Major Differences Between RNA & DNA

- Both RNA & DNA are nucleic acids and are composed of a base, a sugar & a phosphate group.

DNA - Deoxyribonucleic Acid	RNA - Ribonucleic Acid
• Double stranded, helix shaped molecule • *Looks like a twisted ladder!*	• Single-stranded molecule
• DNA is located in the nucleus & mitochondria only	• RNA is found throughout the cell (nucleus & cytoplasm)
• Sugar = Deoxyribose (*5-Carbon*)	• Sugar = Ribose (*5-Carbon*)
• DNA is metabolically, & structurally stable	• RNA is unstable
• Bases Include: A-T & C-G	• Bases Include: A-U & C-G • Uracil replaces Thymine in RNA
• Only 1 type of DNA	• 3 Types of RNA: • m-RNA = messenger • t-RNA = Transfer • r-RNA = Ribosomal
• DNA is rigid & Long	• RNA is flexible & short

DNA The Keeper of the Code of Life!

- DNA holds our inherited genes, which we may consider to be our genotype.
- These genes are phenotypically expressed in the form of proteins. PLEASE NOTE THAT DNA CODES FOR PROTEINS!
  - Examples of proteins: enzymes, hormones, muscle tissue, etc. → you are either a protein or produced by a protein!
  - The question is how is this done?
  - We will build from our experience of DNA replication. Instead a new complimentary copy will be made → mRNA (messenger RNA which carries the message from the DNA in the nucleus to the ribosome to make the protein).

PROTEIN SYNTHESIS IS A 2 STEP PROCESS:

I – **Transcription**: the construction of a complimentary copy of the DNA into a mRNA. (takes place in the nucleus)

II – **Translation**: the process where mRNA code is read and translated into a protein by the tRNA (t = transfer) (takes place at the ribosome)

Q. During what phase of the cell cycle does this happen?

Basic Overview of the first step: ~~Translation~~ Transcription

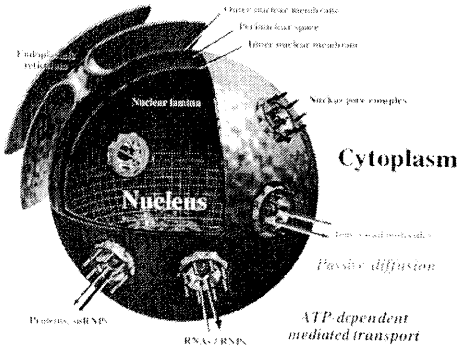
DNA strand #2 ATG GCA GCT TTT GTC TGA
DNA strand #1 TAC CGT CGA AAA CAG ACT

mRNA (codons) AUG GCA GCU UUU GUC UGA
(transcription – for this example it compliments strand #1)

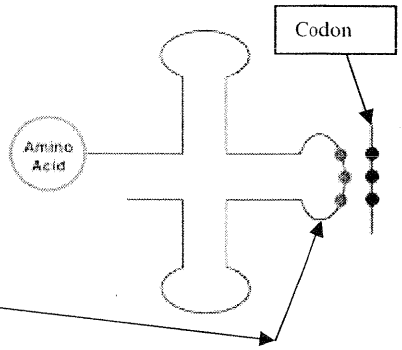
- each of the above codons codes for a specific amino acid necessary to construct a unique protein!

Step 2 of Protein Synthesis → Translation

1) The DNA is the keeper of the code of life. As it opens up one strand will have a complimentary copy made which we call the mRNA (**CODON**). – each set of 3 bases
2) The mRNA is now free to leave the nucleus through the nuclear pore and move into the cytoplasm.
3) Once in the cytoplasm the mRNA joins with a ribosome, which contains another RNA called rRNA (r = ribosomal). The rRNA helps the mRNA move through the ribosome in a process called translocation.



4) Each mRNA is called a **CODON**, which compliments to the strand of DNA it was made from.
5) In the cytoplasm the mRNA **CODON** must be translated. This is done through a matching up of a new compliment to the mRNA.
6) A new RNA called tRNA (t = transfer) in the cytoplasm compliments mRNA. Shaped like a three leaf clover it has 2 ends to it: one end carries a specific amino acid coded for by the mRNA, the other end carries a compliment to the mRNA codon called the **ANTICODON**.



Example:

mRNA (codon)	UGG	GGG	GCA	UUG
tRNA (anticodon)	ACC	CCC	CGU	AAC
	↓	↓	↓	↓
	tryptophan	– glycine	– alanine	– leucine

7) After the tRNA binds to the mRNA the neighbouring amino acids link up by forming **peptide bonds** between themselves.
8) The tRNA then leaves the mRNA and moves back into the cytoplasm where it can pick up another specific amino acid and redo its job of carrying amino acids to the ribosome necessary to make proteins
9) When the mRNA codon reads stop (UAA, UAG, and UGA), then the polypeptide (protein) is released to perform its function. The mRNA is also released from the ribosome and may be reused or it disintegrates.

Always interpreted in terms of the mRNA codon.

Tear-out Page

Messenger RNA Codons and Their Corresponding Amino Acids

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA stop **	UGA stop **	A
	UUG leucine	UCG serine	UAG stop **	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG methionine*	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G

* Note: AUG is an initiator codon and also codes for the amino acid methionine.

** Note: UAA, UAG, and UGA are terminator codons.

→ To read the table, find the 1st letter of the mRNA codon (under 1st Base)
→ Then read across the rows in the column titled 'second base' to find the second letter of the codon
→ Finally read down column (third Base)

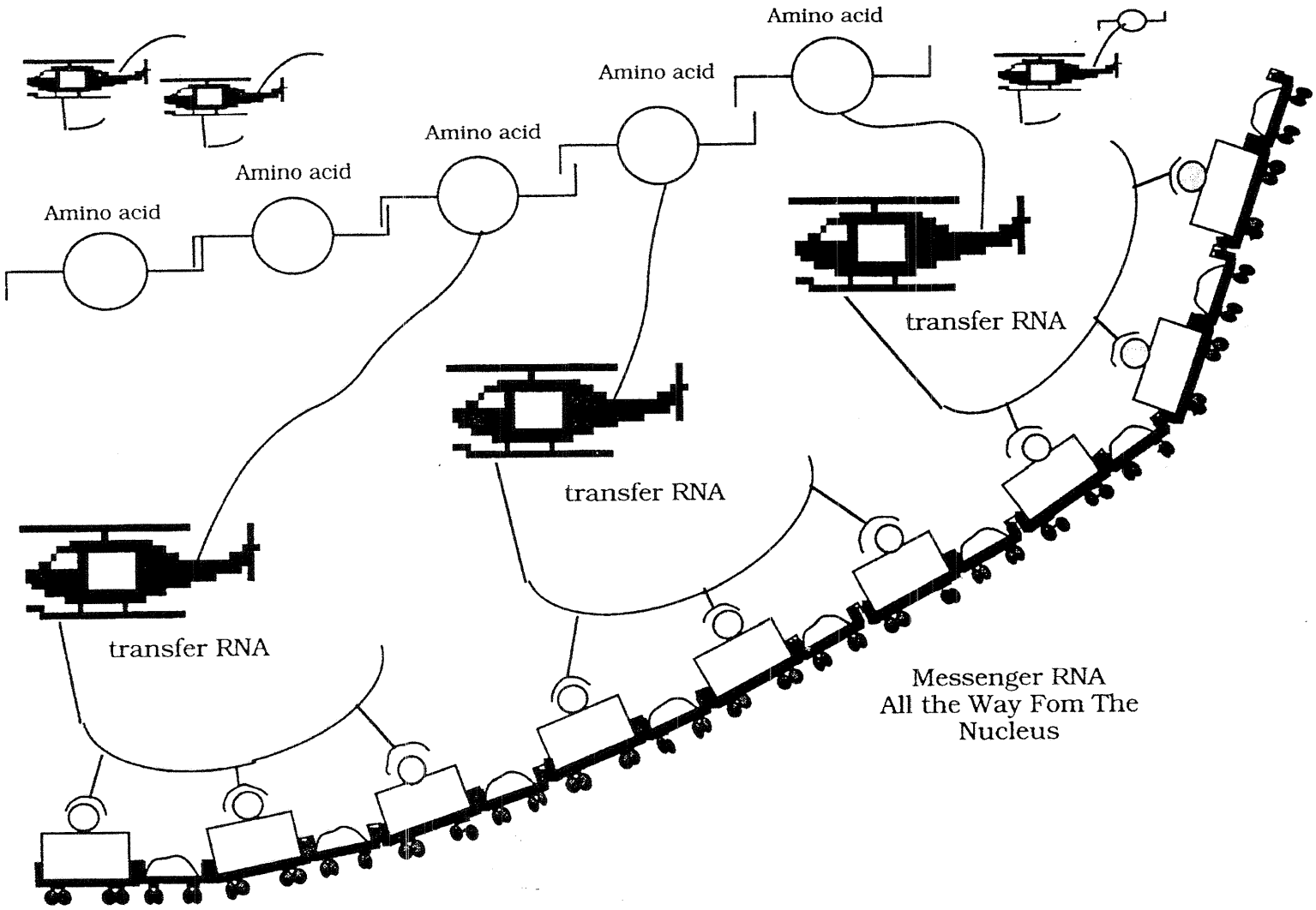
ex) ACC → threonine

Information About Nitrogen Bases

Nitrogen Base	Classification	Abbreviation
Adenine	Purine	A
Guanine	Purine	G
Cytosine	Pyrimidine	C
Thymine	Pyrimidine	T
Uracil	Pyrimidine	U

- more than one codon can code for any amino acid
- genetic code is continuous (a shift of one or two nucleotides in either direction can alter codon groupings and result in an incorrect amino acid sequence)
- genetic code is nearly universal → good (important implications for gene technology)

Translation



Transcription / Translation Practice Sheet

- Given the strand of DNA identify the appropriate m-RNA, t-RNA & amino acid for each of the following questions:
- **PLEASE NOTE:For this exercise the m-RNA will compliment DNA strand #2!**

1)

DNA #1									
DNA #2	AAA	TAC	TTT	AGC	GTC	CAT	CCC	ATT	-
m-RNA									
t-RNA									
Amino Acid									

2)

DNA #1		AGC	TGC				GTC		
DNA #2	ATA			TAT	TTT	GCG		ACT	-
m-RNA									
t-RNA									
Amino Acid									

3)

DNA #1			CGT	AGC	ATG				TAG
DNA #2	TAC	TAT				CCC	TGT	ATA	
m-RNA									
t-RNA									
Amino Acid									

4)

DNA #1				AGT		TTT	TCA		
DNA #2	GTC	TCG	ACA		TAC			CAT	ATT
m-RNA									
t-RNA									
Amino Acid									

5)

DNA #1	GTC	TCG	ACA		TAC			CAT	ATT
DNA #2				AGT		TTT	TCA		
m-RNA									
t-RNA									
Amino Acid									

Name:_____

The wise old sayings of DNA!

DNA itself holds a great deal of code for the biological activity of our cells. The DNA code is carried to the ribosomes by m-RNA (messenger) after transcription from the DNA.

The code shown below is the DNA code. You are to change the code into the m-RNA codon and then look up each triplet codon to determine the letter the codon equals. The letters will form words from common expressions.

Example:
DNA = CCC ATG TTC CGT CTG TCC TTC
mRNA = GGG UAC AAG GCA GAC AGG AAG
phrase = BENICE = BE NICE

RIBOSOME 1:
DNA = CCCGCGCTGCGCCCATTCCGTCCATTTTTCGCGCGATTCAGGCGC

mRNA =

phrase =

RIBOSOME 2:
DNA = CCCATGTTCTTACTGCGTCGAAGGTTCGTCCTGCGTCGA

mRNA =

phrase =

RIBOSOME 3:
DNA = CCCGCGTTTATCTTCAGCTTTGACAGGCGTTTCCTGCTAGTTATGTTTGACAGG

mRNA =

phrase =

RIBOSOME 4:
DNA = CCCTTATTCTTCAGTAGCTTCAGGCGCCCACTGTCCTTATTTCGTCCAGTTTTCCTGTCCTTC

mRNA =

phrase =

RIBOSOME 5:
DNA = CCCGCGTTTTTTTTAATGTTCGAGTTTAGGTTCAGCTTTGACGCGTTCAAAAGT

mRNA =

phrase =

Name:_____

RIBOSOME 6:
DNA = CCCAGTTTCCGTCGTAGCGTCCTGCGCTTCAGTTTTGACCGTCGAGAGTTTTTTGCG CTGCGCGTT

mRNA =

phrase =

RIBOSOME 7:
DNA = CCCTTCAAAAGGGCGAGCCCATTTATGTTCCGATTCAAAAGGGCGAGCCCATTTAGG CTGCGCTTC

mRNA =

phrase =

RIBOSOME 8:
DNA = CCCGTCAAACGCCCATTCCGTTTTCCAGTCAAACGTCCACGTTTTCCA

mRNA =

phrase =

RIBOSOME 9:
DNA = CCCGCGTTCAAAAGGCGTGAGAGGTTTTAGAGCTTTGACAGGTAGCAGCGCCCAAAA TTATTCCGC

mRNA =

phrase =

RIBOSOME 10:
DNA = CCCTCCAAACGTCCAAGTGACCGCGTTGTCAAACCATTCAGGGACAGTCGCCCAAGG TTCAAATAG

mRNA =

phrase =

RIBOSOME 11:
DNA = CCCGAGTTTTTTGCGCGCAGGGACCGCGTTCTGCGT

mRNA =

phrase =

The amino acid sequence (order) is represented by the _____ in this activity.
The DNA code & mRNA codons are represented by the _____ in this activity.

Write a paragraph explaining what will happen if the DNA message is wrong.

Name:_____

The Secret Code (m-RNA CODONS)

UUU = A	CAA = H	AAA = O	UAG = V
UAC = B	GAC = I	UCA = P	CAG = W
AGG = C	CCC = J	GAG = Q	UGG = X
GCU = D	AAU = K	UCC = R	UCG = Y
AAG = E	CGC = L	GCG = S	ACC = Z
CUC = F	AUC = M	GGU = T	GGG = Start reading Code Here!
GAU = G	GCA = N	CUG = U	

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