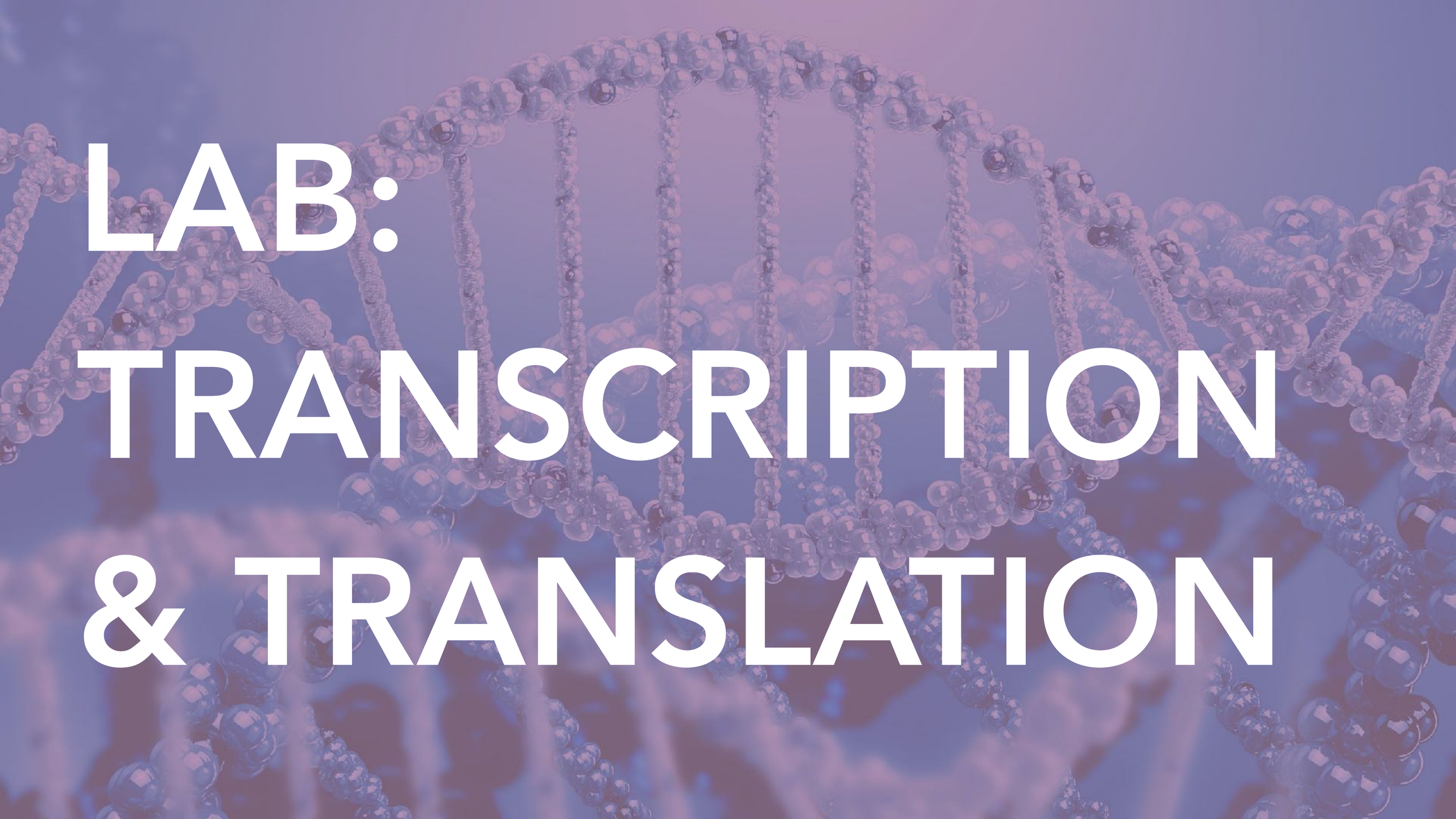


LAB: TRANSCRIPTION & TRANSLATION

TRANSCRIPTION & TRANSLATION

WHAT YOU SHOULD HAVE GOT OUT OF THE LAST HOUR

- DNA contains the genetic information that encodes traits
- DNA is double stranded, complementary and anti-parallel
- The beginning of a DNA strand is called the 5’ (“five prime”) region and the end of a DNA strand is called the 3’ (“three prime”) region
- Proteins are produced through the processes of transcription and translation
- Amino acids are encoded by nucleotide triplets called codons
- mRNA transcripts contain “start” and “stop” codons that initiate and terminate protein translation

TRANSCRIPTION & TRANSLATION

- DNA is complementary and anti-parallel

Gene or
coding *or*
sense strand

5′– CCGATGTCATAAGAC – 3′

DNA IS READ 5′ TO 3′

GENES ARE TRANSCRIBED FROM 5′ TO 3′

TRANSCRIPTION & TRANSLATION

- DNA is complementary and anti-parallel

Gene or
coding *or*
sense strand

Template or
non-coding or
anti-sense strand

5′– CCGATGTCATAAGAC – 3′

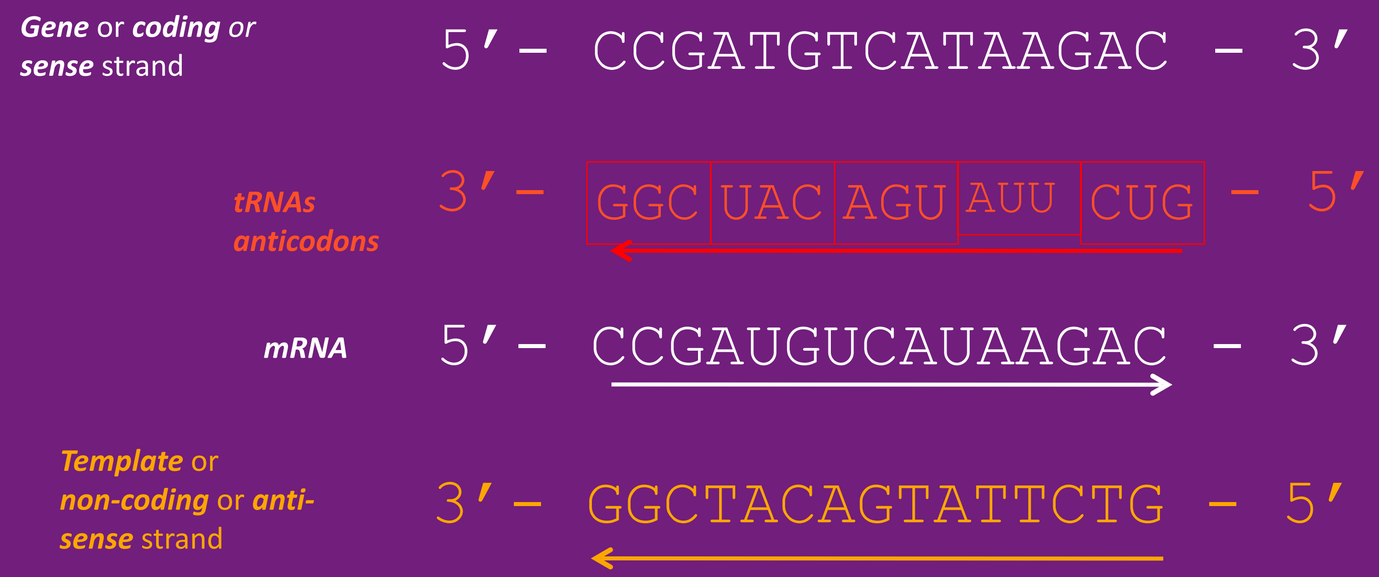
3′– GGCTACAGTATTCTG – 5′

DNA STRANDS ARE ANTI-PARALLEL, PARALLEL BUT OPPOSITE

DNA STRANDS ARE COMPLEMENTARY; ADENINE (A) PAIRS WITH THYMINE (T), CYTOSINE (C) PAIRS WITH GUANINE (G)

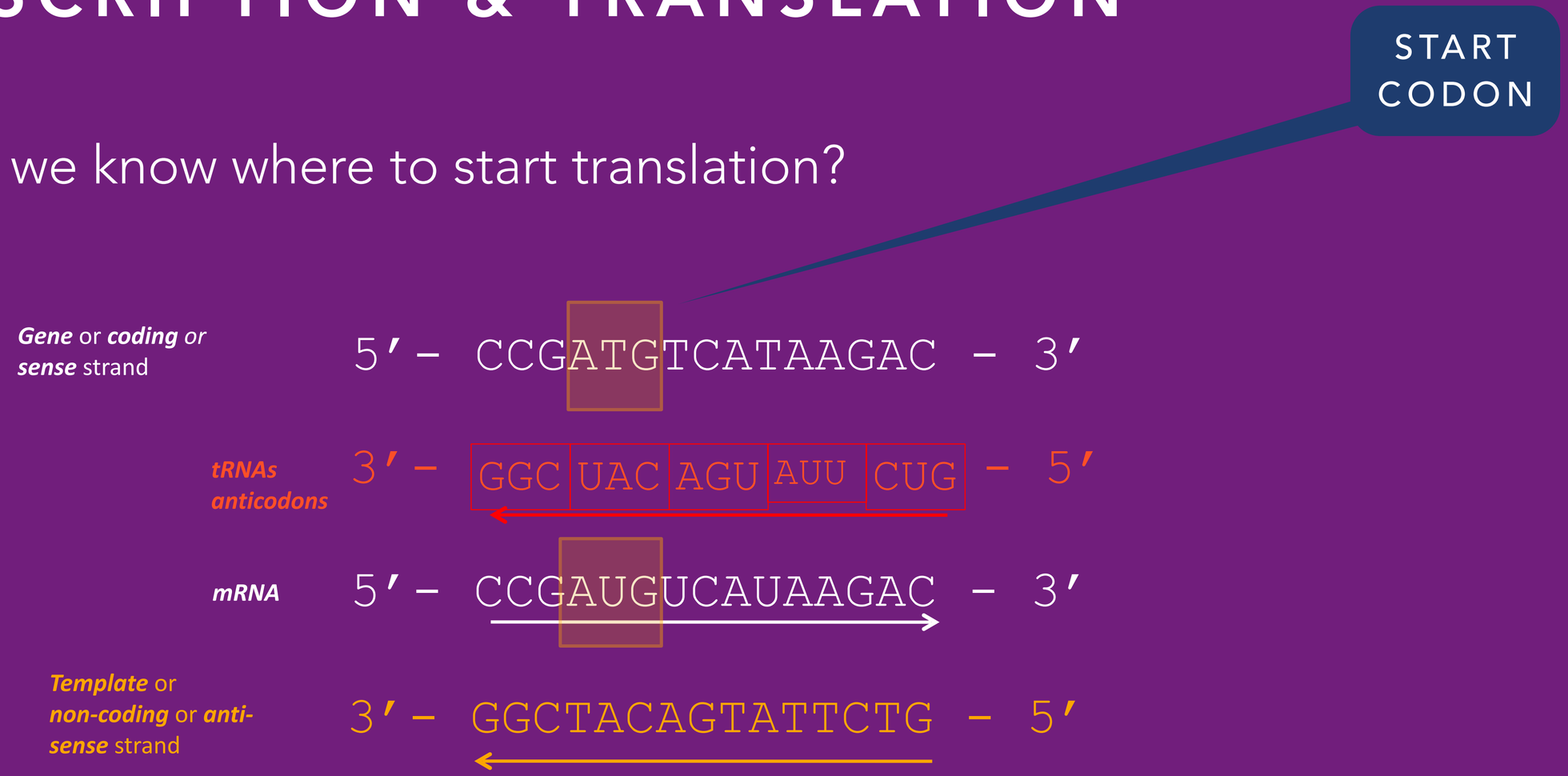
TRANSCRIPTION & TRANSLATION

- Translating DNA into proteins



TRANSCRIPTION & TRANSLATION

- How do we know where to start translation?



TRANSCRIPTION & TRANSLATION

- Codon
  - Series of 3 nucleotides in a row
  - Specifies the genetic code information for a particular amino acid (e.g. AAU = I)
  - Also called “nucleotide triplet”
  - Codon table

First Position 5′	Second Position				Third Position 3′
	U	C	A	G	
U	UUU F UUC F UUA L UUG L	UCU S UCC S UCA S UCG S	UAU Y UAC Y UAA stop UAG stop	UGU C UGC C UGA stop UGG W	U C A G
C	CUU L CUC L CUA L CUG L	CCU P CCC P CCA P CCG P	CAU H CAC H CAA Q CAG Q	CGU R CGC R CGA R CGG R	U C A G
A	AUU I AUC I AUA I AUG M	ACU T ACC T ACA T ACG T	AAU N AAC N AAA K AAG K	AGU S AGC S AGA R AGG R	U C A G
G	GUU V GUC V GUA V GUG V	GCU A GCC A GCA A GCG A	GAU D GAC D GAA E GAG E	GGU G GGC G GGA G GGG G	U C A G

STOP CODONS

START CODON

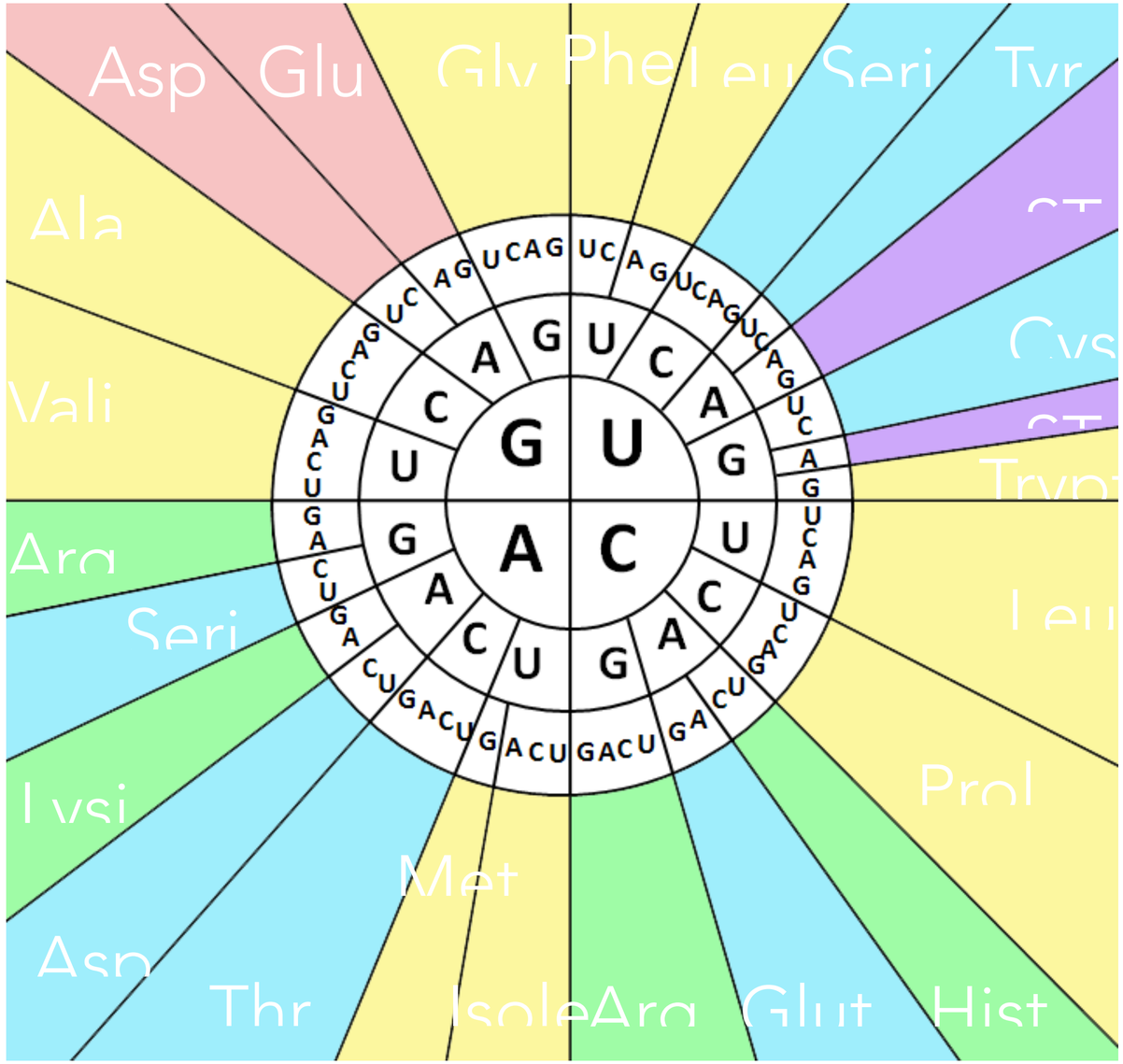
AMINO ACID SINGLE-LETTER

TRANSCRIPTION & TRANSLATION

- Built-in redundancy

Side Chain (R-Group) Chemistry:

- Hydrophobic / Nonpolar
- Hydrophilic/ Polar
- Acidic / Negative
- Basic / Positive



TRANSCRIPTIONS & TRANSLATION

- Reading frames
  - Non-overlapping sequence of three-nucleotide codons
  - There are 3 possible reading frames in an mRNA strand
  - There are 6 in a double-stranded DNA molecule (three reading frames from each of the two DNA strands)
  - Nomenclature
    - 1,2,3 coding strand
    - -1,-2,-3 for template strand

TRANSCRIPTIONS & TRANSLATION

"Gene" Sequence: thecatatetherat.

PERIOD IS "STOP CODON"

Reading Frame +1 starts at the **first** letter:

the cat ate the rat.

Reading Frame +2 starts at the **second** letter:

t hec ata tet her at.

Reading Frame +3 starts at the **third** letter:

th eca tat eth era t.

Reading Frames -1, -2 & -3 would be like reading the sentence "backwards."

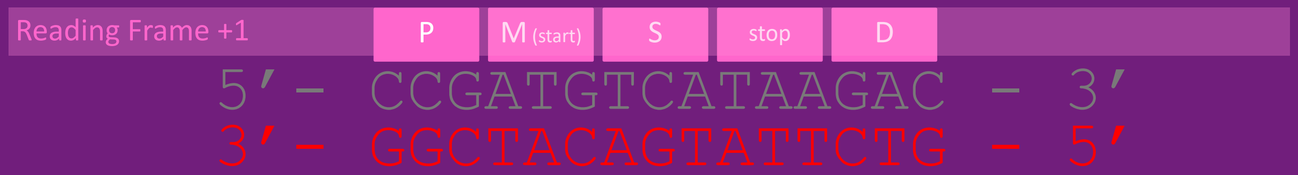
TRANSCRIPTIONS & TRANSLATION

- Open reading frame (ORF)
  - A reading frame that contains a start codon and a stop codon, with multiple three-nucleotide codons in between
  - Hypothesis for correct reading frame from which to translate the DNA into protein
  - May contain introns (non-coding regions) in eukaryotes

- Coding Sequence (CDS)
  - The actual region of DNA that is translated to protein

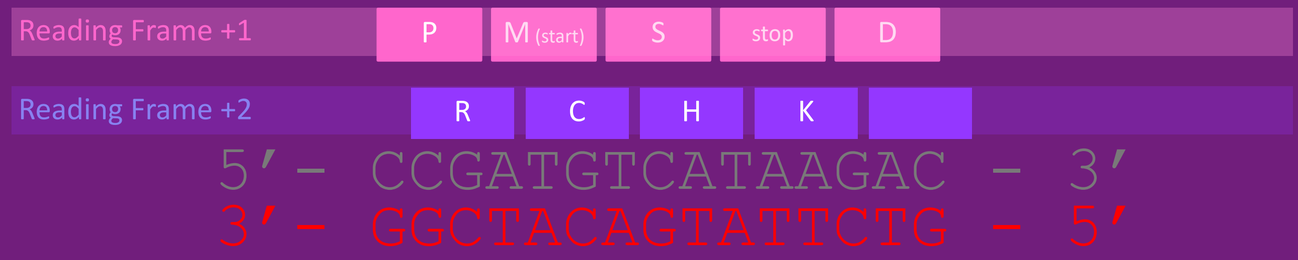
TRANSCRIPTIONS & TRANSLATION

- Reading frames



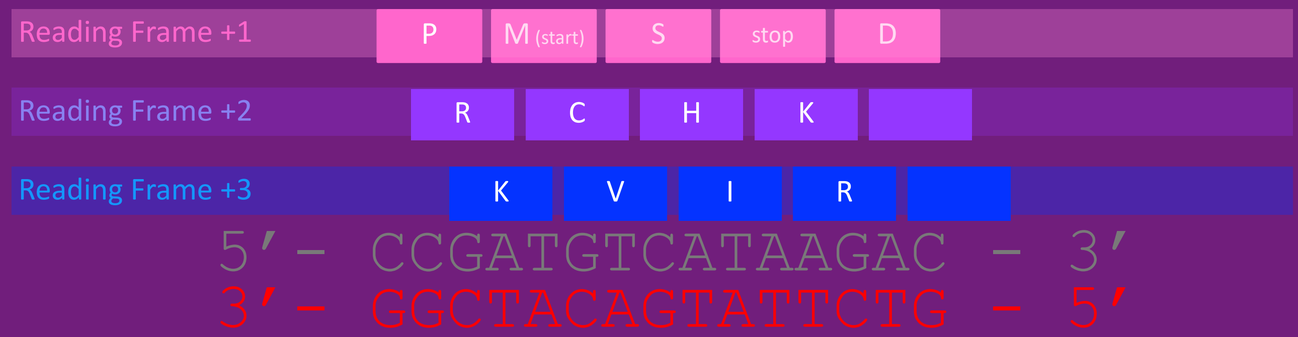
TRANSCRIPTIONS & TRANSLATION

- Reading frames



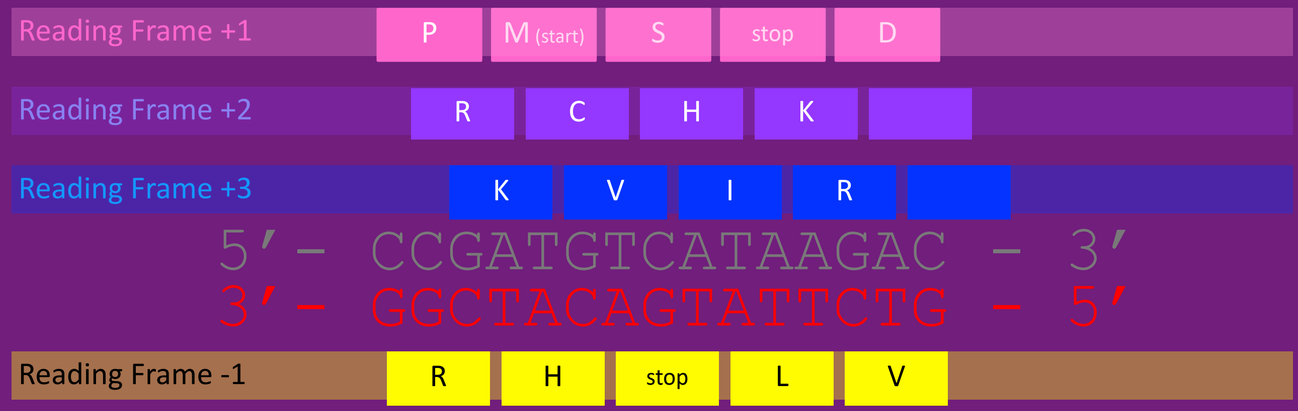
TRANSCRIPTIONS & TRANSLATION

- Reading frames



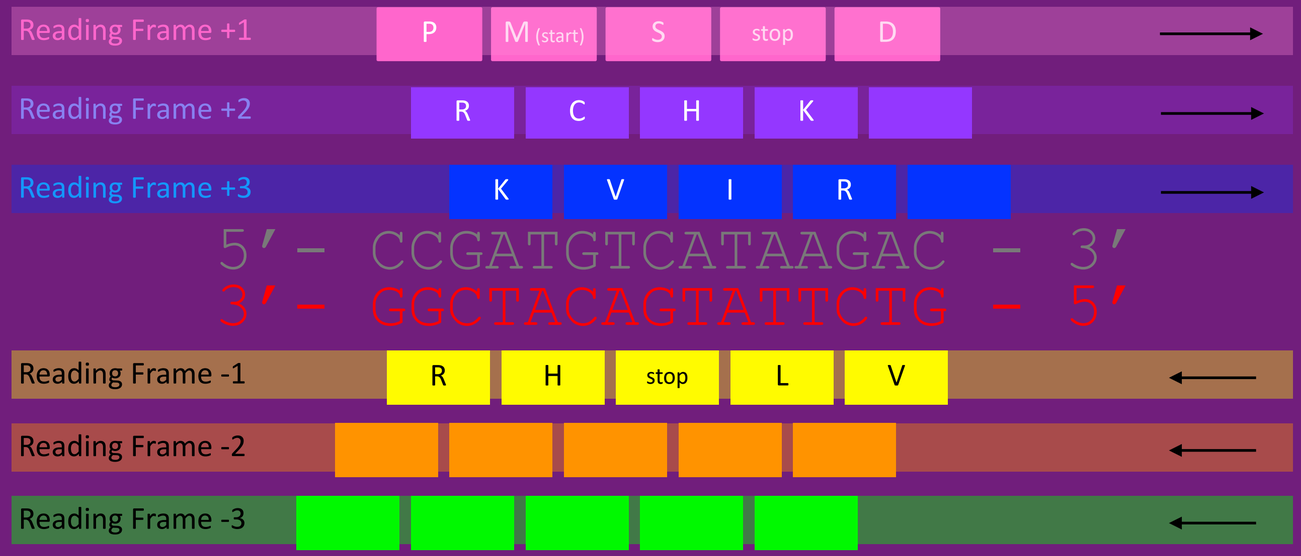
TRANSCRIPTIONS & TRANSLATION

- Reading frames



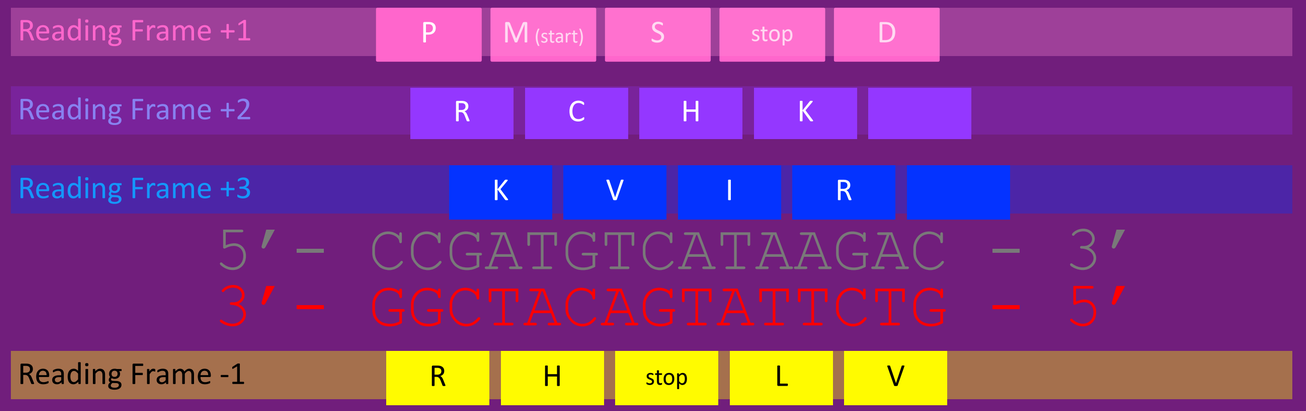
TRANSCRIPTIONS & TRANSLATION

- Reading frames



TRANSCRIPTIONS & TRANSLATION

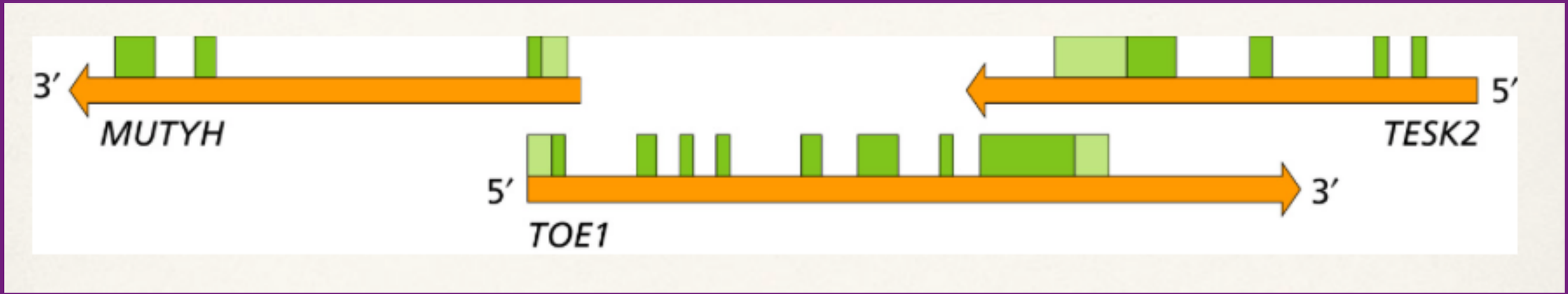
- Possible Sequences
  - PMS-stop-D
  - RCHK
  - KVIR
  - VL-stop-HR



TRANSCRIPTIONS & TRANSLATION

- Possible Sequences
  - PMS-stop-D
  - RCHK
  - KVIR
  - VL-stop-HR
- Which one is an actual coding sequence?
  - PMS-stop-D
  - Coding sequence has to have a start (M) and stop codon with at least one amino acid in between

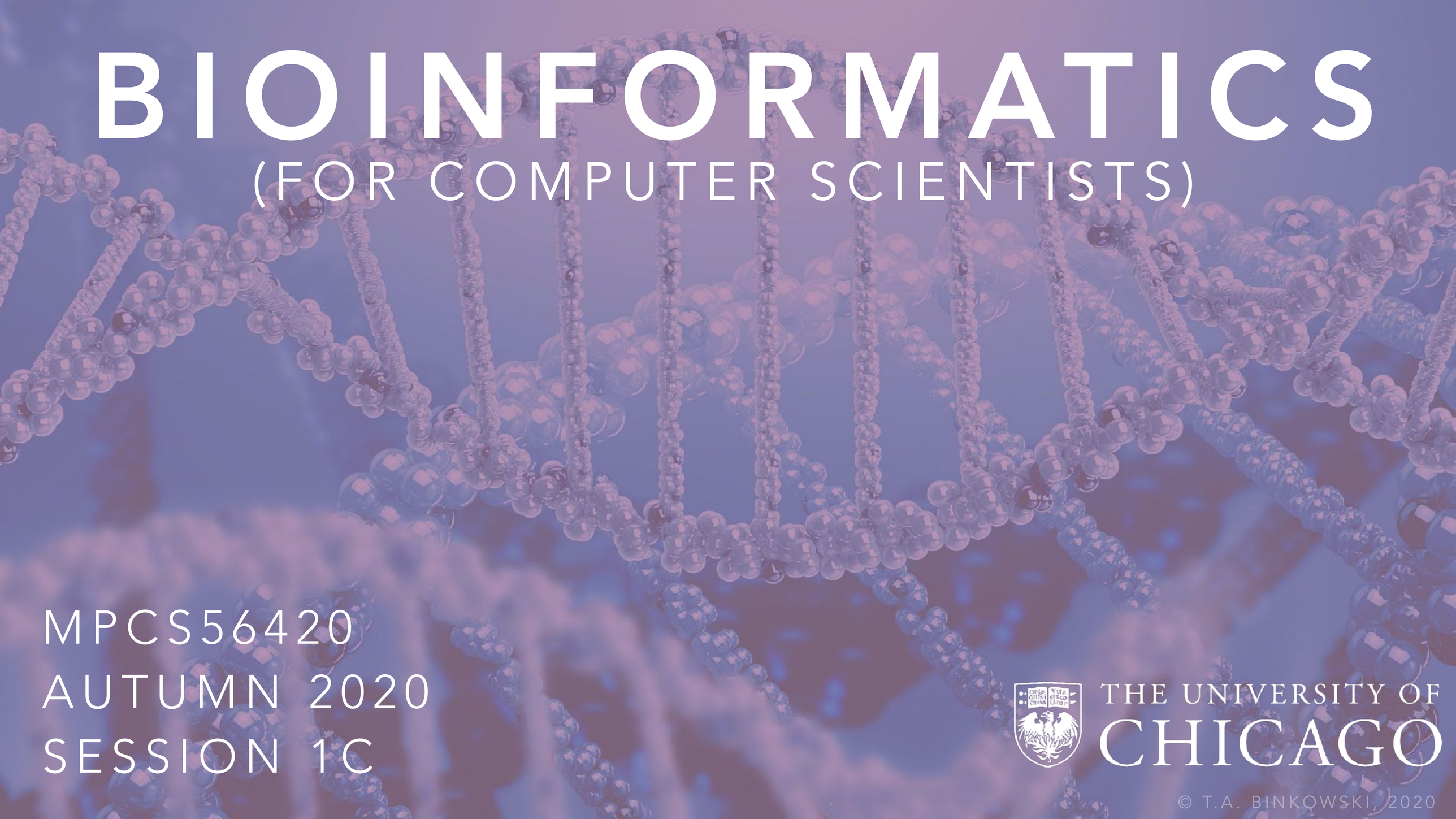
TRANSCRIPTIONS & TRANSLATION



- Common misconceptions
  - Translation always starts with the first letter of a DNA sequence
  - Translation begins at the first start codon (AUG/ATG)
  - All DNA codes for proteins
  - Genes are found only on one of the strands of DNA

BIOINFORMATICS

(FOR COMPUTER SCIENTISTS)



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SESSION 1C

THE UNIVERSITY OF CHICAGO