

Basic Biology Related to Technology for Measuring Gene Expression

1/11/2011

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Central Dogma

DNA contains genes that code for proteins.

DNA

↓ (transcription)

RNA

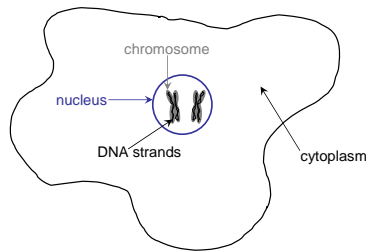
↓ (translation)

protein

Proteins perform essential biological functions.

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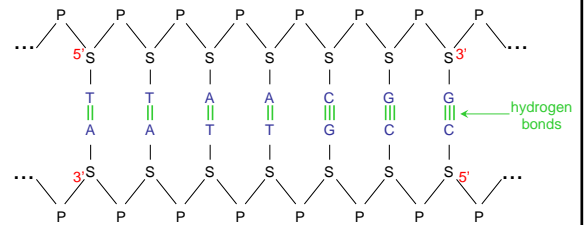
A VERY Simplified Eukaryotic Cell



DNA contains thousands of genes.

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Deoxyribonucleic Acid (DNA)



S=deoxyribose sugar
P=phosphate

Bases

A=adenine

C=cytosine

G=guanine

T=thymine

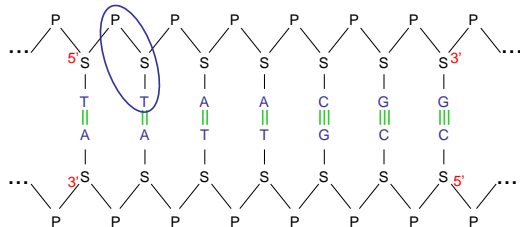
purines

The two DNA strands are twisted in the famous double helix shape (base pairs like rungs in a spiraling ladder).

pyrimidines

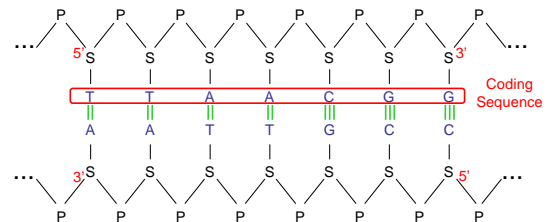
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Nucleotide=Phosphate-Sugar-Base



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Sequence of bases holds instructions for manufacturing proteins



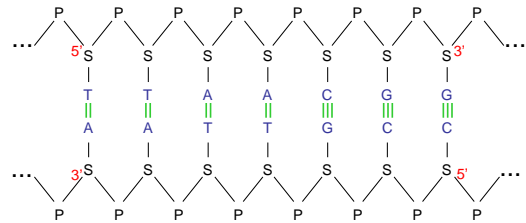
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RNA Polymerase

- An enzyme is a protein that catalyzes chemical reactions.
- RNA polymerase is the enzyme responsible for transcribing DNA to RNA.

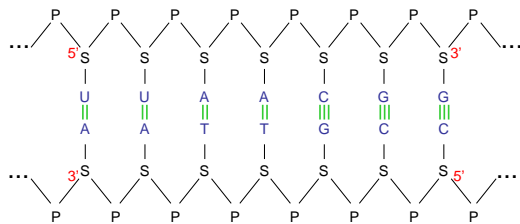
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Transcription



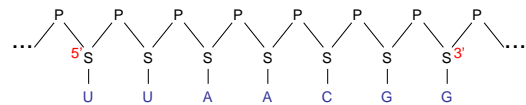
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Transcription



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Ribonucleic Acid (RNA)



S=ribose sugar
P=phosphate

Bases
A=adenine
C=cytosine
G=guanine
U=uracil

The product of transcription is known as the *primary transcript*.

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Posttranscriptional Modifications to Primary Transcript

Primary transcript



Intervening sequences corresponding to *introns* that are removed through splicing

Primary transcript after modification: messenger RNA (mRNA)



5' cap

Coding portions of RNA sequence corresponding to *exons*

poly-A tail

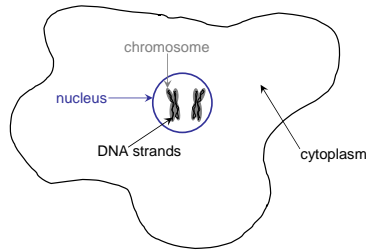
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Expression Levels

- The amount of messenger RNA (mRNA) produced by a gene is known as the gene's expression level.
- This course focuses on the design and analysis of experiments that involve the simultaneous measurement of gene expression levels for thousands of genes.

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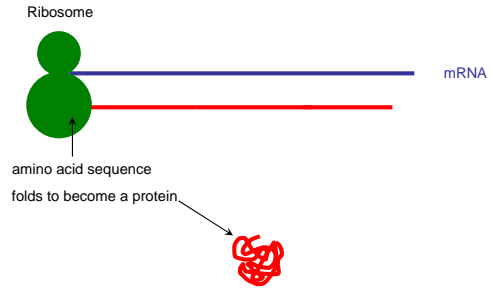
Transcription takes place inside the nucleus.



Translation takes place outside the nucleus.

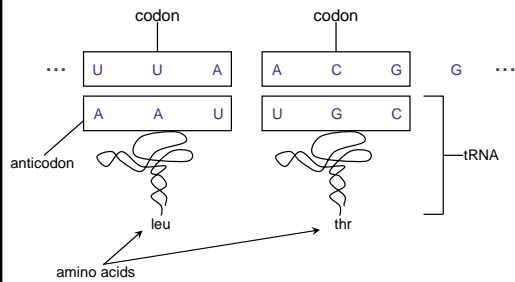
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Translation



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During translation transfer RNA (tRNA) translates the genetic code



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The Genetic Code

		Second Base				mRNA codon	amino acid
		U	C	A	G		
U	U	UUU phe	UCU ser	UAU tyr	UGU cys		
	U	UUC phe	UCC ser	UAC tyr	UGC cys		
	U	UUA leu	UCA ser	UAA STOP	UGA STOP		
	U	UUG leu	UCG ser	UAG STOP	UGG trp		
C	C	CUU leu	CCU pro	CAU his	CGU arg		
	C	CUC leu	CCC pro	CAC his	CGC arg		
	C	CUA leu	CCA pro	CAA gln	CGA arg		
	C	CUG leu	CCG pro	CAG gln	CGG arg		
A	A	AUU ile	ACU thr	AAU asn	AGU ser		
	A	AUC ile	ACC thr	AAC asn	AGC ser		
	A	AUA ile	ACA thr	AAA lys	AGA arg		
	A	AUG met	ACG thr	AAG lys	AGG arg		
G	G	GUU val	GCU ala	GAU asp	GGU gly		
	G	GUC val	GCC ala	GAC asp	GGC gly		
	G	GUA val	GCA ala	GAA glu	GGA gly		
	G	GUG val	GCG ala	GAG glu	GGG gly		

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Miscellaneous Comments

- The biology is more complicated than I described.
- It is amazing!
- Humans have somewhere around 30,000 genes. (The exact number is a subject for debate.)
- Much of the variation is created by differences in how cells use the genes they have.
- Microarrays and Next Generation Sequencing are tools that can help us understand how cells of various types use their genes in response to varying conditions. This helps us to understand gene function.

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