The Central Dogma

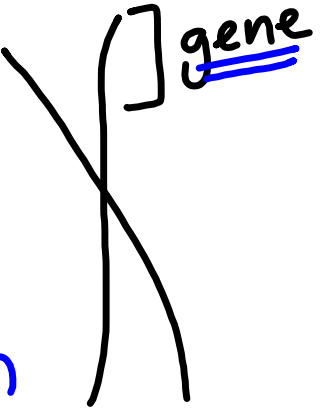
The Central Dogma of Molecular Biology

transcription (nucleus)

DNA --> RNA --> Proteins

replication

translation
↳ cytoplasm
ribosome



Chromosome
5,000 genes

Reminder:

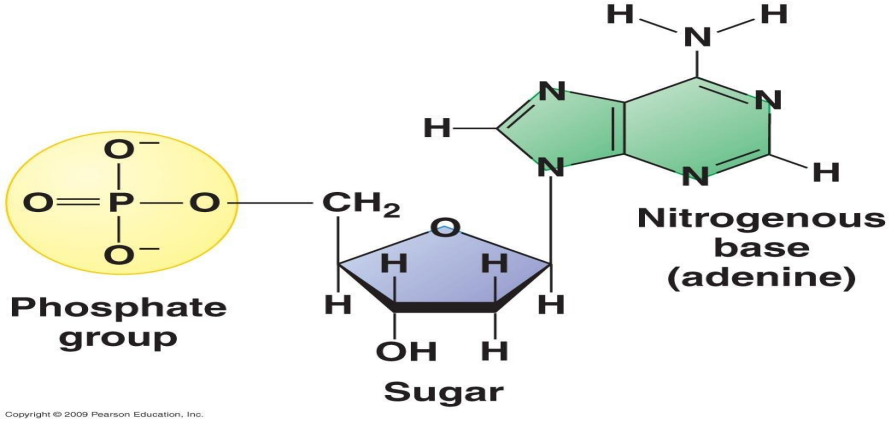
-- Nucleic acids are polymers of nucleotides

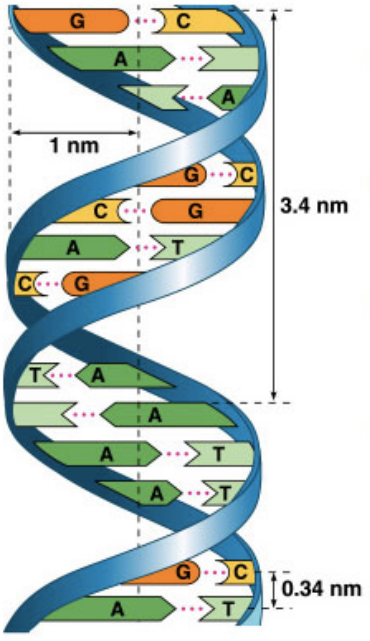
-- Nucleotides are made of

a nitrogenous base, a pentose sugar, phosphate

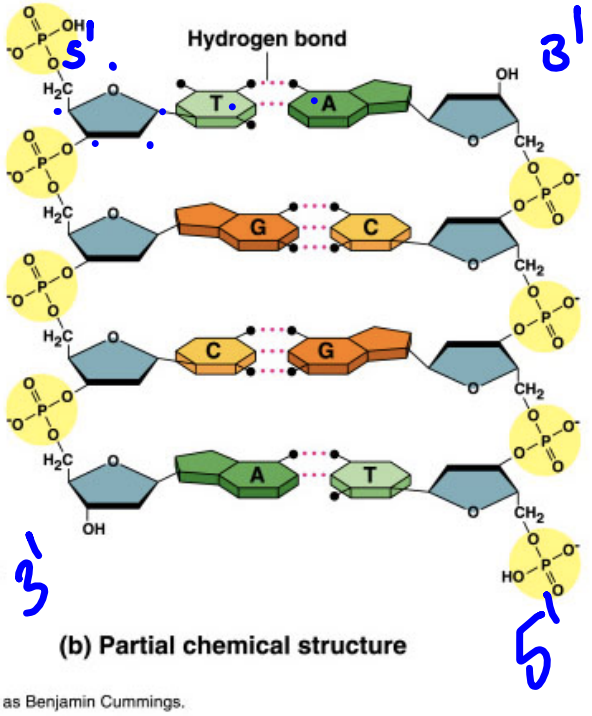
-- A gene is a segment of DNA that codes for a polypeptide chain.

-- Proteins are polymers of amino acids





(a) Key features of DNA structure



(b) Partial chemical structure

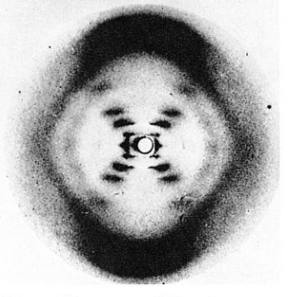
(c) Space-filling model

DNA is organized into a double helix.

The discovery of the structure is credited to James Watson and Francis Crick.

Main parts: sugar-phosphate backbone with the nitrogenous bases forming the rungs of a ladder.

(a) Rosalind Franklin



(b) Franklin's X-ray diffraction photograph of DNA

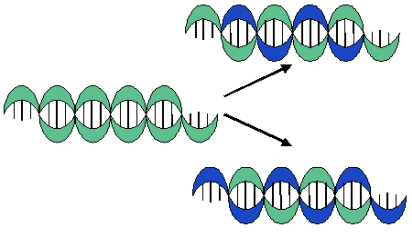
DNA Replication: Big Ideas

-- During DNA replication, base pairing allows for each parent strand to serve as a template for the new strands.

-- DNA replication involves a large team of proteins, including **helicase, primase, DNA polymerase and ligase**.

-- DNA repair enzymes proofread the DNA to identify and fix any mistakes.

-- DNA Replication is semi-conservative.



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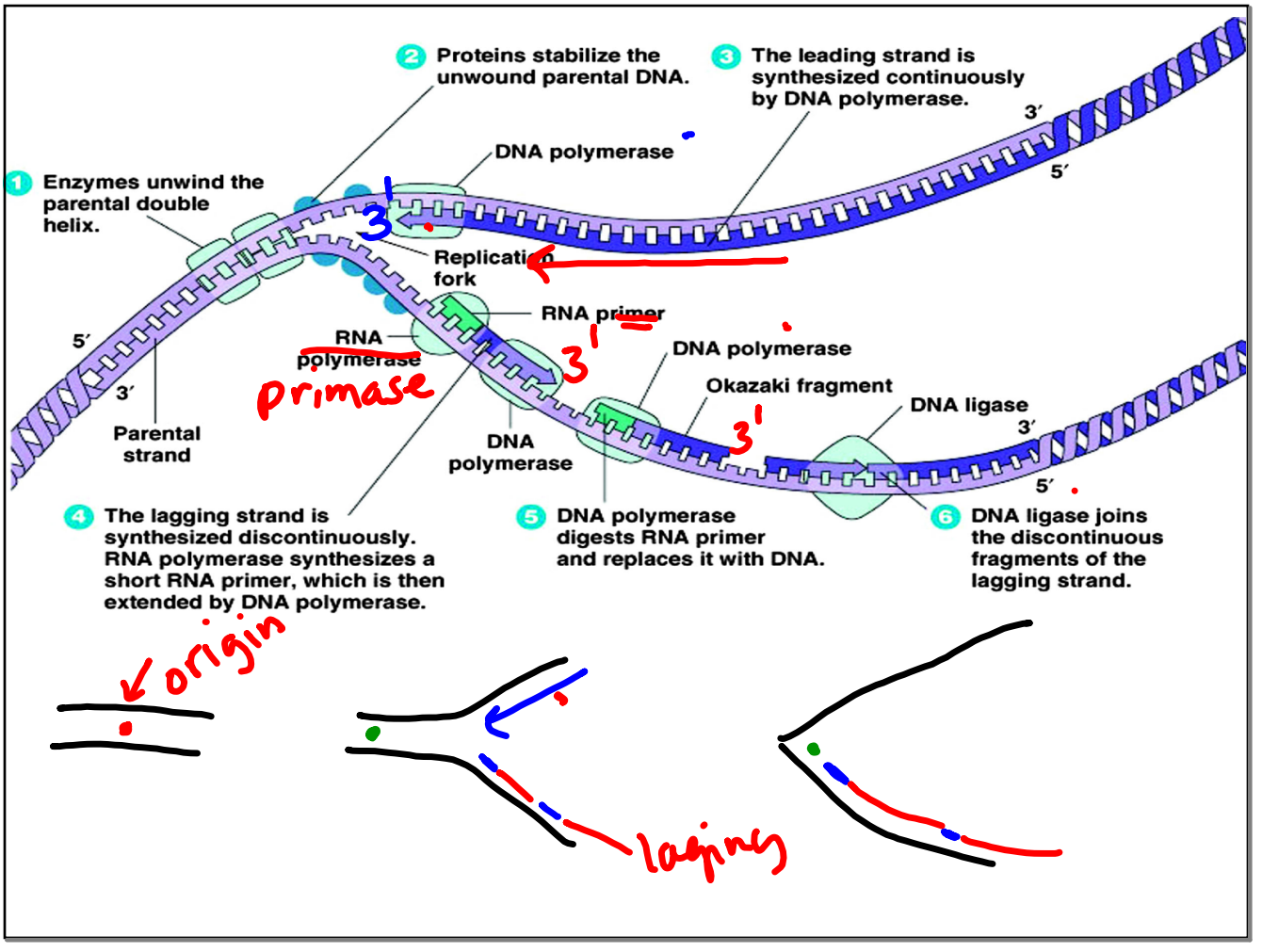
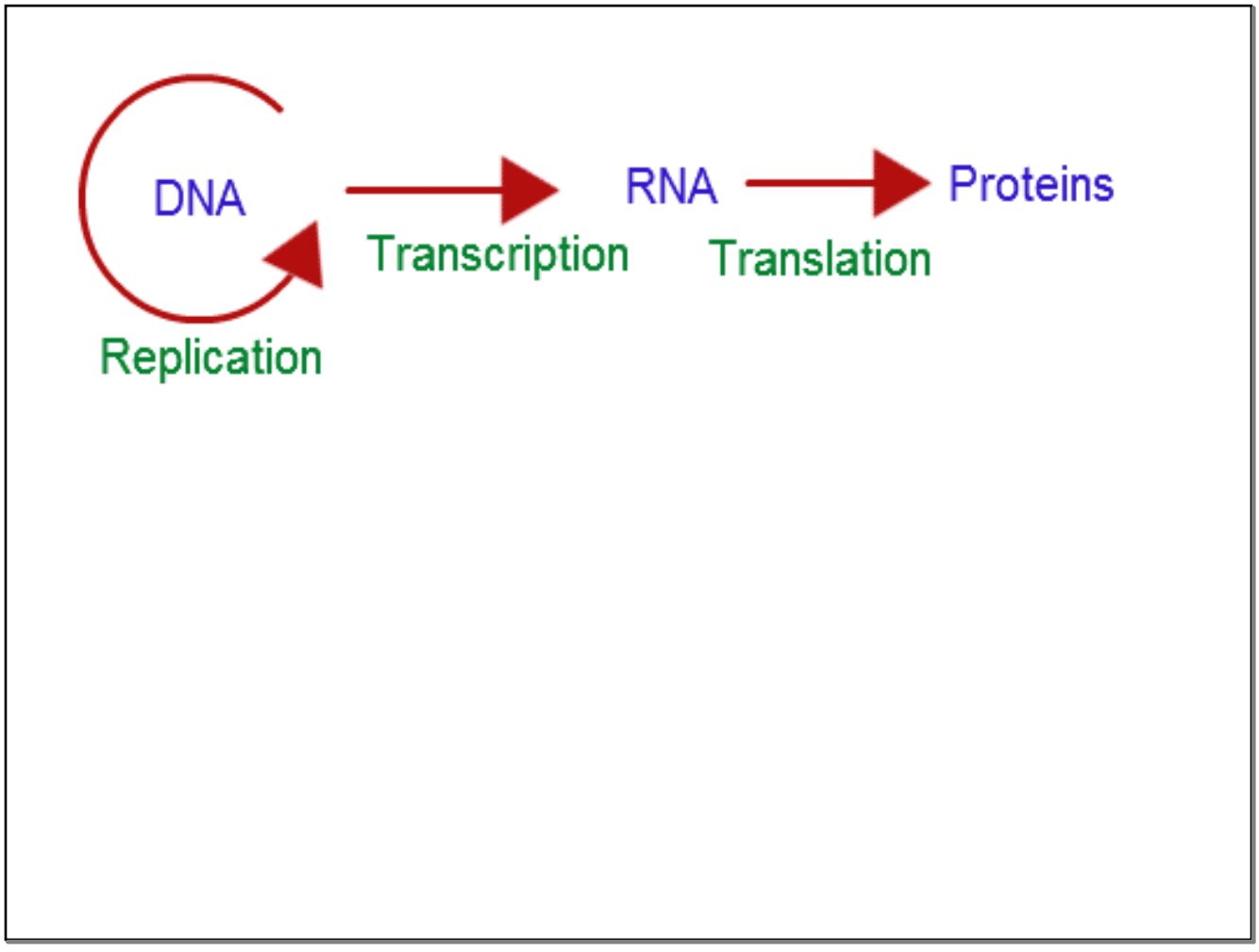

1 Enzymes unwind the parental double helix.
2 Proteins stabilize the unwound parental DNA.
3 The leading strand is synthesized continuously by DNA polymerase.
DNA polymerase
Replication fork
RNA primer
RNA polymerase
Primase
DNA polymerase
Okazaki fragment
DNA ligase
DNA polymerase
5′
3′
Parental strand
4 The lagging strand is synthesized discontinuously. RNA polymerase synthesizes a short RNA primer, which is then extended by DNA polymerase.
5 DNA polymerase digests RNA primer and replaces it with DNA.
6 DNA ligase joins the discontinuous fragments of the lagging strand.
origin
lagging


DNA
Transcription
RNA
Translation
Proteins
Replication

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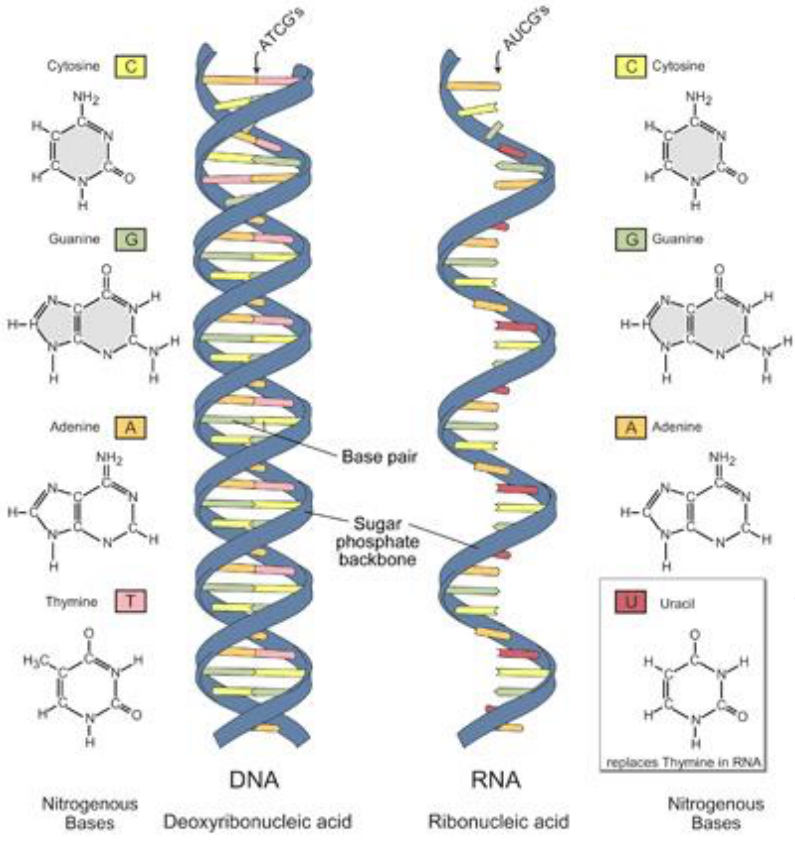

DNA	RNA
double stranded	single
T	U
deoxi-ribose	ribose

Image adapted from: National Human Genome Research Institute.

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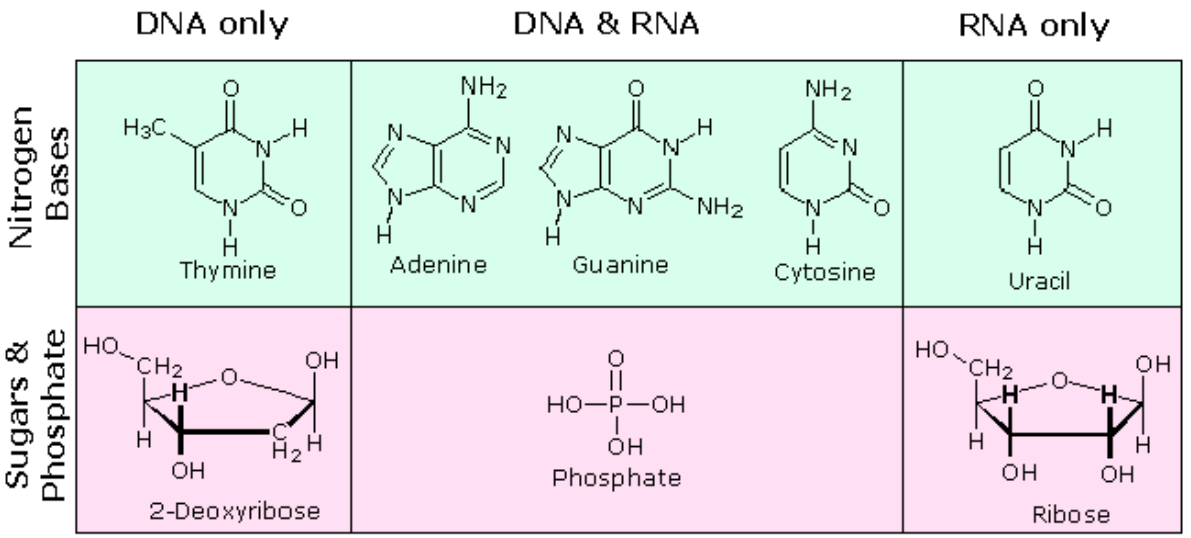
Components of Nucleic Acids



Big Ideas

Transcription:

-- Occurs in the nucleus

-- Performed by RNA polymerase

-- DNA serves as the template the mRNA molecule

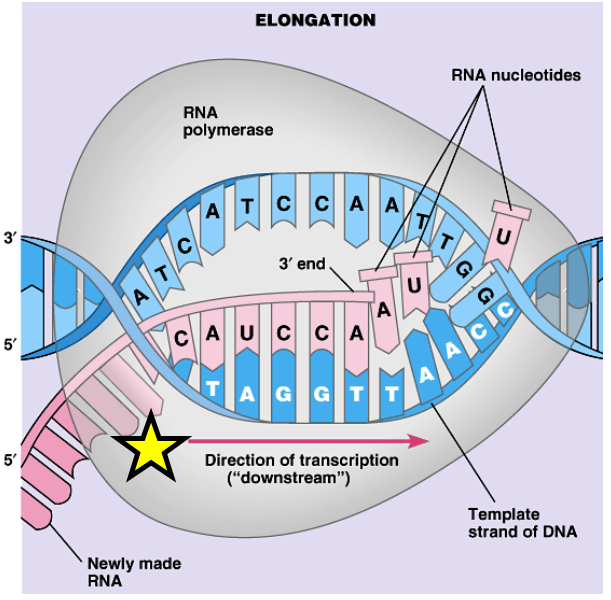
Translation:

-- Occurs in the cytoplasm

-- Performed by ribosomes with tRNA

-- mRNA serves as the template for the protein

Transcription



In translation, the mRNA is used as a template by the ribosome to create a polypeptide chain.

The coding sequence in the mRNA takes the form of nucleotide triplets called codons.

Each codon interacts with a specific tRNA that carries one type of amino acid (the anti-codon on the tRNA is used to line up the proper amino acid).

Every THREE nucleotides code for ONE amino acid.

Example: AUG

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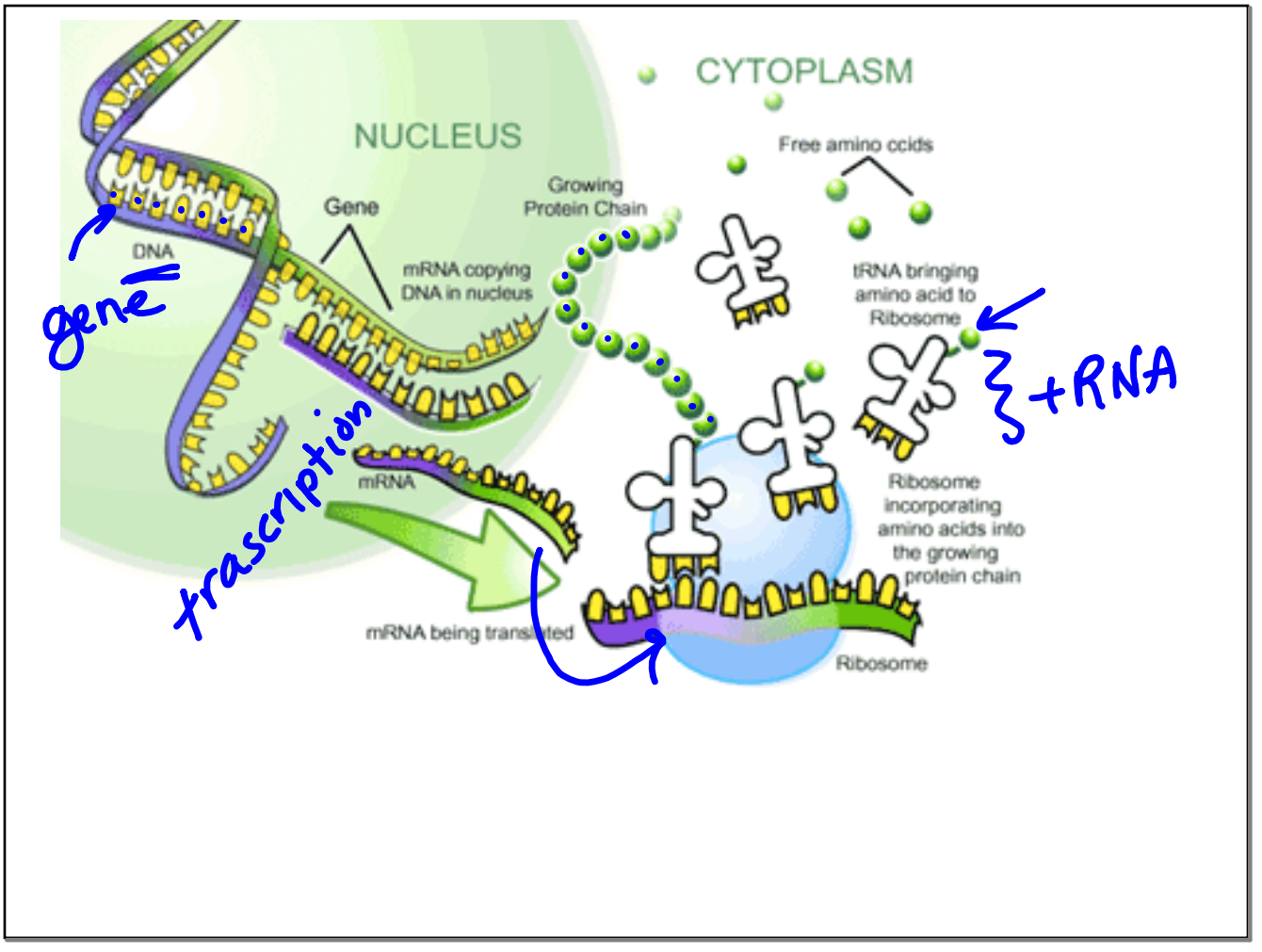
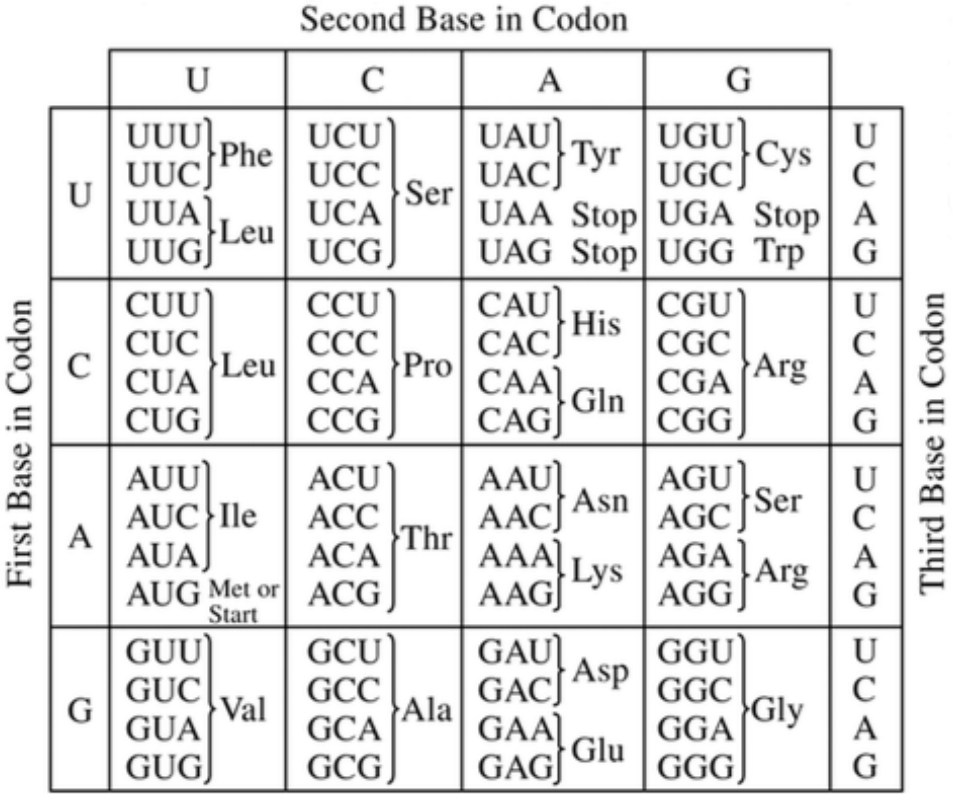

CYTOPLASM
NUCLEUS
Free amino ccids
Growing
Protein Chain
Gene
DNA
mRNA copying
DNA in nucleus
tRNA bringing
amino acid to
Ribosome
Ribosome
incorporating
amino acids into
the growing
protein chain
mRNA
mRNA being translated
Ribosome
gene
trascription
+RNA

Codon Chart -- Option 1



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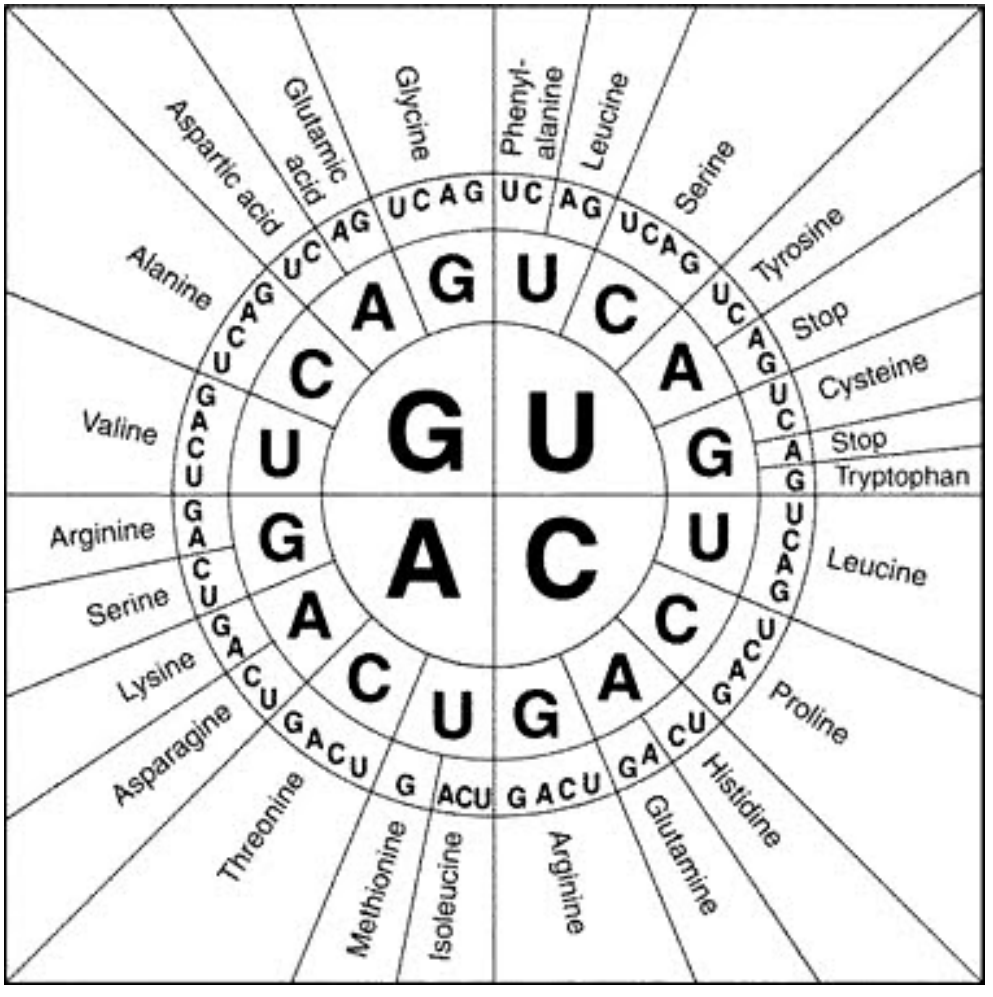
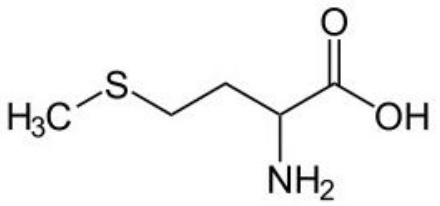
Codon Chart -- Option 2



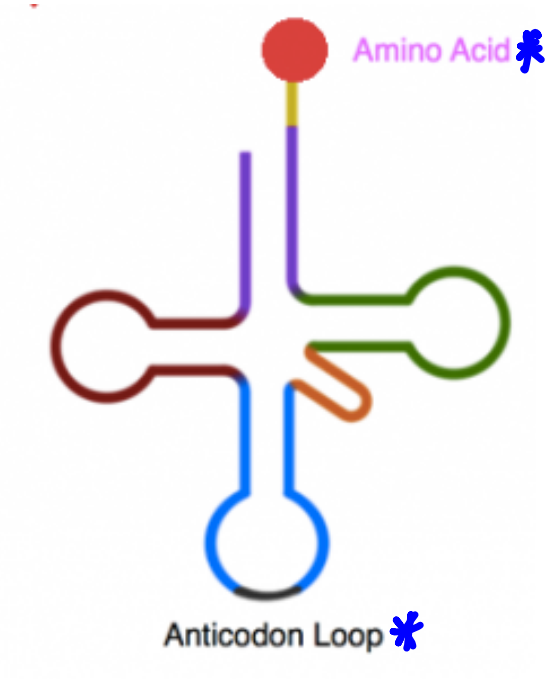
The START codon is AUG and also codes for the amino acid, methionine.

Three of the codons are STOP codons, which tell the ribosome to end protein synthesis.

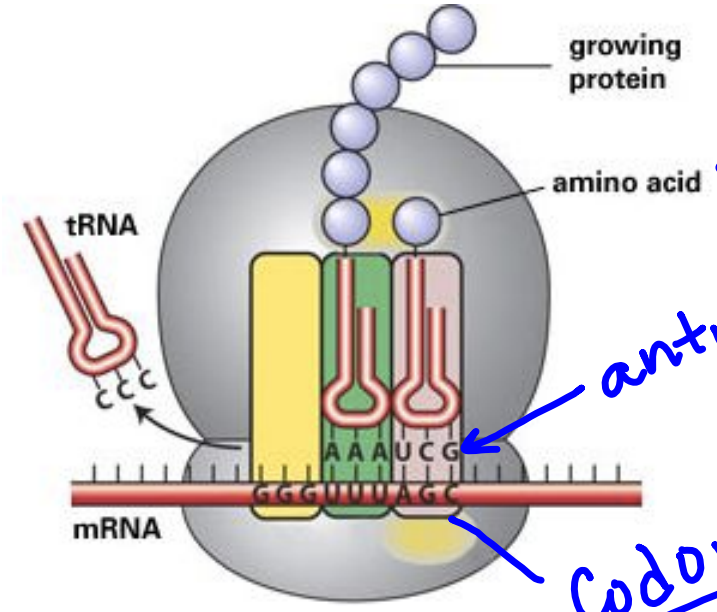


Methionine

tRNA Structure



tRNA in the ribosome



Serine

anticodon

Codon

Practice:

DNA Coding Strand:

Non-coding Strand:

mRNA Strand:

Amino Acid sequence:

Mutations are changes in the genetic code.

Think of an example where the mutation would have no effect.

Think of an example where the mutation would have a large effect.

Use the Mutations Handout to answer the questions about mutations on the worksheet.