Tutorial 4

Covers Lectures 5, 6, and 7

On 11th April 2023 for D4 and 13th April 2023 for D3

1. *Representing the nucleotide sequence of DNA*

(a) Shown below is a typical way the sequence of DNA is written:

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5'-AGCTAGCCTAGCTTGACA-3'
3'-TCGATCGGATCGAACTGT-5'
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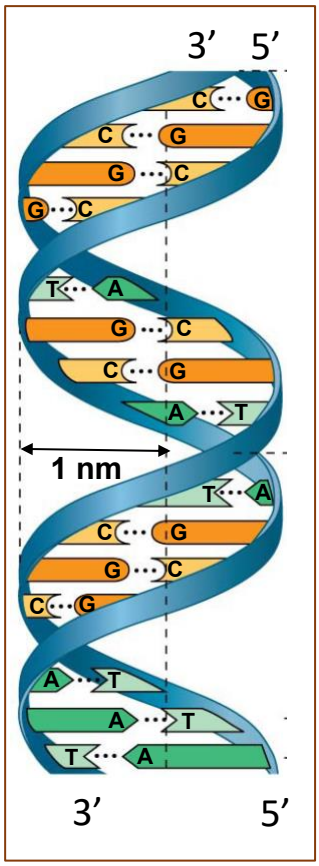
Note: Monospaced fonts (as opposed to proportional fonts) are preferred to write DNA sequence. This ensures that complementary bases are aligned vertically.

(b) Write the sequence of the DNA shown schematically below.



2. Genetic codon table and conceptual translation

Shown below is the standard genetic codon table and this is to be seen as nearly universal. Quite a few alternative codon tables are known each of which are found in select few organisms. Note that codon tables used by chloroplasts and mitochondria are typically distinct from the ones used in the nucleus of the respective organisms.

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

(a) What are start and stop codons? How many of each of these two types are present in the standard genetic codon table?

(b) Write down the amino acid sequences of "proteins" encoded by the following DNA fragment in all six reading frames:

5'-AGCTAGCCTAGCTTGACA-3'
3'-TCGATCGGATCGAACTGT-5'

(c) Introduce a substitution mutation. Does this result in a missense, synonymous, or nonsense mutation?

Note: pick any one of the possible six reading frames to determine if the substitution results in a missense, synonymous, or nonsense mutation.

3. ΔG depends upon cellular concentrations

(a) Show that ΔG varies with concentrations of reactants and products.

Relationship between DG and mass action ratio

$\triangle = - 2.303 \frac{}{eq}$

R = 8.315 J/mol.K and
T = 298 K
RT2.303 = 5706.5 J/mol

= 0.001 $_{eq}$ DG = -17.1 kJ/mol
= 0.01 $_{eq}$ DG = -11.4 kJ/mol
= 0.1 $_{eq}$ DG = -5.7 kJ/mol
= $_{eq}$ DG = 0
= 10 $_{eq}$ DG = 5.7 kJ/mol
= 100 $_{eq}$ DG = 11.4 kJ/mol
= 1000 $_{eq}$ DG = 17.1 kJ/mol

DG changes with the cellular concentrations of the reactants and product

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