**RNA and Protein Synthesis Guided Notes**

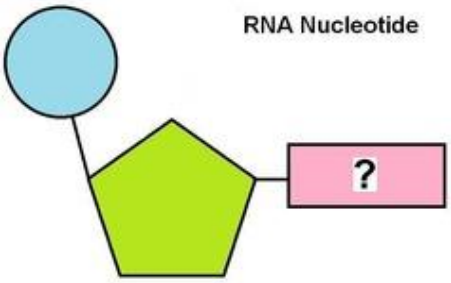
- _____ is responsible for controlling the production of _____ in the cell, which is essential to life!
  - DNA→RNA→Proteins
- _____ contain several thousand _____, each with directions to make one _____

## Where are Proteins Produced?

- Proteins are produced on _____!
- Found in two places:
  - Free floating in _____
  - Attached to _____
- How does information needed to build a protein gets delivered from the DNA to the ribosomes?
  - With the help of _____ in a process called _____

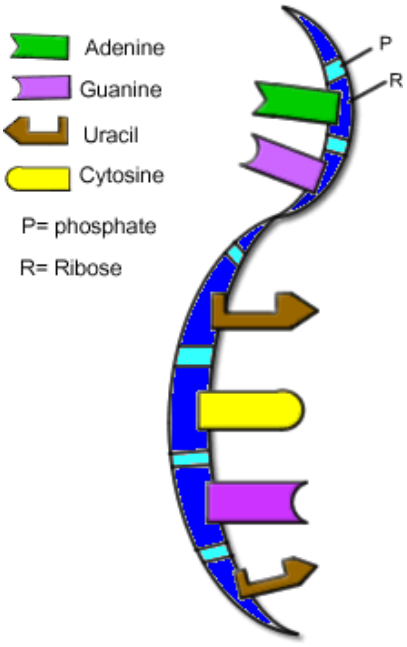
## What is RNA?

- ***RNA*** stands for _____
- One subunit is called a _____
  - 1 5-carbon _____ (ribose)
  - 1 _____ group
  - 1 nitrogenous _____
- Three types of RNA: _____




## A Closer Look at mRNA

- How is mRNA different from DNA?
  - _____ stranded
  - _____ and able to leave the _____
  - The sugar is _____
  - There is a different base
    - _____ (U) takes the place of _____ (T)
- The job of mRNA is to take directions for one gene and transport it to a _____ in the _____.
  - This is so a cell can begin assembling _____, the building blocks of _____!
  - It's sending a _____ on how to do the job!



## Protein Synthesis

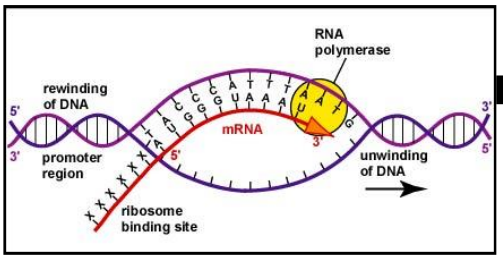
- ***Protein synthesis*** is a two stage process: _____
  - A _____ molecule (mRNA) carries instructions from DNA to ribosomes
    - DNA _____ leave the nucleus; _____ can!
    - _____ makes it possible for _____ to be assembled by _____ outside the nucleus

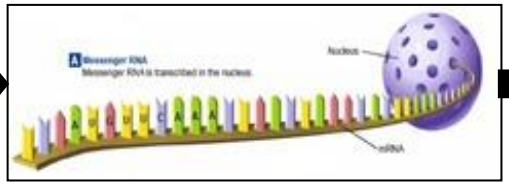
## Protein Synthesis: Transcription

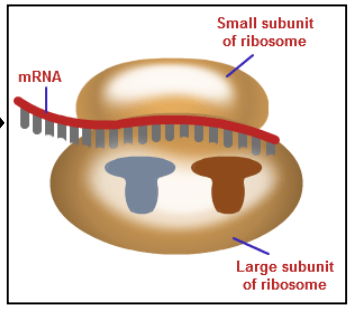
- ***Transcription*** is when _____ is turned to _____
- Happens when _____ need to be made in the _____
- Since DNA CANNOT leave the _____, it is _____ into RNA (DNA→RNA)
  - Transcribe: _____ (copy in the same nucleic acid language, but only what is needed!)

- How does it happen?
  1) After an _____ targets the portion of the DNA that should be copied (_____), the sections of DNA (_____) will temporarily _____ to allow mRNA to _____ (copy). This will continue until an enzyme signals "the end"
  2) mRNA leaves the _____, travels into the _____ and attaches to a _____
  3) The "message" from DNA can now be translated to make a _____

*Think about it:* What is happening in each photo below during transcription?






- Transcribing DNA to mRNA is very easy if you remember these complementary pairs!
  - _____ (in RNA) will attach to a _____ (in DNA)
  - _____ (in RNA) will attach to a _____ (in DNA)
  - _____ (in RNA) will attach to a _____ (in DNA)
  - _____ **(in RNA)** will attach to a _____ (in DNA)
- Try it!
  - A piece of DNA reads: T A G C A T T C C G A U
    Transcribe to mRNA: _____
  - 1 side of DNA reads: A A G C G T A T C C C G
    Transcribe to mRNA: _____

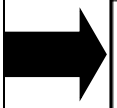
**Protein Synthesis: Translation**

- ***Translation***→ The process in which _____ is used as a _____ to form chains of _____ (RNA→Protein)
  - Amino acids linked together form a _____
  - Translate: To change a sentence from one language (_____) to another (_____)
- Every 3 letters on an mRNA chain = _____
- Each codon (3 DNA letters) = 1 _____

- Given the _____, we can read a _____ chart to translate it into amino the amino acid it codes for!
  - Remember, 1 word in nucleic acid language is a _____ (three nucleotides)

*Think about it*: What amino acid is coded for?

1) AUG _____
2) GUC _____
3) GCC _____
4) CGA _____
5) UAA _____



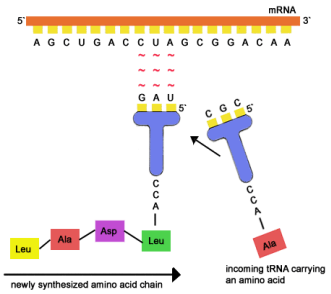
| First Letter | Second Letter | | | | Third Letter |
|---|---|---|---|---|---|
| | U | C | A | G | |
| U | phenylalanine | serine | tyrosine | cysteine | U |
| | phenylalanine | serine | tyrosine | cysteine | C |
| | leucine | serine | stop | stop | A |
| | leucine | serine | stop | tryptophan | G |
| C | leucine | proline | histidine | arginine | U |
| | leucine | proline | histidine | arginine | C |
| | leucine | proline | glutamine | arginine | A |
| | leucine | proline | glutamine | arginine | G |
| A | isoleucine | threonine | asparagine | serine | U |
| | isoleucine | threonine | asparagine | serine | C |
| | isoleucine | threonine | lysine | arginine | A |
| | (start) methionine | threonine | lysine | arginine | G |
| G | valine | alanine | aspartate | glycine | U |
| | valine | alanine | aspartate | glycine | C |
| | valine | alanine | glutamate | glycine | A |
| | valine | alanine | glutamate | glycine | G |

- ***Translation*** occurs in a _____ in ALL cells
- Uses all three forms of RNA (_____)
- DNA is not directly used!

## Steps of Translation

1) The mRNA leaves the _____ and lands on a _____ (rRNA)
2) _____ (with correct anticodon) lands on the ribosome opposite a _____ on the mRNA
3) The tRNA leaves the ribosome, but the _____ that it coded for stays on the ribosome to wait for next codon to be read
4) The _____ moves to the next _____ bringing in another _____ to the growing protein chain

### tRNA: A Closer Look

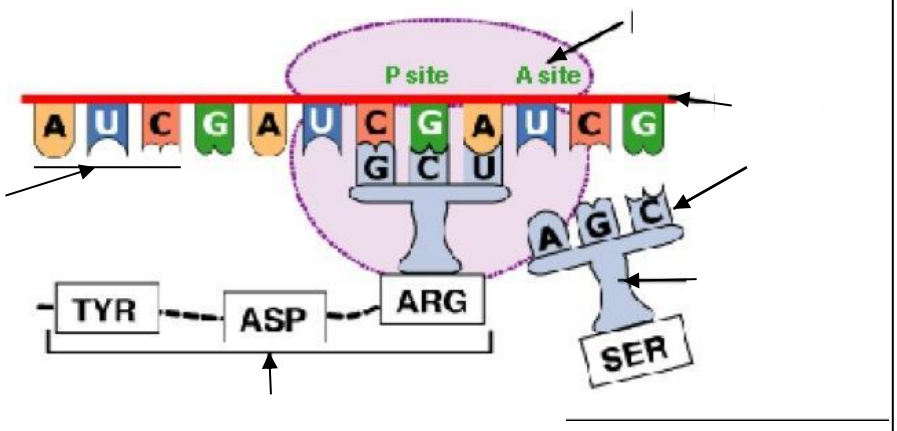



- Notice the tRNA is carrying the amino acid leucine, coded for by the sequence "CUA"
- The tRNA knows how to match using bases!
- So…mRNA codon reads "CUA," so the tRNA anticodon will be "GAU"

- The amino acid chain will ALWAYS begin with the "_____"- AUG
- The tRNA will continue to add amino acids until it reaches a "_____" (UAA, UAG, UGA)
- When it reaches a stop codon, then a complete _____has been built! The protein _____ from the ribosome.

*Think about it*: Label the diagram of translation to the right with the following terms!

a) ribosome
b) mRNA
c) tRNA
d) codon
e) anticodon
f) amino acid chain




Let's Practice!

- Given the strand of DNA→ **ATC**
  - What would it's *complementary* DNA strand read? _____
  - Now, transcribe the DNA to mRNA _____
  - What amino acid does the codon code for? (use chart) _____
  - What would the anticodon on tRNA read? _____

- Given the strand of DNA→ **TGA**
  - What would it's *complementary* DNA strand read? _____

- Now, transcribe the DNA to mRNA _____
- What amino acid does the codon code for? (use chart) _____
- What would the anticodon on tRNA read? _____

## Mutations

- Changes to DNA are called _____
  - Change the _____
  - Change the _____
  - May change _____
  - May change _____

## Types of Mutations

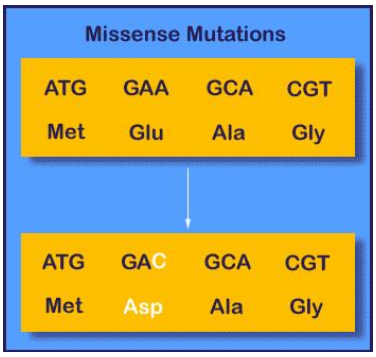
- Changes to the letters (ATGC bases) in DNA!
- ***Point mutation***→ change to _____ letter in the DNA!
  - May (or may not) cause a change to protein
- ***Frame shift mutation***→ addition of a _____letter; or deletion of a letter!
  - Both of these _____ DNA so it changes how the codons are read
  - Big changes to protein

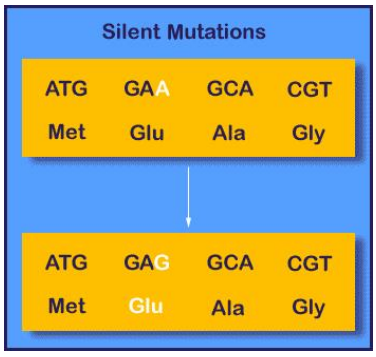
## Point Mutations

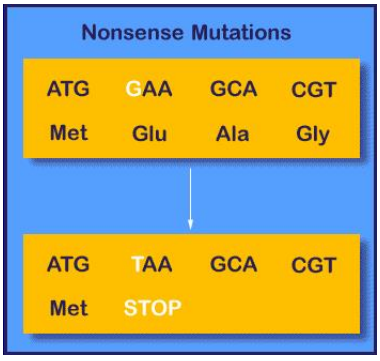
***Missense mutation*** = _____ (Ex. Sickle Cell Anemia)

***Silent mutation***= _____

***Nonsense mutation***=_____

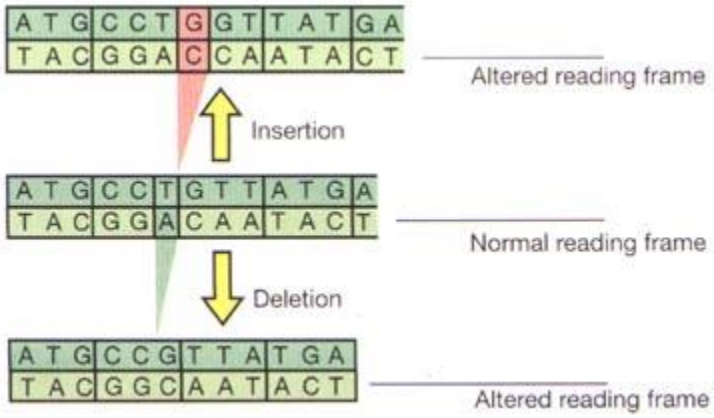



## Frameshift Mutations

- _____ or _____ one or more bases
  - Change the meaning of the whole protein!
- ***Addition***→ _____
- ***Deletion***→_____


A T G C C T G G T T A T G A
T A C G G A C C A A T A C T
Altered reading frame
Insertion
A T G C C T G T T A T G A
T A C G G A C A A T A C T
Normal reading frame
Deletion
A T G C C G T T A T G A
T A C G G C A A T A C T
Altered reading frame