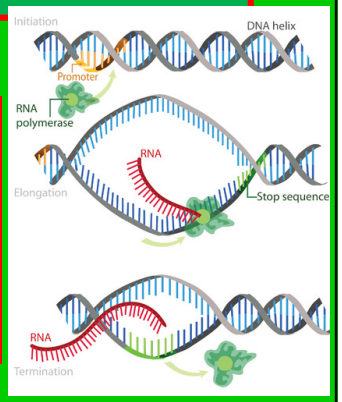
TRANSCRIPTION 8.4



Key Concept: Transcription coverts a gene into a single-stranded RNA molecule.

DNA/RNA and How they work

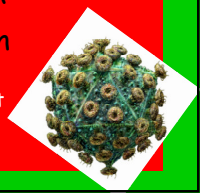
The CENTRAL DOGMA of biology: Francis Crick

Information flows in one direction: from DNA to proteins

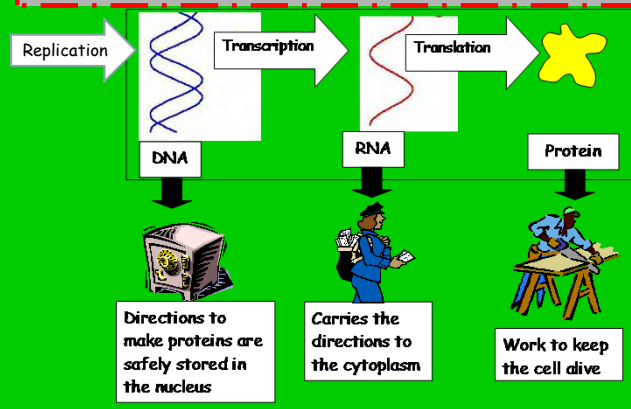
Involves 3 processes:

1. Replication of DNA
2. Transcription of DNA into RNA
3. Translation of RNA into protein

True for all organism except Retrovirus

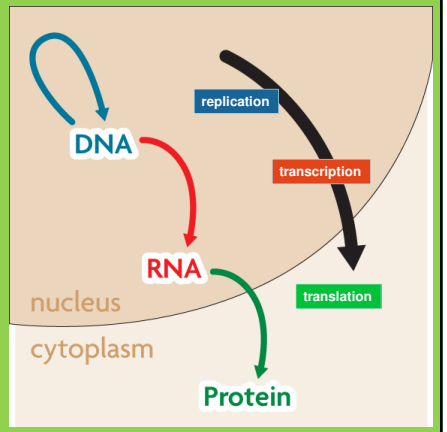


The CENTRAL DOGMA

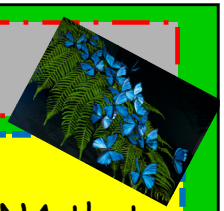


The CENTRAL DOGMA

- RNA is the link between DNA and proteins.



What is RNA?

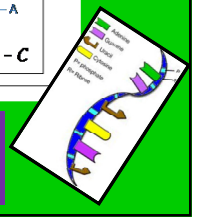


- Ribonucleic Acid
- Nucleic acid made from DNA that goes out into the cytoplasm of the cell to help it stay alive
- RNA is made in a process called transcription.

How does RNA differ from DNA?

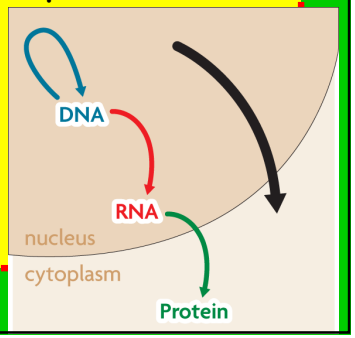
	DNA	RNA
How many strands?	2	1
Nucleotide subunit	Phos-phate Group; Deoxyribose sugar; Nitro-gen Base — **Deoxyribose sugar**	Phos-phate Group; Ribose Sugar; Nitro-gen Base — **Ribose sugar**
Bases	Thymine (T) Adenine (A) Guanine (G) Cytosine (C) T–A G – C	Uracil (U) Adenine (A) Guanine (G) Cytosine (C) U–A G – C

1. Sugar is ribose
2. Contains the base uracil in place of thymine (A=U)
3. Single-strand of nucleotides



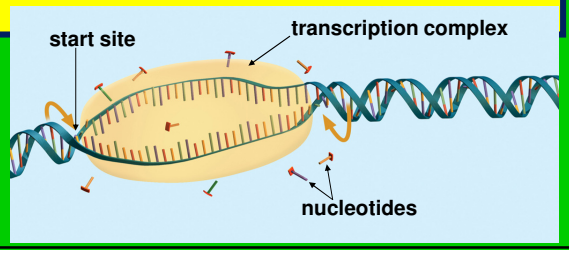
TRANCSRIPTION

- Process of copying a sequence of DNA (a gene) to produce a strand of RNA
- Occurs in the nucleus



The Transcription Process:

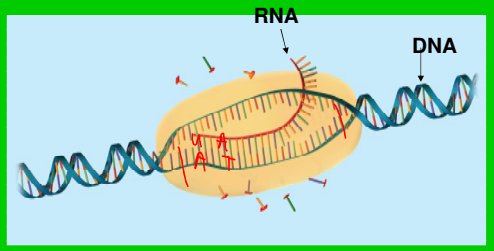
1. A large transcription complex made of RNA polymerase and other proteins recognizes the start of a gene and begins to unwind the segment of DNA.



The Transcription Process:

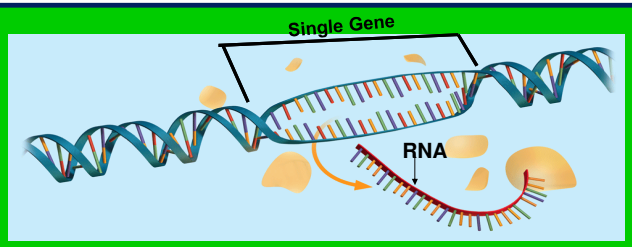
2. RNA polymerase bonds nucleotides together to make a strand of RNA using DNA as a template

**Rules of base pairing for RNA: C=G A=U



The Transcription Process:

3. The completed RNA strand separates from the DNA template and the DNA molecule closes back together.



3 types of RNA:

1. Messenger RNA (**mRNA**): carries a message that will be translated to form a protein (made from DNA during transcription)
2. Ribosomal RNA (**rRNA**): forms part of ribosomes where proteins are made
3. Transfer RNA (**tRNA**): carries amino acids from the cytoplasm to ribosomes to make proteins

- **What is the complimentary mRNA strand made from this DNA sequence?**

DNA sequence :A G C G T G C C A

mRNA sequence: U C G C A C G G U

Try this…

- Use the following DNA sequence to create a RNA sequence.

DNA :TAC CCC CCG GAA TGA TGC ACT

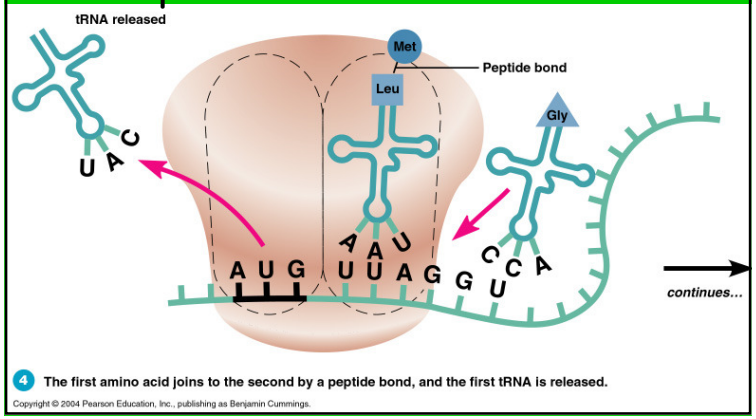
RNA:

Try this…

1. Which of the following is a nucleotide found in DNA?
   - A. ribose + phosphate group + thymaine
   - B. ribose + phosphate group + uracil
   - C. deoxyribose + phosphate group + uracil
   - D. deoxyribose + phosphate group + cytosine
2. What types of RNA are involved in protein systhesis? There are 3.
3. During transcription, an RNA molecule is formed in the _____ of a cell.
4. Transcription is the copying of an entire chromosome to produce a complementary strand of DNA. True or False.

Translation 8.5

Key Concept: mRNA is translated into a protein.



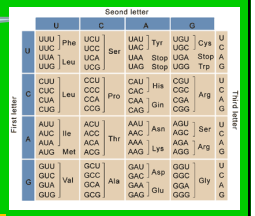
4 The first amino acid joins to the second by a peptide bond, and the first tRNA is released.

Translation 8.5

mRNA sequence: U C G C A C G G U

- Read 3 bases at a time: UCG-CAC-GGU
- Each set of 3 nucleotides is known as a codon.
- Each codon represents an amino acid:
  - 20 amino acids are formed= 4 nucleotides

1 codon = 1 amino acid



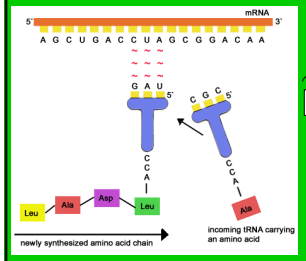
UCG-CAC-GGU
Serine-Histidine-Glycine

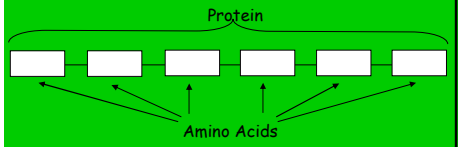
➢ remember proteins are made of amino acids

Translation 8.5

The Genetic Code

- Matches each codon to its amino acid





DNA :TAC CCC CCG GAA TGA TGC ACT

RNA: AUG GGG GGC CUU ACU ACG UGA

Protein: Met- Gly – Gly – Leu – Thr –Thr-Stop

The genetic code matches each RNA **codon** with its amino acid or function.

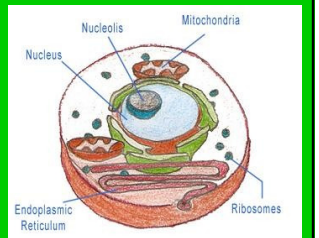
First base	Second base U	Second base C	Second base A	Second base G	Third base
U	UUU phenylalanine (Phe)	UCU serine (Ser)	UAU tyrosine (Tyr)	UGU cysteine (Cys)	U
	UUC phenylalanine (Phe)	UCC serine (Ser)	UAC tyrosine (Tyr)	UGC cysteine (Cys)	C
	UUA leucine (Leu)	UCA serine (Ser)	UAA STOP	UGA STOP	A
	UUG leucine (Leu)	UCG serine (Ser)	UAG STOP	UGG tryptophan (Trp)	G
C	CUU leucine (Leu)	CCU proline (Pro)	CAU histidine (His)	CGU arginine (Arg)	U
	CUC leucine (Leu)	CCC proline (Pro)	CAC histidine (His)	CGC arginine (Arg)	C
	CUA leucine (Leu)	CCA proline (Pro)	CAA glutamine (Gln)	CGA arginine (Arg)	A
	CUG leucine (Leu)	CCG proline (Pro)	CAG glutamine (Gln)	CGG arginine (Arg)	G
A	AUU isoleucine (Ile)	ACU threonine (Thr)	AAU asparagine (Asn)	AGU serine (Ser)	U
	AUC isoleucine (Ile)	ACC threonine (Thr)	AAC asparagine (Asn)	AGC serine (Ser)	C
	AUA isoleucine (Ile)	ACA threonine (Thr)	AAA lysine (Lys)	AGA arginine (Arg)	A
	AUG methionine (Met)	ACG threonine (Thr)	AAG lysine (Lys)	AGG arginine (Arg)	G
G	GUU valine (Val)	GCU alanine (Ala)	GAU aspartic acid (Asp)	GGU glycine (Gly)	U
	GUC valine (Val)	GCC alanine (Ala)	GAC aspartic acid (Asp)	GGC glycine (Gly)	C
	GUA valine (Val)	GCA alanine (Ala)	GAA glutamic acid (Glu)	GGA glycine (Gly)	A
	GUG valine (Val)	GCG alanine (Ala)	GAG glutamic acid (Glu)	GGG glycine (Gly)	G

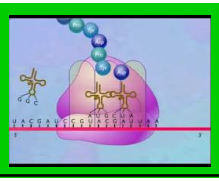
1. Find the first base, C, in the left column.
2. Find the second base, A, in the top row. Find the box where these two intersect.
3. Find the third base, U, in the right column. CAU codes for histidine, abbreviated as His.

Translation 8.5

TRANSLATION

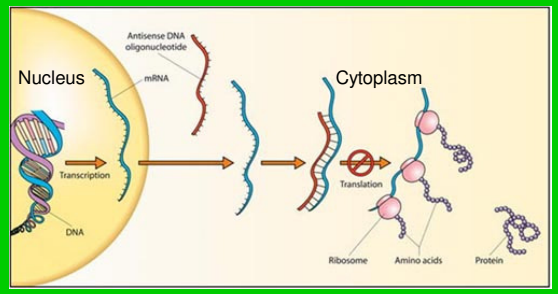
- Information from mRNA is used to make proteins
- Takes place on **ribosomes** in the cytoplasm





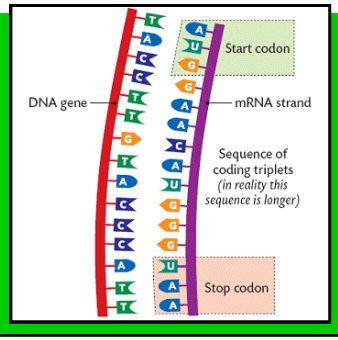
Before Translation Begins:

- mRNA is transcribed from DNA in the nucleus and released into the cytoplasm



Translation 8.5

- Translation begins at a certain codon on mRNA called a **start codon** (AUG) and ends with one of three **stop codons** (UAG, UAA, UGA)



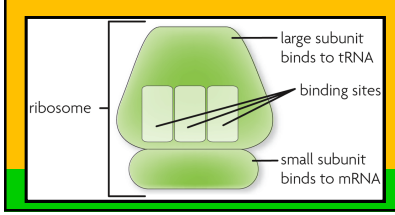
Translation Process

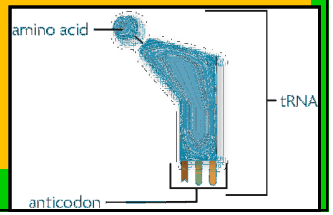
1. mRNA moves through the ribosome. tRNA (transfer RNA) comes into the ribosme with an anticodon on one end and an amino acid on the other and pairs with the start codon (AUG) on mRNA

**anticodon: three bases on tRNA which match one mRNA codon

Ex. mRNA codon: AUG

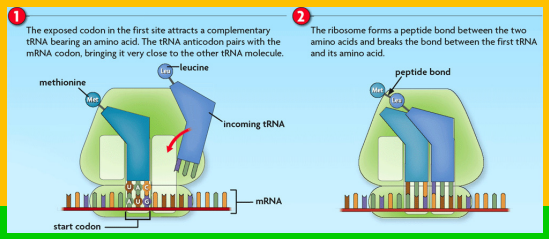
Anticodon: UAC





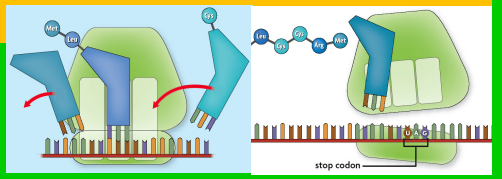
Translation Process

2. A second tRNA comes in with its amino acid. The ribosome forms a **peptide bond** between the two amino acids to begin forming a protein. Once each tRNA has "dropped off" its amino acid it is released into the cytoplasm to pick up another amino acid

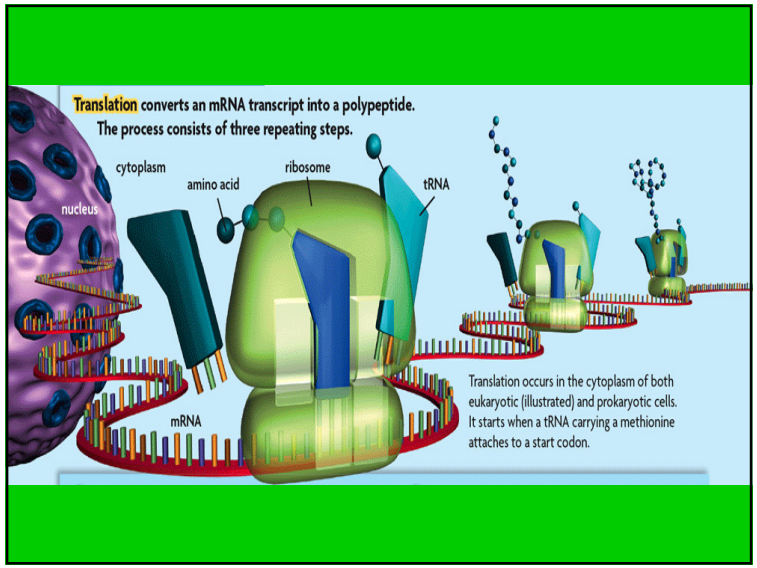


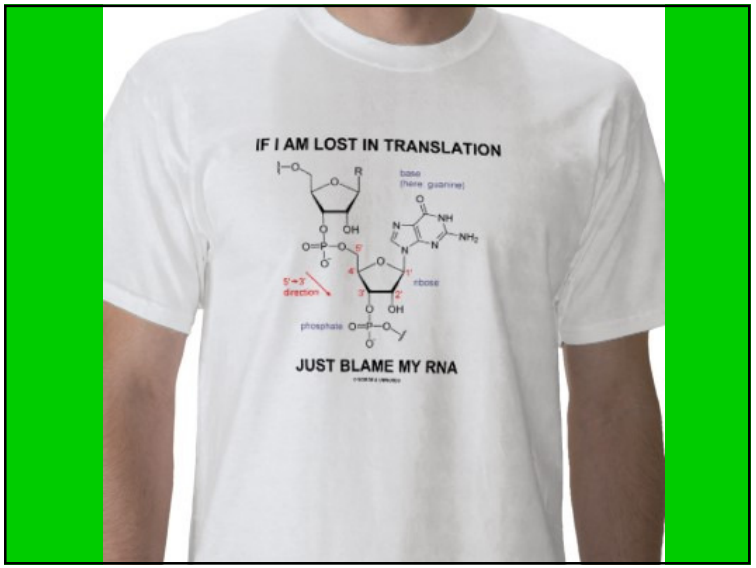
Translation Process

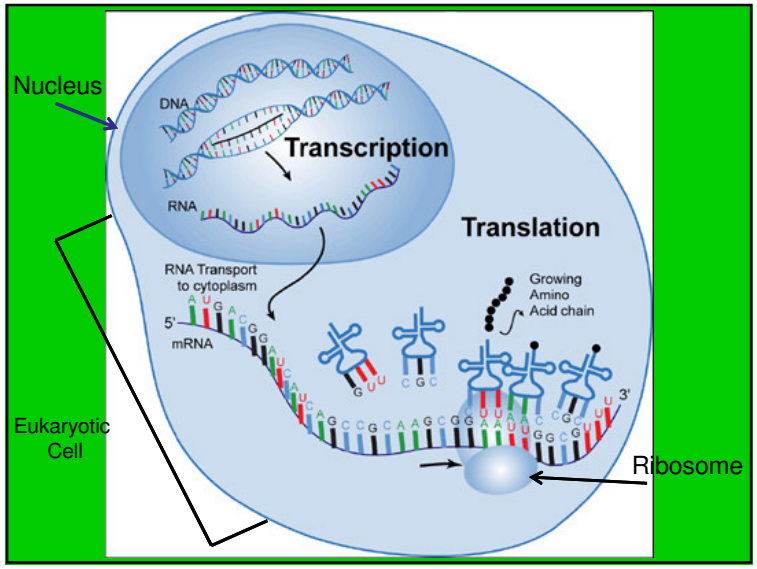
3. tRNA molecules continue to come into the ribosome, bind with mRNA, and leave amino acids that are bonded together to make a growing protein until they reach a stop codon (UAG, UAA, UGA). When a stop codon has been reached the protein & mRNA will be released from the ribosome and translation is complete!!



Protein Synthesis Animation







Starter RNA 3/1/12
True or False

_____ 1) The sugar found in RNA is called deoxyribose.

_____ 2) The DNA molecule is double stranded and the RNA molecule is single stranded.

_____ 3) The process of translation occurs at the ribosome.

_____ 4) The job of mRNA is to pick up amino acids and transport them to the ribosomes.

_____ 5) Transcription must occur before translation may occur.

1) **Which of the following is attached to the transfer RNA (tRNA)?**
A. DNA B. ribosome C. amino acid D. nucleic acid

2) **Which of the following is <u>not</u> part of protein synthesis**?
A. replication B. translation C. transcription

3) The codons are located on the
A. mRNA. B. tRNA. C. rRNA. D. DNA.

4) **In the RNA molecule, which nitrogen base is found in place of thymine?**
A. guanine B. cytosine C. thymine D. uracil

5) **During the process of transcription, which of the following is produced?**
A. H_2O B. ATP C. mRNA D. DNA

6) **The actual site of protein synthesis is the**
A. nucleus. B. mitochondrion. C. chloroplast. D. ribosome.

7) **If the DNA template reads "ATA", then which of the following would be the corresponding sequence on the mRNA?**
A. UAU B. ATA C. TUT D. UCU

8) **The genetic code is based upon the reading of how many bases at a time?**
A. one B. two C. three D. four

9) **Amino acids are held together by __?__ bonds**.
A. hydrogen B. peptide C. ionic D. high energy

10) **How many codons are needed to specify three amino acids**?
A. 3 B. 6 C. 9 D. 12